

Education and innovative perspectives in higher education

Edited by

Ana Luísa Rodrigues

Published in

Frontiers in Education



FRONTIERS EBOOK COPYRIGHT STATEMENT

The copyright in the text of individual articles in this ebook is the property of their respective authors or their respective institutions or funders. The copyright in graphics and images within each article may be subject to copyright of other parties. In both cases this is subject to a license granted to Frontiers.

The compilation of articles constituting this ebook is the property of Frontiers.

Each article within this ebook, and the ebook itself, are published under the most recent version of the Creative Commons CC-BY licence. The version current at the date of publication of this ebook is CC-BY 4.0. If the CC-BY licence is updated, the licence granted by Frontiers is automatically updated to the new version.

When exercising any right under the CC-BY licence, Frontiers must be attributed as the original publisher of the article or ebook, as applicable.

Authors have the responsibility of ensuring that any graphics or other materials which are the property of others may be included in the CC-BY licence, but this should be checked before relying on the CC-BY licence to reproduce those materials. Any copyright notices relating to those materials must be complied with.

Copyright and source acknowledgement notices may not be removed and must be displayed in any copy, derivative work or partial copy which includes the elements in question.

All copyright, and all rights therein, are protected by national and international copyright laws. The above represents a summary only. For further information please read Frontiers' Conditions for Website Use and Copyright Statement, and the applicable CC-BY licence.

ISSN 1664-8714
ISBN 978-2-8325-4861-5
DOI 10.3389/978-2-8325-4861-5

About Frontiers

Frontiers is more than just an open access publisher of scholarly articles: it is a pioneering approach to the world of academia, radically improving the way scholarly research is managed. The grand vision of Frontiers is a world where all people have an equal opportunity to seek, share and generate knowledge. Frontiers provides immediate and permanent online open access to all its publications, but this alone is not enough to realize our grand goals.

Frontiers journal series

The Frontiers journal series is a multi-tier and interdisciplinary set of open-access, online journals, promising a paradigm shift from the current review, selection and dissemination processes in academic publishing. All Frontiers journals are driven by researchers for researchers; therefore, they constitute a service to the scholarly community. At the same time, the *Frontiers journal series* operates on a revolutionary invention, the tiered publishing system, initially addressing specific communities of scholars, and gradually climbing up to broader public understanding, thus serving the interests of the lay society, too.

Dedication to quality

Each Frontiers article is a landmark of the highest quality, thanks to genuinely collaborative interactions between authors and review editors, who include some of the world's best academicians. Research must be certified by peers before entering a stream of knowledge that may eventually reach the public - and shape society; therefore, Frontiers only applies the most rigorous and unbiased reviews. Frontiers revolutionizes research publishing by freely delivering the most outstanding research, evaluated with no bias from both the academic and social point of view. By applying the most advanced information technologies, Frontiers is catapulting scholarly publishing into a new generation.

What are Frontiers Research Topics?

Frontiers Research Topics are very popular trademarks of the *Frontiers journals series*: they are collections of at least ten articles, all centered on a particular subject. With their unique mix of varied contributions from Original Research to Review Articles, Frontiers Research Topics unify the most influential researchers, the latest key findings and historical advances in a hot research area.

Find out more on how to host your own Frontiers Research Topic or contribute to one as an author by contacting the Frontiers editorial office: frontiersin.org/about/contact

Education and innovative perspectives in higher education

Topic editor

Ana Luísa Rodrigues — University of Lisbon, Portugal

Citation

Rodrigues, A. L., ed. (2024). *Education and innovative perspectives in higher education*. Lausanne: Frontiers Media SA. doi: 10.3389/978-2-8325-4861-5

Table of contents

06	Editorial: Education and innovative perspectives in higher education Ana Luísa Rodrigues
10	Social Media Technologies Used for Education: An Empirical Study on TAM Model During the COVID-19 Pandemic Omar A. Alismaiel, Javier Cifuentes-Faura and Waleed Mugahed Al-Rahmi
22	Reputation in Higher Education: A Systematic Review Marelby Amado Mateus and Fernando Juarez Acosta
41	A mixed-method investigation into international university students' experience with academic language demands Bruce Russell, Christine Barron, Hyunah Kim and Eunice Eunhee Jang
59	Pre-licensure medical students' knowledge and views on interprofessional learning: A qualitative concept analysis based on real-world data Joana Berger-Estilita, Sofia Merlo, Sissel Guttormsen, Alexander Fuchs, Robert Greif and Hsin Chiang
71	Academic integration in higher education: A review of effective institutional strategies and personal factors Nurudeen Abdul-Rahaman, Vincent E. Arkorful and Tochukwu Okereke
80	The effects of a mindfulness-based program on higher education students Carla Serrão, Ana Rita Rodrigues and Tiago Ferreira
91	Bibliometric analysis of the flipped classroom pedagogical model: Trends and strategic lines of study Isabel del Arco, Pere Mercadé-Melé, Anabel Ramos-Pla and Òscar Flores-Alarcia
105	The influence of work values of college students on entrepreneurial intention: The moderating role of psychological capital Lijun Tian
114	A systematic review of doctoral graduate attributes: Domains and definitions Janine S. Senekal, Erica Munnik and Jose M. Frantz
136	Digital age: The importance of 21st century skills among the undergraduates Malissa Maria Mahmud and Shiau Foong Wong
145	Developing effective student learning environment: Case study from Sharjah, United Arab Emirates Nadia Solovieva, Anita Dani, Patrick Kane, Sophy Thomson, Doaa Hamam and Fares Keramatulah Solaimani

- 151 **A review of the application of virtual reality technology in higher education based on Web of Science literature data as an example**
Xiaoqin Ding Zhe Li
- 161 **Active learning to develop disciplinary competencies related to automatic control in engineering curricula using low cost do-it-yourself didactic stations**
David Navarro-Durán, Luis C. Félix-Herrán,
Jorge Membrillo-Hernández, Kevin C. Craig,
Miguel J. Ramírez-Cadena, and Ricardo A. Ramírez-Mendoza
- 174 **A teachers' based approach to assessing the perception of critical thinking in Education university students based on their age and gender**
Héctor Galindo-Domínguez, María-José Bezanilla, Lucía Campo,
Donna Fernández-Nogueira and Manuel Poblete
- 184 **Drawing skills at the beginning of higher education: Teachers' perspectives, expectations, and realities**
Pedro Ramalho da Silva and Odete Palaré
- 193 **Views and experiences of using advanced technologies in higher education of healthcare professionals: A systematic mixed-method review**
Maha Atout and Sylvia Nalubega
- 201 **Mapping the helix model of innovation influence on education: A bibliometric review**
Haziman Zakaria, Diyana Kamarudin, Muhammad Ashraf Fauzi and
Walton Wider
- 218 **Education quality and student satisfaction nexus using instructional material, support, classroom facilities, equipment and growth: Higher education perspective of Pakistan**
Maryam Ikram and Husaina Banu Kenayathulla
- 233 **Multi-level education for sustainability through global citizenship, territorial education and art forms**
Sandrine Simon, Inês Vieira and Marta Jecu
- 244 **The potential of an exam villa as a structural resource during prolonged exam preparation at university**
Tom Reschke, Thomas Lobinger and Katharina Reschke
- 255 **Do entrepreneurship challenges raise student's entrepreneurial competencies and intention?**
Geraldina Silveyra-León, Lucía Rodríguez-Aceves and
Verónica I. Baños-Monroy

- 268 **Exploring the relationship between students' note-taking and interpreting quality: a case study in the Chinese context**
Yuqiao Liu, Weihua Luo and Xiaochen Wang
- 282 **Effects of service-learning as opposed to traditional teaching-learning contexts: a pilot study with three different courses**
J. C. Pinto and Susana Costa-Ramalho



OPEN ACCESS

EDITED BY

Imran Anwar,
Sir Padampat Singhan University, India

REVIEWED BY

Naveed Yasin,
Canadian University of Dubai, United
Arab Emirates
Alam Ahmad,
Saudi Electronic University, Saudi Arabia

*CORRESPONDENCE

Ana Luísa Rodrigues
✉ alrodrigues@ie.ulisboa.pt

RECEIVED 01 February 2024

ACCEPTED 15 April 2024

PUBLISHED 24 April 2024

CITATION

Rodrigues AL (2024) Editorial: Education and
innovative perspectives in higher education.
Front. Educ. 9:1380280.
doi: 10.3389/feduc.2024.1380280

COPYRIGHT

© 2024 Rodrigues. This is an open-access
article distributed under the terms of the
[Creative Commons Attribution License \(CC
BY\)](#). The use, distribution or reproduction in
other forums is permitted, provided the
original author(s) and the copyright owner(s)
are credited and that the original publication
in this journal is cited, in accordance with
accepted academic practice. No use,
distribution or reproduction is permitted
which does not comply with these terms.

Editorial: Education and innovative perspectives in higher education

Ana Luísa Rodrigues*

Instituto de Educação, Universidade de Lisboa, Lisbon, Portugal

KEYWORDS

innovation, technologies, skills, global citizenship, entrepreneurship education (EE), pedagogical developments, active learning, higher education

Editorial on the Research Topic

Education and innovative perspectives in higher education

Globalization, digitalization, and a rapid technological development of many areas of life and society, bring humanity to another level of development. Changes in the educational organizations are inevitable and the university must meet new requirements in a new paradigm (Gafurov et al., 2020).

This Research Topic “*Education and Innovative Perspectives in Higher Education*” invited the submission of articles on: globalization effects; impact of education on development and new challenges in the higher education area; generic, soft, and transversal skills and global citizenship education; entrepreneurship education and innovation in educational institutions; new pedagogical and didactic developments, including learning, assessment and teaching methodologies and models, as active learning and flipped classroom; and technological issues in education, as distance education, technology-enhanced learning, technological skills, and digital platforms.

This edition had 70 submissions of which 23 articles were accepted for publication by 74 authors from different countries, including 6 systematic review, 15 original research, 1 conceptual analysis article, and 1 brief research report, as shown in Table 1.

The publications involved a multiplicity of ideas and perspectives on innovative issues in higher education, with five main themes being particularly evident: issues related to the quality of education; the development of transversal competences by students that can be framed within education for global citizenship; issues related to technologies and innovation; new teaching, assessment and learning methodologies; and general academic issues.

Therefore, this Research Topic addresses theoretical, conceptual, and methodological aspects and topics, including issues related to the quality of education and learning (Ikramand and Kenayathulla; Liu et al.). It also involved studies into the development of skills (Galindo-Domínguez et al.; Serrão et al.; Silva and Palaré), including the global citizenship (Simon et al.) and entrepreneurial questions (Silveyra-León et al.; Tian). Most of the articles in this Research Topic focus on learning, teaching models and methodologies associated with technologies in higher education (see articles by: Alismaiel et al.; Atout and Nalubega; Ding and Li; Mahmud and Wong; Zakaria et al.), covering an active learning experience in didactic stations (Navarro-Durán et al.), an analysis of the flipped classroom pedagogical model (Arco et al.), a study on service-learning (Pinto and Costa-Ramvalho), and experiences of interprofessional learning (Berger-Estilita et al.), with

academic language demands (Russell et al.), and an exam villa for exam preparation at university (Reschke et al.). Also addressed general issues related to reputation (Mateus and Acosta), doctoral graduate attributes (Senekal et al.), academic integration (Abdul-Raham et al.), and learning environment (Solovieva et al.).

In this sense, innovative perspectives on teaching and learning are needed in higher education (Rodrigues, 2023a) and new models of training and instructional methods must be thought of (Rodrigues, 2020; Rodrigues and Alonso, 2022). Teaching contents and techniques should be structured in line with the learners' objectives, students' needs, and professional and soft skills required by the fourth industrial revolution (Atiku and Boateng, 2020) and should be supported by an innovative technology-enhanced pedagogy (Blau et al., 2020). Issues and challenges such as entrepreneurship education, development, and soft and

technological skills should be considered (Fayolle, 2013; Liñán and Fernández-Serrano, 2014; Núñez, 2016; Rodrigues et al., 2021).

In addition to implementing entrepreneurship programmes and analyzing the most recommended instructional methods for developing transversal skills (Rodrigues, 2023b), it is essential to study the entrepreneurship education based on an experiential learning approach, namely through effective practices with technology-based simulation gaming (Yasin and Hafeez, 2018). The future of entrepreneurship education will have to involve a comprehensive theoretical and practical discourse for the innovation of pedagogies with the integration of technology. These will increase student motivation and engagement by making learning more interesting and interactive, with student-centered approaches such as the flipped classroom and gamification activities, involving students in real-life scenarios such as “the

TABLE 1 Titles of articles published by type.

Systematic review	Authors
Views and experiences of using advanced technologies in higher education of healthcare professionals: a systematic mixed-method Review	(Atout and Nalubega)
A review of the application of virtual reality technology in higher education based on Web of Science literature data as an example	(Ding and Li)
Bibliometric analysis of the flipped classroom pedagogical model: trends and strategic lines of study	(Arco et al.)
Academic integration in higher education: a review of effective institutional strategies and personal factors	(Abdul-Raham et al.)
Reputation in Higher Education: a Systematic Review	(Mateus and Acosta)
A systematic review of doctoral graduate attributes: domains and definitions	(Senekal et al.)
Original research	
Multi-level education for sustainability through global citizenship, territorial education and art forms	(Simon et al.)
Drawing skills at the beginning of higher education: teachers' perspectives, expectations, and realities	(Silva and Palaré)
The effects of a mindfulness-based program on higher education students	(Serrão et al.)
The influence of work values of college students on entrepreneurial intention: the moderating role of psychological capital	(Tian)
Do entrepreneurship challenges raise student's entrepreneurial competencies and intention?	(Silveyra-León et al.)
Social Media Technologies Used for Education: an Empirical Study on TAM Model During the COVID-19 Pandemic	(Alismael et al.)
Digital age: the importance of 21st century skills among the undergraduates	(Mahmud and Wong)
Active learning to develop disciplinary competencies related to automatic control in engineering curricula using low cost do-it-yourself didactic stations	(Navarro-Durán et al.)
Mapping the helix model of innovation influence on education: a bibliometric review	(Zakaria et al.)
Effects of service-learning as opposed to traditional teaching-learning contexts: a pilot study with three different courses	(Pinto and Costa-Ramalho)
Pre-licensure medical students' knowledge and views on interprofessional learning: a qualitative concept analysis based on real-world data	(Berger-Estilita et al.)
A mixed-method investigation into international university students' experience with academic language demands	(Russell et al.)
The potential of an exam villa as a structural resource during prolonged exam preparation at university	(Reschke et al.)
Education quality and student satisfaction nexus using instructional material, support, classroom facilities, equipment and growth: higher education perspective of Pakistan	(Ikram and Kenayathulla)
Exploring the relationship between students' note-taking and interpreting quality: a case study in the Chinese context	(Liu et al.)
Conceptual analysis	
A teachers' based approach to assessing the perception of critical thinking in Education university students based on their age and gender	(Galindo-Domínguez et al.)
Brief research report	
Developing effective student learning environment: case study from Sharjah, United Arab Emirates	(Solovieva et al.).

development of university-based business” (Hyams-Sesseki and Yasin, 2022, p. 258).

Higher education institutions can play an important role in the development of global citizenship education for young adults and even in lifelong learning (Massaro, 2022; Saperstein, 2023), either by integrating it into curricula or by creating their own programmes (Ennals et al., 2009; Maire, 2023). At the same time, they can make a strong contribution to the Sustainable Development Goals, especially Goal 4 on Quality Education (Fang et al., 2023; Ludvik et al., 2023).

The European Union study on innovation in higher education (Brennan et al., 2014) concluded that there are three main sets of challenges to enhance innovation in higher education: “(i) challenges from globalization; (ii) challenges from the changing supply and demand for higher education; and (iii) challenges from changes in higher education funding.” (p. 81), which require various innovative practices to tackle, build on an interplay between national/regional and institutional factors, and between bottom-up and top-down approaches to innovation. Policy recommendations for consideration encompass the innovation in teaching and learning, the improvement of student performance through technology, and the consideration of globalization and multi-campus universities.

Thus, this Research Topic is justified to strengthen the current state of international research on new perspectives and reflections regarding the role of higher education in society and how it can contribute to increase the Quality of Education as one of the Sustainable Development Goals. This topic also contributes to discussions on the importance of the changes needed in teaching, assessment and learning processes in higher education, in the context of emerging technology-based environments.

Taken as a whole, the selected articles could serve as a reference for articulating future directions in research and contributing to better practices in the higher education landscape. They also highlight new perspectives for future research, particularly in entrepreneurship and global citizenship education, and new forms of learning, anticipating the potential and challenges of new digital tools and technologies in education.

Without forgetting the fundamental mission of higher education as the guardian of scientific knowledge, new perspectives on innovation are relevant in order to continue to ensure its impartiality, credibility, ethics, and democratic culture.

References

- Atiku, S. O., and Boateng, F. (2020). “Rethinking education system for the fourth industrial revolution,” in *Human Capital Formation for the Fourth Industrial Revolution*, ed. S. O. Atiku (Pennsylvania: IGI Global), 1–17. doi: 10.4018/978-1-5225-9810-7.ch001
- Blau, I., Shamir-Inbal, T., and Avdiel, O. (2020). How does the pedagogical design of a technology-enhanced collaborative academic course promote digital literacies, self-regulation, and perceived learning of students? *Inter. Higher.* 45:100722. doi: 10.1016/j.iheduc.2019.100722
- Brennan, J., Broek, S., Durazzi, N., Kamphuis, B., Ranga, M., and Ryan, S. (2014). *Study on innovation in higher education: final report. European Commission Directorate for Education and Training Study on Innovation in Higher Education*. Available online at: <https://eprints.lse.ac.uk/55819/> (accessed January 10, 2024).
- Ennals, R., Stratton, L., Moujahid, N., and Kovala, S. (2009). Global information technology and global citizenship education. *AI Soc.* 23, 61–68. doi: 10.1007/s00146-007-0161-y
- Fang, H., Zhang, F., Xiao, Q., and Lin, C. (2023). New policy research on education development and global citizenship in a sustainable environment. *Sustainability* 15, 4736. doi: 10.3390/su15064736
- Fayolle, A. (2013). Personal views on the future of entrepreneurship education. *Entrepreneurs. Region. Dev.* 25, 692–701. doi: 10.1080/08985626.2013.821318
- Gafurov, I., Safiullin, M., Akhmetshin, E., Gapsalamov, A., and Vasilev, V. (2020). Change of the higher education paradigm in the context of digital transformation: from resource management to access control. *Int. J. Higher Educ.* 9, 71–85. doi: 10.5430/ijhe.v9n3p71

Author contributions

AR: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. The researcher was part of UIDEF -Unidade de Investigação e Desenvolvimento em Educação e Formação, UIDB/04107/2020, supported by National Funds through FCT-Portuguese Foundation for Science and Technology, I.P., <https://doi.org/10.54499/UIDB/04107/2020>.

Acknowledgments

We would like to thank all authors, reviewers, journal editors, and colleagues involved in preparing this Research Topic.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher’s note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

- Hyams-Sesseki, D., and Yasin, N. (2022). "The future of enterprise and entrepreneurship education in relation to technology," in *Technology and Entrepreneurship: Adopting Creative Technologies in Entrepreneurship Education*, eds. D. H. Hyams-Ssesaki, and N. Yasin (London: Palgrave Macmillan/Springer), 251–260.
- Liñán, F., and Fernández-Serrano, J. (2014). National culture, entrepreneurship and economic development: different patterns across the European Union. *Small Business Econ.* 42, 685–701. doi: 10.1007/s11187-013-9520-x
- Ludvik, M.B., Wills-Jackson, C., Eberhart, T.L., Mulholland, S., Bhansali, S., Nolan-Arañez, S., et al. (2023). Exploring the potential of mindful compassion pedagogies for effective global citizenship education and education for sustainable development. *Int. Rev. Educ. – J. Lifelong Learn.* 69, 275–297. doi: 10.1007/s11159-023-10009-x
- Maire, Q. (2023). Visions of global citizenship: cosmopolitanism and internationalism in citizenship education policy in Australia. *Int. Stud. Sociol. Educ.* 32, 856–878. doi: 10.1080/09620214.2021.1927145
- Massaro, V. R. (2022). Global citizenship development in higher education institutions: a systematic review of the literature. *J. Global Educ. Res.* 6, 98–114. doi: 10.5038/2577-509X.6.1.1124
- Núñez, M. (2016). *La educación emprendedora en la enseñanza escolar en España*. Madrid: Editorial Universitat.
- Rodrigues, A.L., Cerdeira, L., Machado-Taylor, M.L., and Alves, H. (2021). Technological skills in higher education—different needs and different uses. *Educ. Sci.* 11, 326. doi: 10.3390/educsci11070326
- Rodrigues, A. L. (2020). Digital technologies integration in teacher education: the active teacher training model. *J. E-Learn. Knowl. Soc.* 16, 24–33.
- Rodrigues, A. L. (2023a). "Innovative hybrid learning: a new paradigm in teacher education for transformative learning," in *Active and Transformative Learning in STEAM Disciplines*, ed. M. D. Lytras (Bingley: Emerald Publishing Limited).
- Rodrigues, A. L. (2023b). Entrepreneurship education pedagogical approaches in higher education. *Educ. Sci.* 13:940. doi: 10.3390/educsci13090940
- Rodrigues, A. L., and Alonso, D. (2022). Instructional methods and hybrid learning in preservice teacher education – case studies in Portugal and Spain. *J. Higher Educ. Theory Pract.* 22, 47–60. doi: 10.33423/jhetp.v22i3.5080
- Saperstein, E. (2023). Post-pandemic citizenship: The next phase of global citizenship education. *Prospects* 53, 203–217. doi: 10.1007/s11125-021-09594-2
- Yasin, N., and Hafeez, K. (2018). "Enterprise simulation gaming: effective practices for assessing student learning with simventure classic and Ventureblocks," in *Experiential Learning for Entrepreneurship*, eds. D. Hyams-Ssekasi, and E. Caldwell (Cham: Palgrave Macmillan), 51–69.



Social Media Technologies Used for Education: An Empirical Study on TAM Model During the COVID-19 Pandemic

Omar A. Alismaiel^{1*}, Javier Cifuentes-Faura² and Waleed Mugahed Al-Rahmi³

¹ College of Education, King Faisal University, Al-Ahsa, Saudi Arabia, ² Faculty of Economics and Business, University of Murcia, Murcia, Spain, ³ Faculty of Social Sciences and Humanities, School of Education, Universiti Teknologi Malaysia, Skudai, Malaysia

OPEN ACCESS

Edited by:

Ana Luisa Rodrigues,
University of Lisbon, Portugal

Reviewed by:

Ying Xie,
Northern Illinois University,
United States
Norhisham Mohamad Nordin,
Sultan Idris University of Education,
Malaysia

*Correspondence:

Omar A. Alismaiel
oalismael@kfu.edu.sa

Specialty section:

This article was submitted to
Higher Education,
a section of the journal
Frontiers in Education

Received: 24 February 2022

Accepted: 11 April 2022

Published: 28 April 2022

Citation:

Alismaiel OA, Cifuentes-Faura J
and Al-Rahmi WM (2022) Social
Media Technologies Used
for Education: An Empirical Study on
TAM Model During
the COVID-19 Pandemic.
Front. Educ. 7:882831.
doi: 10.3389/educ.2022.882831

The study's major goal was to figure out what factors impact university students' behavior and intentions to use social media to boost their academic performance during the COVID-19 Pandemic. Given the context-dependent nature of online learning, the Technology Acceptance Model (TAM) was adopted and supplemented with components largely relevant to harnessing social media for collaborative learning and engagement. Collaborative learning, student participation, and a social media mindset are just a few of the new features. The enlarged model was validated using empirical data from an online survey questionnaire filled by a sample of 409 Saudi Arabia higher education students, which assesses students' social media usage intentions and academic performance during the COVID-19 Pandemic. AMOS-SEM was used to analyze the model's various assumptions (Analysis of Moment Structures- Structural Equation Modeling). The findings revealed that: (1) utilizing social media for collaborative learning and student engagement has a direct positive impact on perceived usefulness, ease of use, and enjoyment; (2) perceived usefulness, ease of use, and enjoyment has a direct positive impact on attitude to use social media; and (3) the link between TAM characteristics "usefulness, ease of use, and pleasure" and behavior intention to use social media is mediated by attitude to use social media. (4) Students' attitudes and behavior intentions on social media have a direct positive influence on their academic performance during the COVID-19 Pandemic. Academics, higher education institutions, and educational technology application providers will benefit greatly from the conclusions of this study, both theoretically and practically.

Keywords: social media technologies, AMOS-SEM, TAM model, COVID-19 pandemic, academic performance

INTRODUCTION

Previous research on the use of social media in higher education (Awidi et al., 2019; Manca, 2020) has shown that it may be utilized to increase student collaboration and engagement, as well as augment conventional learning and enhance academic success (Awidi et al., 2019; Manca, 2020). This study, on the other hand, aims to look at the use of social media for maintaining formal academic performance during the COVID-19 Pandemic in public institutions that do not have a strong social media presence and were relied on in-class communication before to COVID-19, particularly after the global pandemic. COVID-19 has had a major negative impact on many

facets of education, and has been especially detrimental to those students with the least resources. Institutions with little technological adaptability have also suffered from the changes caused by the pandemic (Faura-Martínez et al., 2021; Talib et al., 2021; Tang et al., 2021). Following their academic success as measured by the TAM model, students' academic performance during the COVID-19 Pandemic entails using social media as the exclusive and official platform for academic-related purposes such as teaching and learning, student support, community building, and participation. The social media phenomenon has had an impact on Saudi Arabia, as it has on many other countries. According to data, education is one of the top five countries in terms of the number of social media profiles created (Alamri et al., 2020; Ali Qalati et al., 2021). Among research students, social media is frequently seen as enhancing active collaborative learning. In higher education, however, there is a scarcity of study on this subject. As a result, the current study attempted to fill a vacuum in the literature by analyzing how the usage of social media for active collaborative learning and engagement affects research students' academic performance during the COVID-19 Pandemic. The technology acceptance model and constructivism theory were used to create the research model (TAM). This study examined the interactive and perceptual aspects of social media use using constructivism theory and the technology acceptance paradigm (TAM). Active collaborative learning, according to Shen et al. (2021), is a continuous process in which students communicate and exchange ideas and opinions *via* social media (Phuthong, 2021). These modes of communication also include social media technologies such as e-mail, intranets, blogs, video conferencing, photograph sharing, wikis, and virtual mobile phone enterprises (Anser et al., 2020). Communication, in its broadest sense, is a system that enables people to connect, cooperate, and communicate with one another in a group setting *via* active collaborative learning and engagement with material, opinions, encounters, experiences, and technologies (Rahman et al., 2020). Due to the ease of use and utility of social media, students may become more active, increase understanding and conversation among classmates, supervisors, professors, and experts, seek professional support, and solve problems (Ghani et al., 2019). The reported ease of use and usefulness were statistically significant satisfaction indicators. People who have more friends and engage with more pupils are happier, according to research, than those who have fewer friends and contact with fewer students (Mostafa, 2020). Despite this, educators who use social media have expressed concerns about its difficulties, as well as insufficient evaluation and assessment (Moran et al., 2019). Students on campus require more support in accessing extra social media active collaborative learning choices than they do in face-to-face sessions, according to an empirical research. When it comes to using social media for active collaborative learning and engagement, lecturers may play a vital role in supporting students with speedy questions, solutions, and coordination (Hamadi et al., 2021). Evaluative times were created to allow teachers and students to provide feedback (Khan et al., 2021). Use of social media has an impact on study habits and can be a study distraction (Van Den Beemt et al., 2020). Individual learning capacity and accountability for

vast amounts of communal information should also be fostered and monitored, despite the fact that the present educational focus has shifted substantially from individual learning to active collaborative learning (Liang et al., 2021). Students must also become more self-directed in their usage of technology as it becomes increasingly integrated into school (Sakurai et al., 2021). Students who were unfamiliar with the technology, as well as those who had had negative experiences with it, expressed interest in using social media for active collaborative learning and engagement, but stated that they would prefer to use media for interaction (Dzogbenuku et al., 2021). In the United States sample, multitasking and time wasting were also shown to attenuate the unfavorable connection between social media use and GPA. It's conceivable that this is related to European pupils' lower proclivity for multitasking (Rasheed et al., 2020). Active collaborative learning, on the other hand, will be successfully managed (Bouton et al., 2021). University students who use Facebook spend less time studying and get poorer marks than those who do not, according to Ohio State College data (Abbasi et al., 2021). As a result, students' overall academic performance during the COVID-19 Pandemic suffers as a result (Masood et al., 2020). Cañabate et al. (2021) discovered that students' comprehension of networking technology is passive rather than active (Cañabate et al., 2021). While there have been many social media studies aimed at elucidating influential factors on the use of social media networks, there have been few comprehensive studies on social media networks that have combined all essential factors of social media network use for active collaborative learning and engagement in a single study (Pitafi et al., 2020). As a result, social media research in higher education will be able to include all factors related to social media, which is seen as a critical step in understanding students' use of social media for active collaborative learning and engagement, as well as the impact it has on their academic performance during the COVID-19 Pandemic. As a result, the primary goal of this research is to overcome the flaws that will be developed in a model that demonstrates perceptual, social media use to active collaborative learning, engagement, and satisfaction of research students in higher education using the Technology Acceptance Model TAM model (Davis, 1989) to evaluate academic performance during the COVID-19 Pandemic. Furthermore, while many social media models exist for measuring research students' academic performance during the COVID-19 Pandemic and satisfaction *via* social media for active collaborative learning and participation in higher education, none exist for measuring research students' academic performance during the COVID-19 Pandemic and satisfaction *via* social media for active collaborative learning and participation in higher education, indicating a gap in the field. As a result, using the TAM model, the study's research subject will be to analyze and examine the aspects that define the relationships between active collaborative learning and engagement in order to affect research students' academic success. According to the researcher's major study question, what are the perceptual features that influence active collaborative learning and engagement, and hence academic success? Thus, the goal of this study is to create a model of social media

use for active collaborative learning and engagement based on perceptual factors that influence academic performance during the COVID-19 Pandemic in higher education institutions, as well as to validate the Technology Acceptance Model (TAM) for interactivity and social media use for active collaborative learning and engagement on research students' academic performance during the COVID-19 Pandemic in higher education institutions.

Social Media Use in Higher Education

In terms of skills, higher education has recently moved its emphasis from knowledge to lifelong learning (Greenhow et al., 2020). Cooperation skills are highly valued by employers, hence they are included in this list (Raza et al., 2020). The most broad definition of active collaborative learning was offered by Bui et al. (2021), who defined it as a scenario in which two or more individuals study or seek to learn something new together. Given the broad definition of the term “social media,” the bulk of research looked at specific social media platforms like MySpace, Facebook, and Twitter as educational successes, which seems sensible. The objective and functions of social media sites are to make it easier for users to exchange emails, add friends, construct personal profiles, join groups, develop apps, and locate other users (Stockdale and Coyne, 2020). Web 2.0, as opposed to its predecessor, web 1.0, which was more static and less dynamic, allows for increased user engagement, collaboration, and customization (Tajvidi and Karami, 2021). They include active collaborative learning *via* Facebook, blogs, and YouTube, among other things, as noted in Shahbaznezhad et al. (2021).

PERCEPTUAL VARIABLES USED WITH THEORIES

Davis et al. (1989) introduced the Technology Acceptance Model (TAM), which will be used in this investigation. This model looks at the elements that determine how people utilize social media when they try out a new product or service (Davis et al., 1989). According to several research, perceived simplicity of use and utility have a substantial influence on satisfaction and willingness to utilize new technology (Rahmi and Birgören, 2020). The Technology Acceptance Model (TAM) is also used in this study, which says that perceived usefulness and ease of use are the most important criteria in determining whether or not a new technology is adopted. The most widely used theoretical model in this subject is TAM, which was established by Davis et al. (1989) to explain why people embrace or reject computer innovations like social media. Prior research provides the foundation for building and creating a research model to examine the influence of social media use in collaborative learning on research students' learning outcomes. Constructivism theory and the technology acceptance model were used to design the research model (TAM). Based on the findings, eight operational themes of key factors on social media use for active collaborative learning and engagement that impact academic performance during the COVID-19 Pandemic were identified and classified (see **Figure 1**).

Using Social Media for Collaborative Learning

Individuals work together to attain their shared learning goals through cooperative learning, which takes occur in groups (Khan and Mansoor, 2020). Positive interdependence, individual accountability, promotive interaction, interpersonal and small group abilities, and group processing are the five core aspects of collaborative learning (Lee and Yang, 2020). Positive interdependence, which “exists when group members think that they are linked in such a way that no one can achieve unless everyone succeeds,” is the most important aspect. “Everyone fails if one person fails” (Khan and Mansoor, 2020). Group processing is the last component, which entails group members analyzing their work in accordance to their objectives and maintaining positive working relationships (Khan and Mansoor, 2020). To guarantee that all five key aspects are in place, teachers must dedicate substantial planning time to cooperative learning (Junco et al., 2013; Al-Rahmi and Zeki, 2017; Al-Rahmi et al., 2019a). Cooperative learning groups, according to Khan and Mansoor (2020), are generally 2–4 students in size, with smaller groups being recommended. There is no ideal group size for cooperative learning. The number of students in a group is decided by a variety of factors, including the length of time the group will be working together, the ages and previous group work experience of the students, as well as the resources and equipment available (Chatterjee and Correia, 2020).

Student Engagement

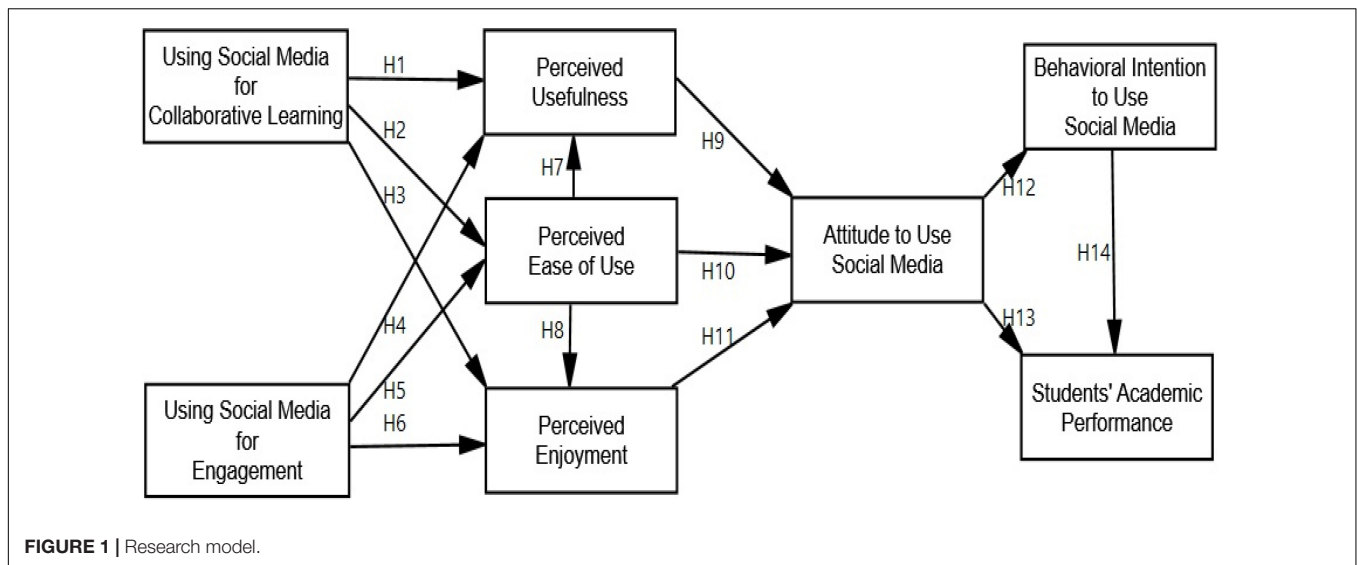
The theory of student engagement arose from a proportionate educational approach to increase student involvement. Today, engagement is defined as the amount of energy a student devotes to educational activities that are scientifically linked to better college outcomes (Bond et al., 2020). Academic interactions with professors, participation in class activities, and interaction with classmates in the quest are all forms of engagement (Meintjes and van Wyk, 2020). Because this type of online tool has been proved to boost student academic success and experience by fostering cognitive engagement and social connection, the social media network was chosen (Aljuboori et al., 2020).

Perceived Usefulness

Perceived usefulness is the most crucial measure of IT use among users, according to the TAM model (Davis, 1989). On the other hand (Acharya and Ganesan, 2019), discovered that the utility of information systems (IS) had a negative influence on attitudes about their utilization. According to previous study, PU has the largest influence on attitude (Martinho et al., 2018). Furthermore, PU had a significant impact on future intentions to utilize social media (Abdullah et al., 2016; Scherer et al., 2019). According to Al-Rahmi et al. (2018a) perceived utility (PU) in the context of social media is defined as the degree to which users believe that social media may assist them achieve teaching and learning objectives.

Perceived Ease of Use

In the context of social media, Al-Rahmi et al. (2018a) defined perceived ease of use (PEU) as the degree to which consumers



believe that utilizing social media is straightforward. According to past research, PEU has a significant influence on perceived usefulness (Abdullah et al., 2016; Binyamin et al., 2019). In addition, past research has found that PEU is a significant predictor of attitudes toward social media use (Fokides, 2017; Al-Rahmi et al., 2021a). PEU influences perceived usefulness, behavioral attitude, intention, and actual usage, according to TAM (Davis, 1989). The regression results, according to Davis (1989), indicate that, from a causative standpoint, PEU may come before perceived usefulness, rather than being a parallel and direct driver of utilization (Venkatesh and Davis, 2000).

Perceived Enjoyment

Perceived joy has an impact on the rising popularity of social media as a motivator (Rauniar et al., 2014; Al-Rahmi and Zeki, 2017). “The degree to which the act of utilizing technology is designed to be pleasurable in and of itself, independent of any potential performance concerns,” according to the definition (Davis et al., 1992). Users on social media are more interested in a service if they can experience it in a more immersive environment (Rauniar et al., 2014). People who love using a web system have a positive perspective of their interactions with it, according to Moon and Kim (2001), and are thus more inclined to utilize it to increase their collaborative learning (Sa'neh et al., 2014). However, when compared to other external factors, perceived enjoyment as an external factor in the context of student learning has not been frequently detected in previous TAM investigations.

Attitude to Use Social Media

Triandis (1971) defines attitude as a representation of sentiments and understanding about a topic or situation, as well as an individual's positive or negative behavior. Attitude includes three components, according to Mantle-Bromley (1995), which are concerned with people's preferences, knowledge of the attitudinal object, and reactions and intents toward the object, respectively. Previous study on the acceptability of social media has discovered that attitude is a key factor in determining whether or not to utilize it (e.g., Al-Rahmi et al., 2018b, 2021b).

Attitude is discovered to be a significant influencer on behavioral intention (Al-Rahmi et al., 2018b; Rasheed et al., 2020). As a result, the researchers observed that students' opinions had an impact on their desire to use online learning technologies. Furthermore, according to a study done by Sujeet and Jyoti (2013), attitude and PEU may influence enhanced behavioral intention among Omani students. Rupak et al. (2014) discovered that TAM has a substantial positive association between perceived usefulness and PEU, and that both categories had a favorable influence on behavioral intention in their research of social media usage behavior.

Behavior Intention to Use Social Media

Many earlier research on technology adoption have highlighted attitude as an important determinant of online learning and social media learning (Tosuntaş et al., 2015). Users that have a good mindset are more likely to use social media, according to Cheung and Vogel (2013). Given the rapid rise of online learning, Wang and Wang (2009) claim that the desire to utilize it differs greatly from actual use. To have a better knowledge of how different social media platforms are used. Al-Rahmi et al. (2020a) argue that there is a chance that the intention and behavior are conflicting, since the intention to embrace social media might be impacted by unanticipated occurrences. As a result, Dlalisa and van Niekerk (2015) performed an assessment of users' intentions and discovered that there is no substantial link between their intention and their actual usage of learning management systems and social media platforms. TAM is an extension of the TRA established by Davis (1986), and it gives a theoretical foundation for analyzing how external variables affect interior beliefs, attitudes, and actual usage, which determines their pleasure and use of technology. It also serves as a framework for explaining user behavior when it comes to adopting new technology and investigating the factors that impact attitudes toward such technology use (Davis, 1989). The purpose of this study is to analyze students' and instructors' satisfaction with the use of social media for active collaborative learning and

participation, as well as its impact on academic advancement in higher education institutions, using a TAM-based questionnaire.

Academic Performance During the COVID-19 Pandemic

Active participation in collaborative learning is encouraged by social media. To say that social scientists' attention is drawn to social media by the increased interest in active collaborative learning is an understatement (Abdillah et al., 2020). Clapp et al. (2021) used a social bookmarking application to increase active collaborative learning by using the method and virtual framework built for the benefit of student motivation and collaborative group learning among peers, teachers, and owners in another study (SSCL). Knowledge and experience transfer are seen as complements to precise knowledge development that is relevant to real-world circumstances (Sohaei et al., 2020). The primary advantages of using social media to aid learning and teaching will not be fully appreciated until more research is conducted into how social media's social characteristics can be used to attract low- and disengaged students to interact in educationally purposeful ways with their high-engaged peers and teachers, ensuring that it contributes to the prosperity of many students (Al-Rahmi et al., 2015). However, data reveal a beneficial association between social media platforms and how they may be utilized to increase learning in a few rare circumstances (Bond et al., 2020).

RESEARCH METHODOLOGY

We sent out 430 questionnaires for the study, and 419 were returned by respondents; after human processing, 7 of the 419 questionnaires were incomplete ("students did not complete the survey") and had to be deleted, leaving 412. Outliers, defined as "data that differs abnormally from other values in a random sample," were found in three of the remaining 412 questionnaire copies put into SPSS, bringing the total number of viable surveys to 409 students (Hair et al., 2012) argued for such exclusions, claiming that outliers might lead to erroneous statistical conclusions and should be removed. For the purpose of the study, we built a conceptual model based on the TAM model to measure student satisfaction and academic performance during the COVID-19 Pandemic.

Instrument Development

Despite the fact that Likert scales are widely used in IS research and have been fully evaluated in marketing and social science, they were utilized to gauge responses in this study (Krejcie and Morgan, 1970; Garland, 1991; Shih, 2004). All of the factors in this study are rated on a five-point Likert scale from 1 to 5: The five alternatives are (1) Strongly disagree, (2) Disagree, (3) Undecided, (4) Agree, and (5) Strongly Agree. When choosing and creating a measuring scale, several elements that affect the scale's reliability, validity, and usability must be taken into account. With the support of a pilot study with students, the questionnaire was fine-tuned and tested ahead of time to examine how students and researchers in higher education felt about using

social media for active collaborative learning and engagement, as well as how it influenced their academic performance during the COVID-19 Pandemic. A 30-item questionnaire was prepared after minor layout adjustments, and the online survey was given near the end of the semester in September 2021. In the questionnaire adapted from previous studies, four items extracted from Lee and Yang (2020) were utilized to investigate the usage of social media for collaborative learning. Three questions obtained from the study were used to assess students' use of social media (Shahbaznezhad et al., 2021). To measure PEU, perceived enjoyment, and perceived usefulness, a subset of four questions from Davis et al. (1992) were employed. Students' attitudes toward using social media were assessed using three questions adapted from Davis (1986), four items from Davis et al. (1992), and four items from Davis et al. (1992). Students' academic success was assessed using four items from Davis et al. (1992) and Al-Rahmi et al. (2020b).

Sample Size and Data Collection

In higher education, sampling is a statistical strategy for selecting a subset of individual observations from a population with the goal of influencing student and researcher academic performance during the COVID-19 Pandemic through the use of social media for active involvement and collaborative learning. Random and non-random sampling are the two types of sampling methods. Because a random sample strategy assures that the research target group has an equal chance of being picked, it was adopted in this study.

DATA ANALYSIS AND RESULTS

The empirical analysis of the current study attempts to see how the interrelationships of numerous independent and dependent factors related to using social media for active collaborative learning affect students' and researchers' academic performance during the COVID-19 Pandemic. Structural Equation Modeling was the primary statistical tool employed in the data analysis for a variety of reasons (SEM). When using the SEM, researchers have long contested whether the two-step or one-step procedure is better. The responses that have been authorized are entered into the SPSS software for analysis. This requires coding and data processing. The SPSS application is used to code the data in this investigation. The application of character symbols (mainly numerical symbols) to data is what data coding is all about. The data is modified for acceptability before being entered into SPSS and AMOS-SEM.

Validity and Reliability

A range of statistical approaches, such as the split-half methodology, internal consistency, intra-observer, and test-retest, can be used to investigate reliability (see **Tables 1, 2**). Individual item and scale reliability were investigated in this work, with scale reliability comprised of three types of measures: internal reliability (IR), composite reliability (CR), and average variance extracted (AVE). IR, are examples of scale reliability. Because internal consistency dependability is a widely used approach, it was adopted in this investigation. IR is critical in

TABLE 1 | Relationship between factors and items (Validity and Reliability).

Relationship between factors and items			Estimate	Composite reliability	Cronbach's alpha	Average variance extracted (AVE)	Squared multiple correlations in (R^2)
Using social media for collaborative learning	<—	SMC4	0.791	0.889	0.893	0.612	
	<—	SMC3	0.876				
	<—	SMC2	0.861				
	<—	SMC1	0.796				
Using social media for engagement	<—	SME3	0.824	0.911	0.907	0.593	
	<—	SME2	0.769				
	<—	SME1	0.722				
Perceived usefulness	<—	PU4	0.771	0.870	0.891	0.637	
	<—	PU3	0.833				
	<—	PU2	0.754				
	<—	PU1	0.747				
Perceived enjoyment	<—	PE4	0.831	0.907	0.897	0.582	
	<—	PE3	0.810				
	<—	PE2	0.814				
	<—	PE1	0.824				
Perceived ease of use	<—	PEU4	0.824	0.900	0.899	0.607	
	<—	PEU3	0.784				
	<—	PEU2	0.860				
	<—	PEU1	0.803				
Attitude to use social media	<—	ATT3	0.881	0.875	0.887	0.650	
	<—	ATT2	0.762				
	<—	ATT1	0.824				
Behavior intention to use social media	<—	BIU4	0.824	0.917	0.911	0.672	
	<—	BIU3	0.821				
	<—	BIU2	0.803				
	<—	BIU1	0.7762				
Students' academic performance	<—	SAP4	0.794	0.921	0.910	0.665	
	<—	SAP3	0.872				
	<—	SAP2	0.891				
	<—	SAP1	0.823				

TABLE 2 | Sample covariances (Group number 1).

Factors	Code	SMC	SME	PU	PE	PEU	ATT	BIU	SAP
Using social media for collaborative learning	SMC	0.910							
Using social media for engagement	SME	0.431	0.832						
Perceived usefulness	PU	0.509	0.452	0.873					
Perceived enjoyment	PE	0.422	0.455	0.392	0.888				
Perceived ease of use	PEU	0.471	0.386	0.409	0.465	0.907			
Attitude to use social media	ATT	0.307	0.471	0.428	0.369	0.495	0.911		
Behavior intention to use social media	BIU	0.494	0.400	0.393	0.419	0.502	0.444	0.923	
Students' academic performance	SAP	0.452	0.332	0.543	0.423	0.309	0.421	0.343	0.898

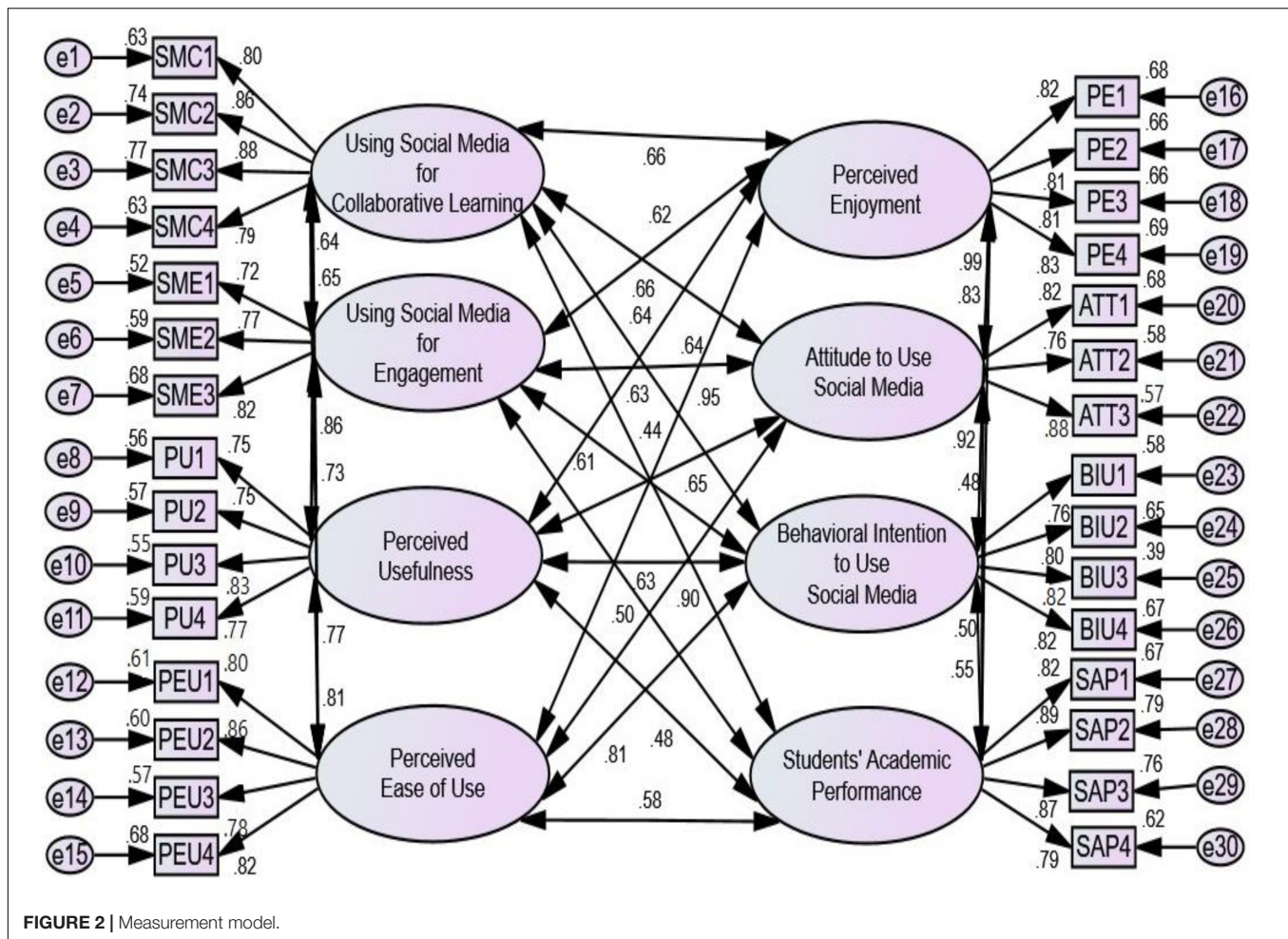


TABLE 3 | Contrast media-induced nephropathy (CMIN) and the adjusted goodness-of-fit index (AGFI).

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	93	3295.859	372	0.000	8.860
Saturated model	465	0.000	0	0.000	0
Independence model	30	27192.126	435	0.000	62.511
Adjusted goodness-of-fit index (AGFI)					
Tucker-lewis index			TLI	0.000	0.967
Incremental fit index			IFI	0.000	0.934
Comparative fit index			CFI	0.000	0.955
Root-mean-square residual			RMR	0.000	0.032

this study because it involves many item scales (Bryman and Cramer, 2004; Hair et al., 2012). The item is deemed dependable if the squared multiple correlations in (R^2) of each item in the measurement model exceed 0.5. Individual item dependability is established when the standardized loading is equal to or greater than 0.50. Furthermore, the AVE displays the overall amount of variation explained by the hidden construct in the indicators (Hair et al., 2012).

Measurement Model

According to Hair et al. (2012), a range of goodness of fit metrics may be used to evaluate the overall model measure, which are split into three categories: absolute fit measures, incremental fit measures, and parsimonious fit measures. The measurement model is first examined for its validity (unidimensionality, reliability, and validity) using the two-step technique. Second, the structural model will perform further estimations between variables to see whether it matches the observed data (Hair et al., 2012). The adjusted goodness-of-fit index (AGFI), Tucker-Lewis index (TLI), incremental fit index (IFI), and comparative fit index are examples of incremental fit measures (CFI) shown in Figure 2 and Table 3.

Hypothesis Testing

According to Hair et al. (2012), a direct impact is a relationship between two constructions that follows a single path. In other words, it is the direct relationship between variables and their impact on one another. The Critical Ratio (CR) and p -value recommendation values for the present research, which contains sixteen direct impacts, must be estimated to guarantee that all routes in the model are supported. To arrive at a suggested value,

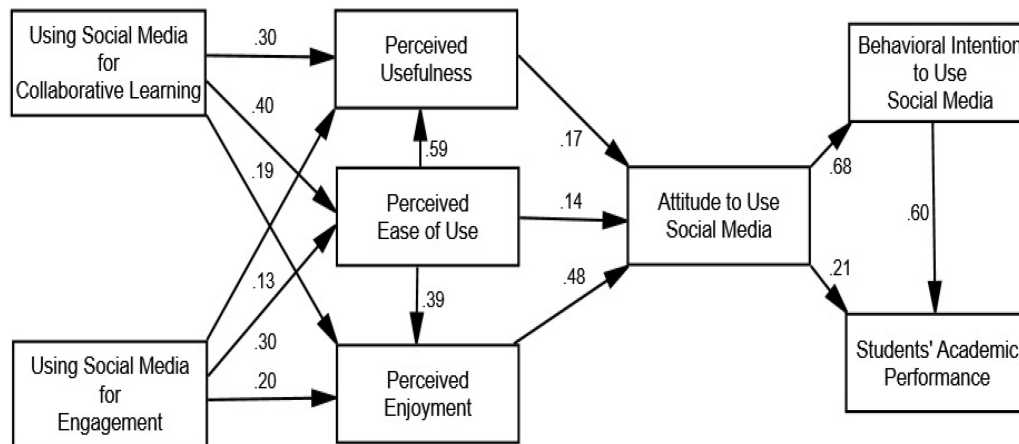


FIGURE 3 | Structural model.

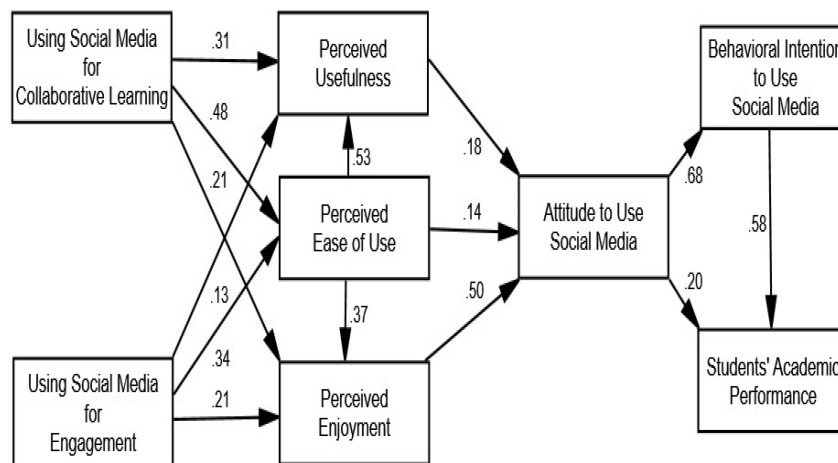


FIGURE 4 | Hypothesis testing.

the CR parameter estimate divided by an estimate of its standard error should be more than 1.96 (see **Figures 3, 4**, and **Table 4**).

DISCUSSION AND IMPLICATIONS

This study contributes to the existing body of knowledge by using the TAM model to better understand how students utilize social media for collaborative learning and management. Students' communication, participation, and collaboration have all changed as a result of social media. Students are encouraged to learn through social media collaboration and participation, where students and professors interact as well as students and students communicate (Stevens, 2009; Al-Rahmi et al., 2021b). Perceived usefulness, PEU, and perceived enjoyment all exhibited a strong positive relationship with social media use for collaborative learning and engagement, according to our findings. According to these figures, social media has gained in popularity among students due to its simplicity and broad use. Forming groups, transferring resources, communicating

with others, and coordinating through social media are all activities that students like. Perceived usefulness and student engagement and collaborative learning; PEU of social media with student engagement and collaborative learning; attitude toward social media; and behavior intention to use social media to influence students' academic performance during the COVID-19 Pandemic all showed a significant positive relationship. Perceived usefulness, ease of use, and enjoyment are all crucial factors in determining whether or not to use a virtual learning environment, according to a previous study (King and He, 2006; Al-Rahmi et al., 2021a). According to the findings of this study, social media or social networking sites may be a beneficial tool for boosting student engagement and cooperation in the construction of learning environments. According to Al-Rahmi et al. (2019a) the technology acceptance model incorporates indicators of collaborative learning such as "reported ease of use" and "perceived usefulness," as well as "engagement," "peer interaction," and "teacher's participation." Finally, research has been conducted on the influence of social media on collaborative learning and participation. However, in this study, the TAM's

TABLE 4 | Regression weights: (Group number 1–Default model).

No	Relationships			Estimate	S.E.	C.R.	P	Results
H1	PU	<—	SMC	0.304	0.023	13.236	0.000	Supported
H2	PEU	<—	SMC	0.401	0.021	18.704	0.000	Supported
H3	PE	<—	SMC	0.189	0.026	7.413	0.000	Supported
H4	PU	<—	SME	0.131	0.022	6.057	0.000	Supported
H5	PEU	<—	SME	0.296	0.021	13.889	0.000	Supported
H6	PE	<—	SME	0.201	0.026	7.756	0.000	Supported
H7	PU	<—	PEU	0.592	0.024	24.215	0.000	Supported
H8	PE	<—	PEU	0.394	0.029	13.450	0.000	Supported
H9	ATT	<—	PU	0.167	0.026	6.349	0.000	Supported
H10	ATT	<—	PEU	0.141	0.030	4.673	0.000	Supported
H11	ATT	<—	PE	0.480	0.023	20.861	0.000	Supported
H12	BIU	<—	ATT	0.684	0.019	35.061	0.000	Supported
H13	SAP	<—	ATT	0.207	0.026	7.834	0.000	Supported
H14	SAP	<—	BIU	0.601	0.027	22.276	0.000	Supported

major elements of PEU, perceived enjoyment, and perceived usefulness were employed as predictors of student social media usage. It has been proposed that a student's use of social media predicts their attitude toward it, their behavior while using it, and their academic accomplishment. The following are the key conclusions of the study: PEU influences students' attitudes toward using social media, as well as their behavior intending to use social media and academic accomplishment. This study's findings are comparable, but not identical, to those of earlier investigations. The direct and indirect impacts of PEU on social media enjoyment and utility are investigated in this study. Active technology usage for educational purposes is on the rise, according to the research, and has a substantial influence on collaborative learning and student engagement (Al-Rahmi et al., 2019b). Collaborative learning and student engagement influenced reported ease of use, perceived enjoyment, and perceived usefulness in this study. Furthermore, the attraction, practicality, and ease of use of social media have an indirect influence on collaborative learning and student participation. All of these linkages were examined using a single model. According to our findings, perceived usefulness, ease of use, and enjoyment have a substantial impact on students' attitudes about social media, as well as their behavior intention to use social media to improve academic performance during the COVID-19 Pandemic. Due to its simplicity and widespread usage, social media has grown in popularity among students, according to these statistics. Social media is also popular among students, who utilize it for engagement, resource sharing, and collaborative learning. There was also a substantial positive association between the perceived usefulness and enjoyment of using social media for collaborative learning and engagement.

Conclusion and Future Work

This study updates the TAM Model to better understand students' views regarding social media and their plans to use it to improve their academic performance during the COVID-19 Pandemic. The findings suggest that utilitarian orientations to a social media site's perceived utility, enjoyment, and ease of use are important

determinants of collaborative learning and student engagement, which is a driver of students' academic performance during the COVID-19 Pandemic. Using the TAM model, we found a link between students' attitudes about social media and their behavior intention to use in the context of social media usage for education during the COVID-19 Pandemic. We studied and included additional crucial elements, such as using social media for collaborative learning and students' participation, to make the TAM model more meaningful in the context of understanding the acceptance and usage of social media to affect students' academic performance during the COVID-19 Pandemic. A structural equation modeling (SEM) approach and a 30-question online questionnaire were used to analyze these characteristics. Students' perceptions of social media's usefulness, enjoyment, and ease of use are positively influenced by collaborative learning and engagement, according to the findings; three variables influenced students' attitudes toward social media and intentions to use it to improve their academic performance during the COVID-19 pandemic. In addition, the following four categories of strategic recommendations were discussed: using social media as a platform for education learning during the COVID-19 pandemic; using social media as a platform for collaboration and student engagement; social media as a useful, enjoyable, and easy-to-use platform; students' attitudes toward social media and intentions to use it to improve their academic performance during the COVID-19 Pandemic. When these approaches are paired with a set of standards for using social media in higher education, students may be able to perform better in class. According to the current study, future research could incorporate other and additional variables to analyze the impact of various aspects on students' academic performance during the COVID-19 Pandemic through the use of social media for collaborative learning and student engagement. Future research should look into additional studies and variables that influence the usage of social media for collaborative learning and participation in order to improve students' academic performance during the COVID-19 Pandemic (e.g., environmental and cultural).

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

All authors have contributions, read and agreed to the published version of the manuscript.

FUNDING

This work was supported by the Deanship of Scientific Research, Vice Presidency for Graduate Studies and Scientific Research, King Faisal University, Saudi Arabia (Project No. GRANT140).

REFERENCES

- Abbasi, G. A., Jagaveeran, M., Goh, Y. N., and Tariq, B. (2021). The impact of type of content use on smartphone addiction and academic performance: physical activity as moderator. *Technol. Soc.* 64:101521. doi: 10.1016/j.techsoc.2020.101521
- Abdillah, L., Handayani, T., Rosalyn, E. R., and Mukti, Y. I. (2020). Collaborating digital social media for teaching science and Arabic in higher education during COVID-19 pandemic. *Ijaz Arabi J. Arabic Learn.* 4, 12–25.
- Abdullah, F., Ward, R., and Ahmed, E. (2016). Investigating the influence of the most commonly used external variables of TAM on students' perceived ease of use (PEOU) and perceived usefulness (PU) of e-portfolios. *Comput. Hum. Behav.* 63, 75–90. doi: 10.1016/j.chb.2016.05.014
- Acharya, S., and Ganesan, P. (2019). Factors that affect students' intention and use of technology: an assessment of UTAUT2 in the context of YouTube video forwarding behaviour. *Int. Journal of Bus. Emerg. Mark.* 11, 348–367. doi: 10.1504/ijbem.2019.105231
- Alamri, M. M., Almaiah, M. A., and Al-Rahmi, W. M. (2020). The role of compatibility and task-technology fit (TTF): on social networking applications (SNAs) usage as sustainability in higher education. *IEEE Access* 8, 161668–161681. doi: 10.1109/access.2020.3021944
- Ali Qalati, S., Li, W., Ahmed, N., Ali Mirani, M., and Khan, A. (2021). Examining the factors affecting SME performance: the mediating role of social media adoption. *Sustainability* 13:75. doi: 10.3390/su13010075
- Aljuboori, A. F., Fashakh, A. M., and Bayat, O. (2020). The impacts of social media on university students in Iraq. *Egypt. Inform. J.* 21, 139–144. doi: 10.1016/j.eij.2019.12.003
- Al-Rahmi, A. M., Al-Rahmi, W. M., Alturki, U., Aldraiweesh, A., Almutairy, S., and Al-Adwan, A. S. (2021a). Exploring the factors affecting mobile learning for sustainability in higher education. *Sustainability* 13:7893. doi: 10.3390/su13147893
- Al-Rahmi, A. M., Shamsuddin, A., Alturki, U., Aldraiweesh, A., Yusuf, F. M., Al-Rahmi, W. M., et al. (2021b). The influence of information system success and technology acceptance model on social media factors in education. *Sustainability* 13:7770. doi: 10.3390/su13147770
- Al-Rahmi, W. M., and Zeki, A. M. (2017). A model of using social media for collaborative learning to enhance learners' performance on learning. *J. King Saud Univ. Comput. Inf. Sci.* 29, 526–535. doi: 10.1016/j.jksuci.2016.09.002
- Al-Rahmi, W. M., Alias, N., Othman, M. S., Marin, V. I., and Tur, G. (2018a). A model of factors affecting learning performance through the use of social media in Malaysian higher education. *Comput. Educ.* 121, 59–72. doi: 10.1016/j.compedu.2018.02.010
- Al-Rahmi, W. M., Yahaya, N., Alamri, M. M., Aljarboa, N. A., Kamin, Y. B., and Moafa, F. A. (2018b). A model of factors affecting cyber bullying behaviors among university students. *IEEE Access* 7, 2978–2985. doi: 10.1109/access.2018.2881292
- Al-Rahmi, W. M., Othman, M. S., and Yusuf, L. M. (2015). Effect of engagement and collaborative learning on satisfaction through the use of social media on Malaysian higher education. *Res. J. Appl. Sci. Eng. Technol.* 9, 1132–1142. doi: 10.19026/rjaset.9.2608
- Al-Rahmi, W. M., Yahaya, N., Alamri, M. M., Alyoussef, I. Y., Al-Rahmi, A. M., and Kamin, Y. B. (2019a). Integrating innovation diffusion theory with technology acceptance model: supporting students' attitude towards using a massive open online courses (MOOCs) systems. *Interact. Learn. Environ.* 29, 1–13. doi: 10.1007/978-981-287-532-7_219-1
- Al-Rahmi, W. M., Yahaya, N., Aldraiweesh, A. A., Alturki, U., Alamri, M. M., Saud, M. S. B., et al. (2019b). Big data adoption and knowledge management sharing: an empirical investigation on their adoption and sustainability as a purpose of education. *IEEE Access* 7, 47245–47258. doi: 10.1109/access.2019.2906668
- Al-Rahmi, W. M., Yahaya, N., Alturki, U., Alrobai, A., Aldraiweesh, A. A., Omar Alsayed, A., et al. (2020a). Social media-based collaborative learning: the effect on learning success with the moderating role of cyberstalking and cyberbullying. *Interact. Learn. Environ.* 29, 1–27. doi: 10.1080/10494820.2020.1728342
- Al-Rahmi, W. M., Alzahrani, A. I., Yahaya, N., Alalwan, N., and Kamin, Y. B. (2020b). Digital communication: information and communication technology (ICT) usage for education sustainability. *Sustainability* 12:5052. doi: 10.1016/j.giq.2018.12.008
- Anser, M. K., Zaigham, G. H. K., Imran Rasheed, M., Pitafi, A. H., Iqbal, J., and Luqman, A. (2020). Social media usage and individuals' intentions toward adopting bitcoin: the role of the theory of planned behavior and perceived risk. *Int. J. Commun. Syst.* 33:e4590. doi: 10.1002/dac.4590
- Awidi, I. T., Paynter, M., and Vujosevic, T. (2019). Facebook group in the learning design of a higher education course: an analysis of factors influencing positive learning experience for students. *Comput. Educ.* 129, 106–121. doi: 10.1016/j.compedu.2018.10.018
- Binyamin, S. S., Rutter, M., and Smith, S. (2019). Extending the technology acceptance model to understand students' use of learning management systems in Saudi higher education. *Int. J. Emerg. Technol. Learn.* 14, 4–21. doi: 10.3991/ijet.v14i03.9732
- Bond, M., Buntins, K., Bedenlier, S., Zawacki-Richter, O., and Kerres, M. (2020). Mapping research in student engagement and educational technology in higher education: a systematic evidence map. *Int. J. Educ. Technol. High. Educ.* 17, 1–30. doi: 10.4018/978-1-7998-0119-1.ch001
- Bouton, E., Tal, S. B., and Asterhan, C. S. (2021). Students, social network technology and learning in higher education: visions of collaborative knowledge construction vs. the reality of knowledge sharing. *Internet High. Educ.* 49:100787. doi: 10.1016/j.iheduc.2020.100787
- Bryman, A., and Cramer, D. (2004). *Quantitative Data Analysis with SPSS 12 and 13: A Guide for Social Scientists*. Abingdon: Routledge.
- Bui, T. X. T., Ha, Y. N., Nguyen, T. B. U., Nguyen, V. U. T., and Ngo, T. C. T. (2021). A Study on collaborative online learning among EFL students in van lang university (VLU). *AsiaCALL Online J.* 12, 9–21.
- Cañabate, D., Bubnys, R., Nogué, L., Martínez-Mínguez, L., Nieva, C., and Colomer, J. (2021). Cooperative learning to reduce inequalities: instructional approaches and dimensions. *Sustainability* 2021:10234. doi: 10.3390/su131810234
- Chatterjee, R., and Correia, A. P. (2020). Online students' attitudes toward collaborative learning and sense of community. *Am. J. Distance Educ.* 34, 53–68. doi: 10.1080/08923647.2020.1703479
- Cheung, R., and Vogel, D. (2013). Predicting user acceptance of collaborative technologies: an extension of the technology acceptance model for e-learning. *Comput. Educ.* 63, 160–175. doi: 10.1016/j.compedu.2012.12.003
- Clapp, J., DeCoursey, M., Lee, S. W. S., and Li, K. (2021). "Something fruitful for all of us": social annotation as a signature pedagogy for literature education. *Arts Humanit. High. Educ.* 20, 295–319. doi: 10.1177/147402220915128
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Q.* 13, 319–340. doi: 10.2307/249008
- Davis, F. D., Bagozzi, R. P., and Warshaw, P. R. (1989). User acceptance of computer technology: a comparison of two theoretical models. *Manag. Sci.* 35, 982–1003. doi: 10.1287/mnsc.35.8.982
- Davis, F. D., Baozzi, R. P., and Warshaw, P. R. (1992). Extrinsic and intrinsic motivation to use computers in the workplace. *J. Appl. Soc. Psychol.* 22, 1111–1132.
- Davis, S. G. (1986). *Parades and Power: Street Theatre in Nineteenth-Century Philadelphia*. Philadelphia, PA: Temple University Press, 5.
- Dlalisa, S. F., and van Niekerk, B. (2015). "Factors affecting the post implementation adoption and usage of blackboard amongst academics at dut," in *Proceedings of the 9th Annual teaching and learning in higher education conference Durban*.
- Dzobhenuku, R. K., Doe, J. K., and Amoako, G. K. (2021). Social media information and student performance: the mediating role of hedonic value (entertainment). *J. Res. Innov. Teach. Learn.* 15, 132–146.
- Faura-Martínez, U., Lafuente-Lechuga, M., and Cifuentes-Faura, J. (2021). Sustainability of the Spanish university system during the pandemic caused by COVID-19. *Educ. Rev.* 73, 1–10. doi: 10.1001/jamaintermmed.2022.0033
- Fokides, E. (2017). Greek pre-service teachers' intentions to use computers as in-service teachers. *Contemp. Educ. Technol.* 8, 56–75.
- Garland, R. (1991). The mid-point on a rating scale: is it desirable. *Mark. Bull.* 2, 66–70.

- Ghani, N. A., Hamid, S., Hashem, I. A. T., and Ahmed, E. (2019). Social media big data analytics: a survey. *Comput. Hum. Behav.* 101, 417–428.
- Greenhow, C., Galvin, S. M., Brandon, D. L., and Askari, E. (2020). A decade of research on K–12 teaching and teacher learning with social media: insights on the state of the field. *Teach. Coll. Rec.* 122, 1–72. doi: 10.1177/016146812012200602
- Hair, J. F., Sarstedt, M., Ringle, C. M., and Mena, J. A. (2012). An assessment of the use of partial least squares structural equation modeling in marketing research. *J. Acad. Mark. Sci.* 40, 414–433. doi: 10.1007/s11747-011-0261-6
- Hamadi, M., El-Den, J., Azam, S., and Sriratanaviriyakul, N. (2021). Integrating social media as cooperative learning tool in higher education classrooms: an empirical study. *J. King Saud Univ. Comput. Inf. Sci.* 33, 1–10.
- Junco, R., Elavsky, C. M., and Heiberger, G. (2013). Putting twitter to the test: assessing outcomes for student collaboration, engagement and success. *Br. J. Educ. Technol.* 44, 273–287. doi: 10.1111/j.1467-8535.2012.01284.x
- Khan, A. B., and Mansoor, H. S. (2020). Integrated collaborative learning approach (ICLA): conceptual framework of pedagogical approach for the integration of language skills. *Competit. Soc. Sci. Res. J.* 1, 14–28.
- Khan, M. N., Ashraf, M. A., Seinen, D., Khan, K. U., and Laar, R. A. (2021). Social media for knowledge acquisition and dissemination: the impact of the COVID-19 pandemic on collaborative learning driven social media adoption. *Front. Psychol.* 12. doi: 10.3389/fpsyg.2021.648253
- King, W., and He, J. (2006). A meta-analysis of the technology acceptance model. *Inf. Manag.* 43, 740–755. doi: 10.1016/j.im.2006.05.003
- Krejcie, R. V., and Morgan, D. W. (1970). Determining sample size for research activities. *Educ. Psychol. Meas.* 30(3), 607–610. doi: 10.1177/001316447003000308
- Lee, W. W. S., and Yang, M. (2020). Effective collaborative learning from Chinese students' perspective: a qualitative study in a teacher-training course. *Teach. High. Educ.* 24, 1–17. doi: 10.1080/13562517.2020.1790517
- Liang, H. Y., Hsu, T. Y., Hwang, G. J., Chang, S. C., and Chu, H. C. (2021). A mandatory contribution-based collaborative gaming approach to enhancing students' collaborative learning outcomes in science museums. *Interact. Learn. Environ.* 29, 1–15. doi: 10.1080/10494820.2021.1897845
- Manca, S. (2020). Snapping, pinning, liking or texting: investigating social media in higher education beyond facebook. *Internet High. Educ.* 44:100707. doi: 10.1016/j.iheduc.2019.100707
- Mantle-Bromley, C. (1995). Positive attitudes and realistic beliefs: links to proficiency. *Mod. Lang. J.* 79, 372–386. doi: 10.1111/j.1540-4781.1995.tb01114.x
- Martinho, D. S., Santos, E. M., Miguel, M. I., and Cordeiro, D. S. (2018). Factors that influence the adoption of postgraduate online courses. *Int. J. Emerg. Technol. Learn.* 13, 123–141. doi: 10.3991/ijet.v13i12.8864
- Masood, A., Luqman, A., Feng, Y., and Ali, A. (2020). Adverse consequences of excessive social networking site use on academic performance: explaining underlying mechanism from stress perspective. *Comput. Hum. Behav.* 113:106476. doi: 10.1016/j.chb.2020.106476
- Meintjes, H. H., and van Wyk, M. M. (2020). "Facebook page as a digital pedagogical tool in the business studies class," in *Handbook of Research on Digital Learning*, ed. Matthew M (Hershey PA: IGI Global), 57–74. doi: 10.4018/978-1-5225-9304-1.ch004
- Moon, J., and Kim, Y. (2001). Extending the TAM for a world-wide-web context. *Inf. Manag.* 38, 217–230. doi: 10.1089/tmj.2019.0048
- Moran, G., Muzellec, L., and Johnson, D. (2019). Message content features and social media engagement: evidence from the media industry. *J. Prod. Brand Manag.* 29, 533–545.
- Mostafa, F. (2020). *Teachers' Perceptions of Professional Learning Through Social Media in Environmental Education* (Doctoral dissertation) The University of Waikato: Hamilton.
- Phuthong, T. (2021). Antecedents influencing the adoption of collaborative learning social-media platforms among Thai University students during the Covid-19 'new normal' era. *Int. J. Emerg. Technol. Learn.* 16, 108–127. doi: 10.3991/ijet.v16i13.18083
- Pitafi, A. H., Kanwal, S., and Khan, A. N. (2020). Effects of perceived ease of use on SNSs-addiction through psychological dependence, habit: the moderating role of perceived usefulness. *Int. J. Bus. Inf. Syst.* 33, 383–407. doi: 10.1504/ijbis.2020.10027455
- Rahman, S., Ramakrishnan, T., and Ngamassi, L. (2020). Impact of social media use on student satisfaction in higher education. *High. Educ. Q.* 74, 304–319. doi: 10.1111/hequ.12228
- Rahmi, B. A. K. İ., and Birgören, B. (2020). Analysis of the studies on e-learning acceptance of learners in the Middle East and the proposal of an extended technology acceptance model. *Kastamonu Eğitim Dergisi* 28, 1977–1986. doi: 10.24106/kefdergi.4169
- Rasheed, M. I., Malik, M. J., Pitafi, A. H., Iqbal, J., Anser, M. K., and Abbas, M. (2020). Usage of social media, student engagement, and creativity: the role of knowledge sharing behavior and cyberbullying. *Comput. Educ.* 159:104002. doi: 10.1016/j.compedu.2020.104002
- Rauniar, R., Rawski, G., Yang, J., and Johnson, B. (2014). Technology acceptance model (TAM) and social media usage: an empirical study on facebook. *J. Enterp. Inf. Manag.* 27, 6–30. doi: 10.1108/jeim-04-2012-0011
- Raza, S. A., Qazi, W., Umer, B., and Khan, K. A. (2020). Influence of social networking sites on life satisfaction among university students: a mediating role of social benefit and social overload. *Health Educ.* 120, 141–164.
- Rupak, R., Greg, R., Jei, Y., and Ben, J. (2014). Technology acceptance model (TAM) and social media usage: an empirical study on Facebook. *J. Enterp. Inf. Manag.* 27, 6–30. doi: 10.1108/jeim-04-2012-0011
- Sa'nch, R. A., Cortijo, V., and Javed, U. (2014). Students' perceptions of facebook for academic purposes. *Comput. Educ.* 70, 138–149. doi: 10.1016/j.compedu.2013.08.012
- Sakurai, R., Nemoto, Y., Mastunaga, H., and Fujiwara, Y. (2021). Who is mentally healthy? Mental health profiles of Japanese social networking service users with a focus on LINE, facebook, twitter, and instagram. *PLoS One* 16:e0246090. doi: 10.1371/journal.pone.0246090
- Scherer, R., Siddiq, F., and Tondeur, J. (2019). The technology acceptance model (TAM): a meta-analytic structural equation modeling approach to explaining teachers' adoption of digital technology in education. *Comput. Educ.* 128, 13–35. doi: 10.1016/j.compedu.2018.09.009
- Shahbaznezhad, H., Dolan, R., and Rashidirad, M. (2021). The role of social media content format and platform in users' engagement behavior. *J. Interact. Mark.* 53, 47–65. doi: 10.1016/j.intmar.2020.05.001
- Shen, X. L., Li, Y. J., Sun, Y., and Wang, F. (2021). Good for use, but better for choice: a relative model of competing social networking services. *Inf. Manag.* 58, 103448. doi: 10.1016/j.im.2021.103448
- Shih, H. P. (2004). An empirical study on predicting user acceptance of e-shopping on the Web. *Inf. Manag.* 41, 351–368. doi: 10.1016/S0378-7206(03)00079-X
- Sohaei, S., Mirabolghasemi, M., and Gohari, M. M. (2020). Adoption of educational social network sites in teaching and learning: a task-technology fit perspective. *J. Soft Comput. Decis. Support Syst.* 8, 1–11. doi: 10.4018/978-1-4666-6347-3.ch001
- Stevens, V. (2009). Modeling social media in groups, communities, and networks. *Test-Ej* 13, 1–16. doi: 10.1163/9789047401780_004
- Stockdale, L. A., and Coyne, S. M. (2020). Bored and online: reasons for using social media, problematic social networking site use, and behavioral outcomes across the transition from adolescence to emerging adulthood. *J. Adolesc.* 79, 173–183. doi: 10.1016/j.adolescence.2020.01.010
- Sujeet, K. S., and Jyoti, K. C. (2013). "Technology acceptance model for the use of learning through websites among students in Oman". *Int. Arab J. E-Technol.* 4:2013.
- Tajvidi, R., and Karami, A. (2021). The effect of social media on firm performance. *Comput. Hum. Behav.* 115:105174. doi: 10.1016/j.chb.2017.09.026
- Talib, M. A., Bettayeb, A. M., and Omer, R. I. (2021). Analytical study on the impact of technology in higher education during the age of COVID-19: systematic literature review. *Educ. Inf. Technol.* 26, 6719–6746. doi: 10.1007/s10639-021-10507-1
- Tang, Y. M., Chen, P. C., Law, K. M., Wu, C. H., Lau, Y. Y., Guan, J., et al. (2021). Comparative analysis of Student's live online learning readiness during the coronavirus (COVID-19) pandemic in the higher education sector. *Comput. Educ.* 168:104211. doi: 10.1016/j.compedu.2021.104211

- Tosuntaş, S. B., Karadağ, B. E., and Orhan, S. (2015). The factors affecting acceptance and use of interactive whiteboard within the scope of FATİH project: a structural equation model based on the unified theory of acceptance and use of technology. *Comput. Educ.* 81:169e178.
- Triandis, H. C. (1971). *Attitude and Attitude Change*. Wiley Foundations of Social Psychology Series. New York, NY: Wiley.
- Van Den Beemt, A., Thurlings, M., and Willems, M. (2020). Towards an understanding of social media use in the classroom: a literature review. *Technol. Pedagogy Educ.* 29, 35–55. doi: 10.1080/1475939x.2019.1695657
- Venkatesh, V., and Davis, F. D. (2000). A theoretical extension of the technology acceptance model: four longitudinal field studies. *Manag. Sci.* 46, 186–204. doi: 10.1287/mnsc.46.2.186.11926
- Wang, W. T., and Wang, C. C. (2009). An empirical study of instructor adoption of web-based learning systems. *Comput. Educ.* 53, 761–774. doi: 10.1016/j.compedu.2009.02.021

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Alismaiel, Cifuentes-Faura and Al-Rahmi. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.



Reputation in Higher Education: A Systematic Review

Marelby Amado Mateus* and Fernando Juarez Acosta

Business School, Universidad del Rosario, Bogotá, Colombia

OPEN ACCESS

Edited by:

David Alonso García,
Complutense University of
Madrid, Spain

Reviewed by:

Irving Samadhi Aguilar,
Universidad Autónoma del Estado de
Morelos, Mexico

Beatriz López Medina,
Complutense University of
Madrid, Spain

Nathalie Peña García,
Colegio de Estudios Superiores de
Administración, Colombia

*Correspondence:

Marelby Amado Mateus
marelby.amado@urosario.edu.co

Specialty section:

This article was submitted to
Higher Education,
a section of the journal
Frontiers in Education

Received: 21 April 2022

Accepted: 01 June 2022

Published: 29 June 2022

Citation:

Amado Mateus M and Juarez
Acosta F (2022) Reputation in Higher
Education: A Systematic Review.
Front. Educ. 7:925117.
doi: 10.3389/feduc.2022.925117

Published research on corporate reputation has increased in the last 10 years in various sectors. The higher education sector is no stranger to this growth; however, theoretical developments and empirical research have been conducted across various disciplines of knowledge and theoretical approaches, which has made it difficult to theorize about it. In addition to this, the dimensionality of the construct, its dependence on the perception of public interest, and the difficulty of its measurement have made it a challenge for universities. This article develops a systematic review of reputation in higher education institutions. While there is evidence of contributions in the development of the theory and its conceptualization, these have occurred in other sectors such as banking, service industries, retailing, tourism and hospitality, and are not specifically focused on the higher education sector. As such, we seek to identify and characterize how reputation has been studied in this sector, highlighting conceptual and theoretical approaches that have supported the studies, which will help to overcome the fragmentation of the same from an integral definition applied to the education service.

Keywords: reputation, higher education, systematic review, reputation management, reputation theory, university reputation

INTRODUCTION

The concept of *corporate reputation* dates back to the 1970s when the relevance of the different assessments made by stakeholders of the company's reputation began to be identified (Spence, 1973) and the importance of public reputational signals for company performance and competitiveness became evident (Caves and Porter, 1977). Reputation is beginning to be understood as a group of attributes and characteristics of an organization that are the result of its past actions (Weigelt and Camerer, 1988), of the evaluation of the organization's performance (Rao, 1994; De Quevedo et al., 2005) and the perceptions that stakeholders have of them (Fombrun, 1996, p. 72), through a process of legitimization (Miotto et al., 2020).

Thus, a positive reputation can impact financial performance, customer behavior (Jung and Seock, 2016), competitiveness (Fombrun, 1996), stakeholder decision-making (Hemsley-Brown, 2012), corporate survival and success (Christensen and Gornitzka, 2017) as well as the integration of general management functions (Goldring, 2015). As such, it is important to know how to manage reputation and better invest resources to improve stakeholder perceptions (Lafuente-Ruiz-de Sabando et al., 2018).

Within the university context, reputation is defined as the sum of the impressions received by stakeholders from the communication and interaction they have with the university (Rindova et al., 2005), therefore it is evaluative, reflects consensus judgments (Roberts and Dowling, 2002),

is related to a “strong tradition” (Chevalier and Conlon, 2003) and, like organizational reputation, it takes time to consolidate a positive reputation in its stakeholders and therefore requires an institutional commitment to excellence in educational processes and results, as well as in research results (Roberts and Dowling, 2002; Arambewela and Hall, 2009; Delgado-Márquez et al., 2013). Although reputation is linked to research productivity, this indicator is widely criticized because of its limitation, in addition, as expressed by Nicholas et al. (2015), reputation is evaluated with only one activity, which is research, the product of which are articles and the product of these articles, citations.

Reputation is built through the student’s experience with the university (Chen and Esangbedo, 2018), and influences student attraction (Plewa et al., 2016), student selection of the university (Lafuente-Ruiz-de Sabando et al., 2018), faculty attraction (Christensen and Gornitzka, 2017), the knowledge held by stakeholders (Vogler, 2020a) both internally and externally (Verčič et al., 2016), as well as the valuation and rating of universities (Del-Castillo-Feito et al., 2019). In addition, previous studies have found that reputation requires management and has an important impact on the internal processes carried out by the university, including university reforms (Steiner et al., 2013), which have a significant effect on the quality of the university’s educational service. Within such management, the media play an important role, because they provide the channel and space where stakeholders know, identify, give their opinion and discuss the reputation of an institution (Deephhouse, 2000). This is why more and more universities faced with a competitive context, turn to marketing to improve the perception of their image and reputation, in order not only to attract students, but also teachers and financial resources (Wilkins and Huisman, 2014).

From this perspective, as stated by Reznik and Yudina (2018), reputation is a public evaluation, product of the opinion that stakeholders have of the university, and that can be divided into internal and external, the internal referring to the faculty, administrative staff and students, and external referring to representatives of the external environment. Therefore, *reputation management* implies an important knowledge of how it is built, and how the different stakeholders (both internal and external) perceive and evaluate it (Ressler and Abratt, 2009). In short, it is essential to know how to respond and meet the expectations and needs of each stakeholder and make it a strategic priority for university managers.

However, inconsistencies have been evidenced in the conceptualization of reputation in the *higher education* sector given the rules of operation in the education sector are different to those in the other corporate sectors (Verčič et al., 2016) and the absence of a consensus in the literature (Plewa et al., 2016; Del-Castillo-Feito et al., 2019) in management research (Ali et al., 2015; Veh et al., 2019), as well as its proximity to other terms such as identity and image (Alessandri et al., 2006; Lafuente-Ruiz-de Sabando et al., 2018) which are different but interconnected constructs. The identity is a multidimensional construct composed of communication and visual identity, behavior, culture, and market conditions (Melewar and Akel, 2005), and image is also a higher order multidimensional concept that can be managed to influence other variables such

as student satisfaction and loyalty (Lafuente-Ruiz-de Sabando et al., 2018). Additionally, other factors that make its definition difficult are intangibility (Nguyen and Leblanc, 2001a), given the reputation of the university is the result of the provision of the education service that is essentially intangible and difficult to evaluate in advance. The multidimensionality (Verčič et al., 2016) since the reputation is composed of multiple dimensions such as performance, product, service, leadership, governance, workplace, citizenship, and innovation (Vidaver-Cohen, 2007), especially with regard to origins of corporate reputation research (Veh et al., 2019), and the assessments of the different stakeholders (Plewa et al., 2016) that respond to their different expectations (Vidaver-Cohen, 2007).

Although the contributions found in the *systematic review* conducted by Lafuente-Ruiz-de Sabando et al. (2018) who have sought to differentiate the concepts of image and reputation in higher education institutions (HEIs), the analyses carried out allowed them to conclude that the stakeholders of a university’s academic offerings, such as teaching and research resources, graduate education, and affective image have a positive and significant influence on the image of the university, and that this assessment varies to the extent that the various perspectives of the stakeholders are adopted, and even more so when citizens of other countries are included. The contributions of Rashid and Mustafa (2021) who have studied the background of corporate reputation of higher education institutions by recognizing it as an intangible asset in all types of organizations, including HEIs, from the employees’ perspective, and Prakash (2021) who conducted a literature review on the concept of service quality in higher education institutions where he inquired among several things on the methodologies to measure quality, and found that in some of them, reputation is an important dimension to measure to operationalize it. However, it is necessary to continue investigating its conceptual development, characteristics, tools and relationships with other variables within the context of higher education.

Given the above factors, and the diversity and fragmentation of this concept specifically in the context of higher education, where the contributions are still insufficient (Watkins and Gonzenbach, 2013; Del-Castillo-Feito et al., 2019), it is necessary to conduct a systematic review on reputation in universities (HEIs) with three objectives. First, to understand how empirical reputation research [these studies might be quantitative, qualitative, or mixed methods studies (Creswell, 2014)] in these institutions has been characterized. This will be conducted through a bibliometric analysis using the SciVal tool of Elsevier; second, to identify the variables and/or constructs related to reputation. This will be performed through an analysis using the VOSviewer tool and a direct review of the documents; third, to determine how reputation has been conceptualized in HEIs. This will also be approached through a direct review of documents using the four-eyes principle to avoid bias. These objectives will provide an overview of the construct, and a comprehensive picture to improve the understanding of the university’s reputation.

This article begins with a description of the methodology used, then presents the characterization of the articles reviewed,

followed by an analysis of the relationships found concerning reputation. This is followed by a compilation of the definitions of corporate reputation—specifically those applied to higher education—and its benefits and weaknesses. Finally, the conclusions, limitations of the research, and the agenda for future research are presented.

METHODS

This paper will use a systematic literature review based on previous studies, as a method of analysis of empirical research conducted on reputation in HEIs. This allows a broad and continuous review of the literature, providing a frame of reference to compare the results of this study with previous ones (Creswell, 2014, p. 60). Such a study is also used to find relevant information in the selected context (Aveyard, 2014) and is fundamental in academic works (Lunde et al., 2019), and scientific activities (Mulrow, 1994) in management. Among the benefits of conducting a systematic literature review is understanding the theoretical relationship between the problem to be investigated, the objectives and, the discussion (Rocco and Plakhotnik, 2009). It also facilitates the identification, evaluation, and summary of findings of relevant studies on the topic, providing a strong foundation for the research, which will result in better development of the different investigations and their relationship with the conclusions (Centre for Reviews Dissemination, 2008).

Petticrew and Roberts (2006) propose a methodology for developing systematic reviews, consisting of the following steps: (1) define the question driving the review, (2) determine the types of studies that need to be addressed to answer the questions, (3) conduct a comprehensive literature search, (4) examine

results with inclusion and exclusion criteria, (5) develop a critical appraisal of the studies included to ensure that key aspects of the study are addressed, (6) synthesize the studies and assess the heterogeneity of the findings, and (7) disseminate the conclusions of the review.

Question Formulation

Step 1. Define the Question That Directs the Review

For the development of the first step, the questions posed that will direct the review are: How have empirical studies of reputation in higher education institutions been characterized? Based on this characterization, with which variables and/or constructs has it been related? How has reputation in higher education services been conceptualized? The results will contribute to the identification of a comprehensive overview in order to improve the academic and administrative community's understanding of the implications of reputation management. **Figure 1** presents a summary of the methodological steps, the questions guiding the work, and the results of the analysis that respond to the questions posed.

Article Selection

Step 2. Determine the Types of Studies to Be Addressed

To comply with the second step, the types of studies included in this review are empirical research articles and systematic reviews applied to the higher education sector and published in journals categorized in quartiles 1 and 2, which represent a higher impact factor and quality (Marín and Arriojas, 2021). Critical analyses, editorials, or essays are omitted.

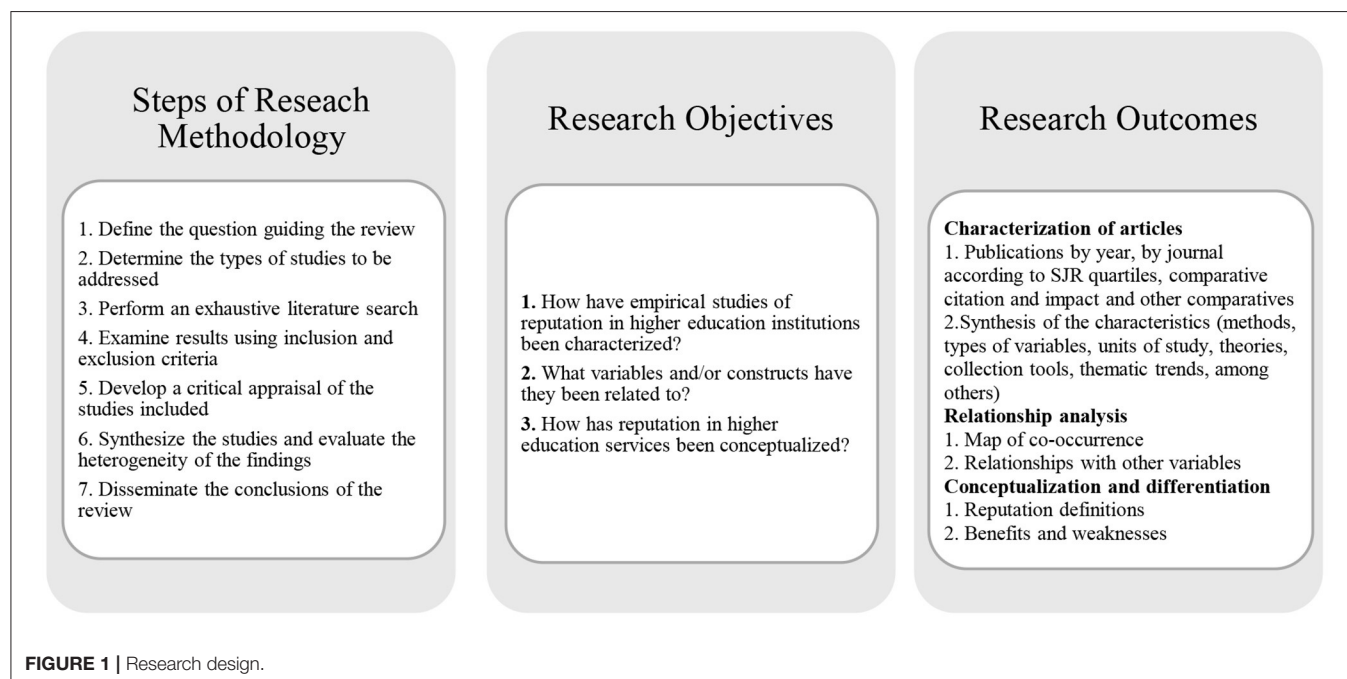
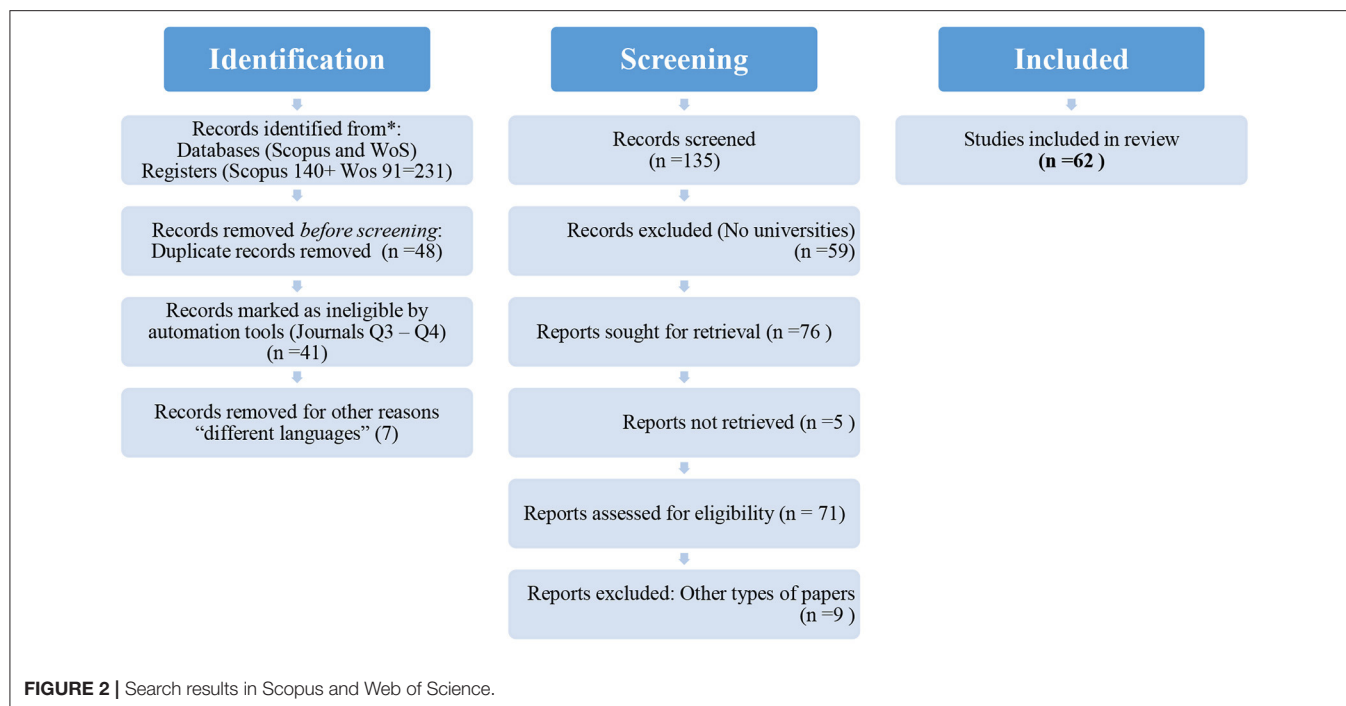


FIGURE 1 | Research design.



Step 3. Conduct an Exhaustive Literature Search

In this step, a search is performed in Scopus and Web of Science (WoS) over a period of 10 years (2010–July 2020), as it is considered sufficiently extensive for the review and is consistent with the indicator of obsolescence of the scientific literature (Price, 1965). Also, these years show the highest number of publications on the subject as will be seen below. The language selected for the review of the articles is English because it is the most recurrent language in the documents of the selected databases considering as keywords: reputation, higher education, university(ies).

In the WoS database, two searches were performed, the first with reputation and higher education, the second with reputation and university; for the Scopus database, reputation, higher education, or universities or university¹ was used. Subsequently, we proceeded to search and download the documents in the WoS and Scopus databases, of which only five could not be accessed.

Step 4. Examine the Results With Inclusion and Exclusion Criteria

For the development of the fourth step, **Figure 2** shows the result of the screening and consolidation of the two searches and the selection process of the articles, indicating the inclusion and exclusion criteria that were taken into account following the PRISMA methodology.

¹Boolean code used in Web of Science: TITLE: (reputation) AND SUBJECT: (higher education) and the second TITLE: (reputation) AND SUBJECT: (university). In the Scopus database, the following Boolean code was used: [TITLE (reputation) AND TITLE (higher AND education) OR TITLE (universities) OR TITLE (university)] AND DOCTYPE (ar OR re) AND PUBYEAR > 2009.

Step 5. Develop a Critical Appraisal of the Studies Included

Once the selection process is completed a critical and taxonomic assessment of the 62 selected articles is carried out. This provides relevant information to answer the research questions posed, evolved from the review of the definitions on which the studies are based; the variables with which they are related; the theories on which the studies are based; the measurement methods identified; as well as the benefits and weaknesses found in reputation management. To present the characterization of the 62 articles found from the process described above, this research performs a bibliometric analysis through Elsevier's SciVal tool, used to analyze the behavior of research in a particular field, make comparisons, associations, identify trends and create reports (Elsevier, 2022). We also use the VOSviewer, which is a program created to build and visualize bibliometric networks (VOSviewer, 2022). In addition, we perform an analysis of texts collected by a reviewer and verified by another researcher, using the four-eyes principle, to reduce the risk of bias (Hiebl, 2015).

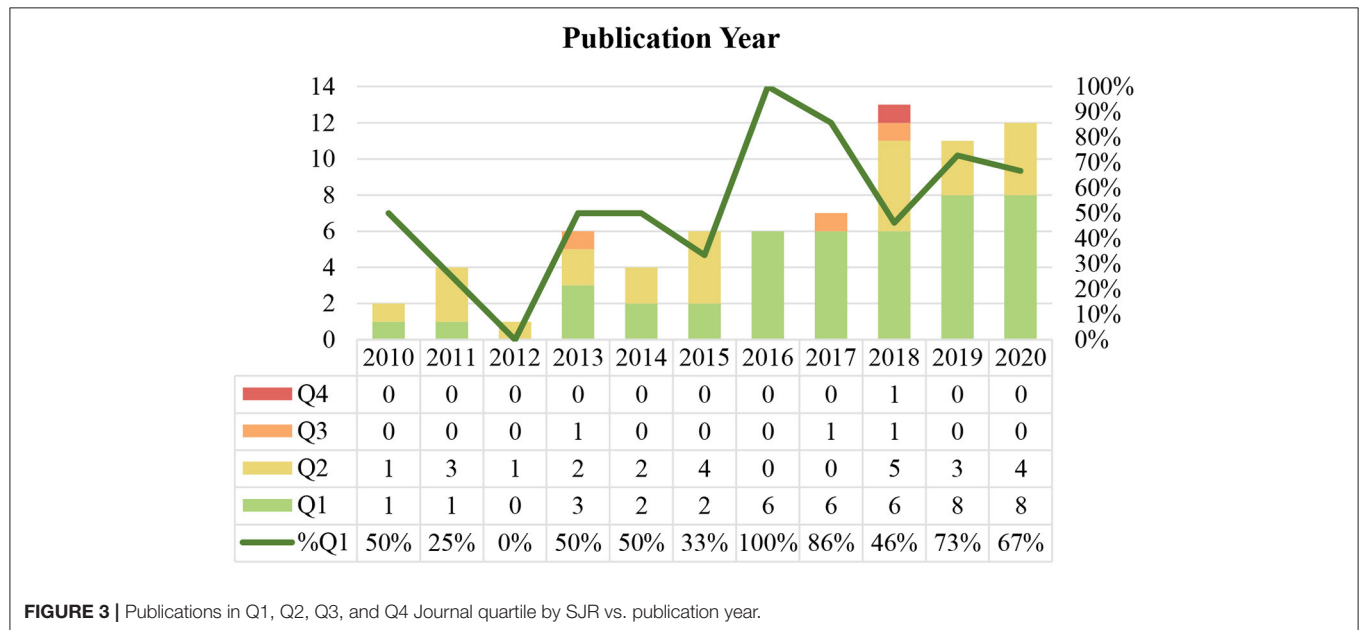
RESULTS

How Have the Empirical Studies of Reputation in Higher Education Institutions Been Characterized?

Using Elsevier's SciVal tool, in March 2022, we analyzed the publications per year within the time range addressed in the study (2010–July 2020), the citation behavior, the Field-Weighted Citation Impact (FWCI), which is the impact of citations obtained compared to the average number of citations expected in the subject field (Elsevier, 2020), citation behavior data by

TABLE 1 | Citations, FWCI, and international collaboration, by year of publication.

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Citation count	117	219	4	82	74	50	191	46	57	54	16
Field-Weighted citation impact	2.43	3.88	2.81	0.88	1.37	0.78	3.89	1.1	1.07	2.21	1.51
International collaboration (%)	0	50	0	0	50	16.7	50	12.5	23.1	0	16.7
Total articles published	2	4	1	7	4	6	6	8	13	12	11

**FIGURE 3** | Publications in Q1, Q2, Q3, and Q4 Journal quartile by SJR vs. publication year.

year, publications by journal quartile, and an analysis of the institutions, their type, country of publication and journals.

The number of articles on reputation in higher education institutions has been increasing in the last 10 years, as shown in **Table 1**, where it is evident that the year with the highest number of articles is 2018 with 13 publications, followed by 2019 with 12 publications, and 11 publications as of July 2020.

It is observed that the years with the highest number of citations were 2011 (219 citations) and 2016 (191 citations), as shown in the table. This trend had an impact on the weighted citations per field, which are 3.88 in 2011, and 3.89 in 2016, the highest evidenced in the period studied. This shows the importance of reputation in the field of study, which may be due to the international collaborations that occurred in those years, as can also be seen in **Table 1**.

In turn, a review of the impact of the quartiles in the publications analyzed within the period studied was carried out, showing that 90.3% of the articles on their date of publication were in journals categorized within the Q1 and Q2 quartiles² (37 and 19 articles, respectively). It should be clarified that on the date the quartiles of the publications were searched, some of them had improved their performance, placing them in the first two

quartiles. Since 2018 there is a growth in the number of articles published on this subject, and in 2016 all published articles are in the Q1 category, as evidenced in the results presented in **Figure 3**.

In contrast, the institutions with the highest academic production, citations, and authors researching and writing on the subject of reputation were reviewed, and it was found that the University of Turku in Finland, the Universidad Rey Juan Carlos in Spain, and the University of Michigan, Ann Arbor in the United States had the highest academic production with three articles each. However, the articles from the University of Michigan are the most cited of the three universities. It also had the highest number of citations among the institutions analyzed, followed by the University of Notre Dame with 227 citations, and Rice University and the University of Georgia with 116 citations each, as shown in **Figure 4**. In terms of the number of authors per institution publishing the most on reputation are Florida State University with five authors, and Mount Royal University, University of Salerno, Indonesia University of Education and, Zhejiang Sci-Tech University with four authors each.

Within this same analysis, a review was made of the publications by each country, their academic production, and the Field-Weighted Citation Impact (FWCI). **Figure 5** shows 26 countries where research has been done on reputation in higher education institutions, with the most representative in terms of academic production being the United States (32),

²Taking into account the SCImago Journal Rank (SJR), which weights the value of a citation based on the subject field, quality and reputation of the source (Elsevier, 2020).

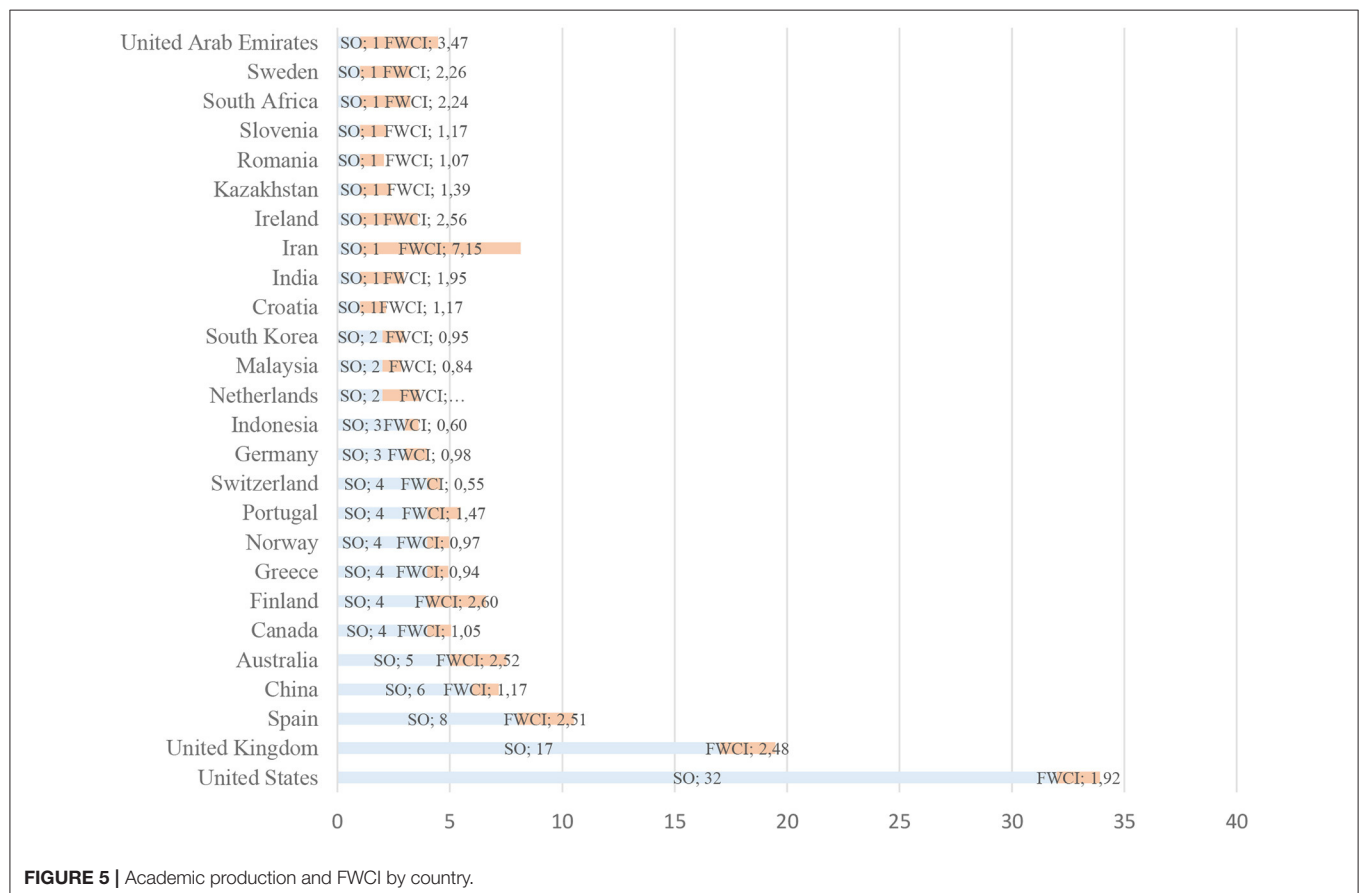
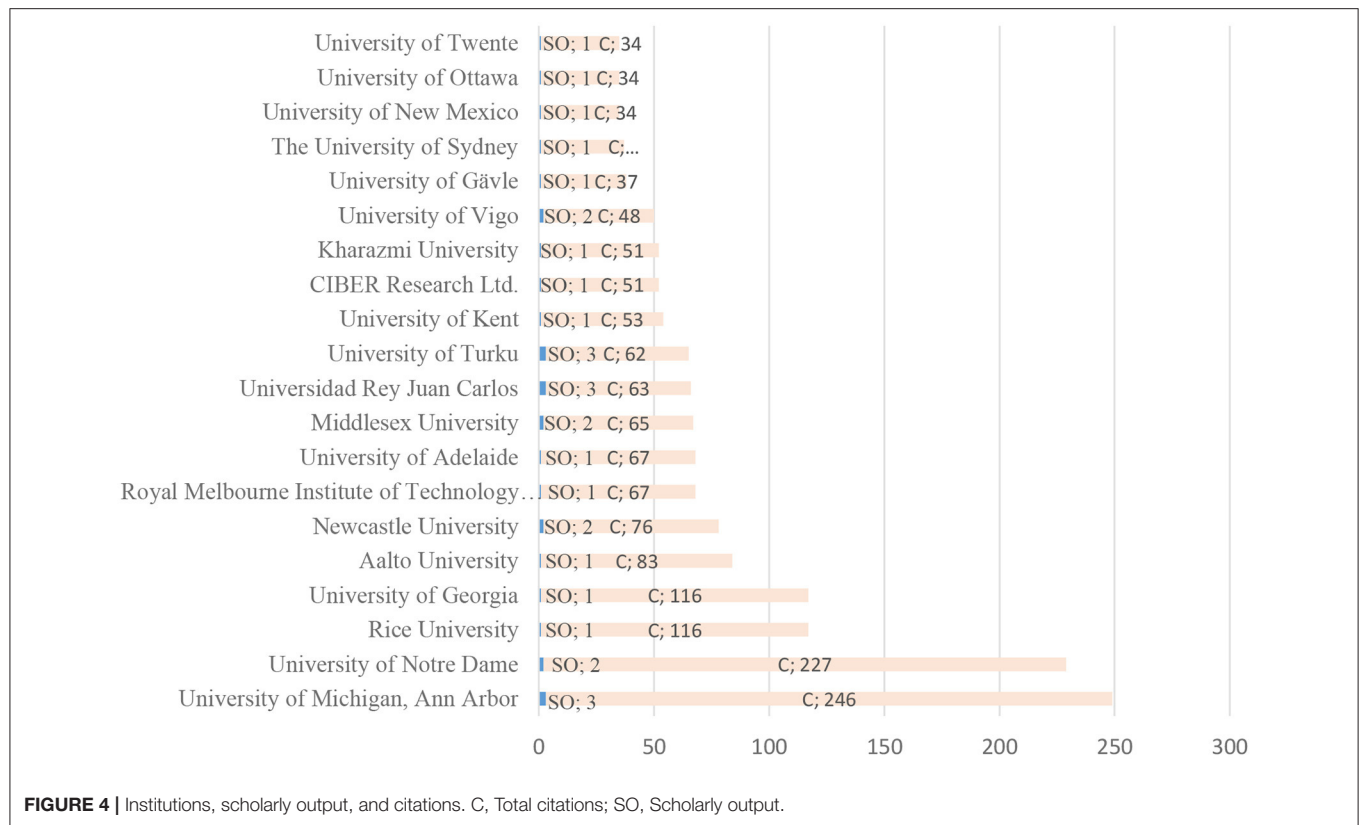


TABLE 2 | Characteristics of the articles reviewed.

Methods	<ul style="list-style-type: none"> • Quantitative (39 papers) • Qualitative (11 papers) • Mixed (12 papers)
Variable types	<ul style="list-style-type: none"> • Reputation as a: • Dependent variable (38 papers) • Independent variable (25 papers)
Population	<ul style="list-style-type: none"> • Students (17 papers) • Universities (13 papers) • Databases and rankings (11 papers) • Internal stakeholders (two or more) (10 papers) • External stakeholders (2 papers) • Teachers (3 papers) • Employers (2 papers) • Graduates (2 papers) • Literature review (2 papers)
Theories	<ul style="list-style-type: none"> • University, academic, media and corporate reputation theory (Delgado-Márquez et al., 2013; Drydakis, 2015; Fine and Wohl, 2018; Vogler, 2020b) • Stakeholder theory (Lafuente-Ruiz-de Sabando et al., 2018; Del-Castillo-Feito et al., 2020; Foroudi et al., 2020) • Institutional theory (Martin et al., 2018; Miotto et al., 2020) • The neo-institutional theory (Bastedo and Bowman, 2010; Christensen and Gornitzka, 2017; Christensen et al., 2020) • Resource-based theory (Steiner et al., 2013; Parente et al., 2015; Plewa et al., 2016) • Signal theory (Lee and Stuenkel, 2016; Bouchet et al., 2017; Kaushal and Ali, 2019) • Theory of strategic alliances and game theory (Steiner et al., 2013) • Configuration theory (Plewa et al., 2016) • Management theory (Finch et al., 2015)
Collection tools	<ul style="list-style-type: none"> • Secondary data analysis (26 papers) • Surveys (15 papers) • Mixed methods (e.g., analysis, surveys, interviews, focus group) (12 papers) • Interviews (4 papers) • Literature review (3 papers) • Experimental essays (2 papers)

United Kingdom (17), Spain (8), and China (6). The two countries with the highest impact factor are Iran (7.15) and the United Arab Emirates (3.47), which may be related to academic production or its quality, followed by Finland (2.60), Ireland (3.56), and Australia (2.52). It is worth mentioning that of the 98 institutions that participated in the publication of the articles analyzed, 94 correspond to higher education institutions, three to governmental entities and, one to independent corporate research entity.

Finally, a review of the journals with the highest number of articles on reputation in higher education was carried out, and it was found that Studies in Higher Education (Q1), Corporate Reputation Review (Q2), Higher Education (Q1), International Journal of Educational Management (Q2), Journal of Business Research (Q1) are the journals that have published the highest number of articles. The four most representative journals that have published at least three articles on the subject of reputation are Corporate Reputation Review, Higher Education, International Journal of Educational Management, and Journal of Business Research.

Synthesis of the Articles Reviewed

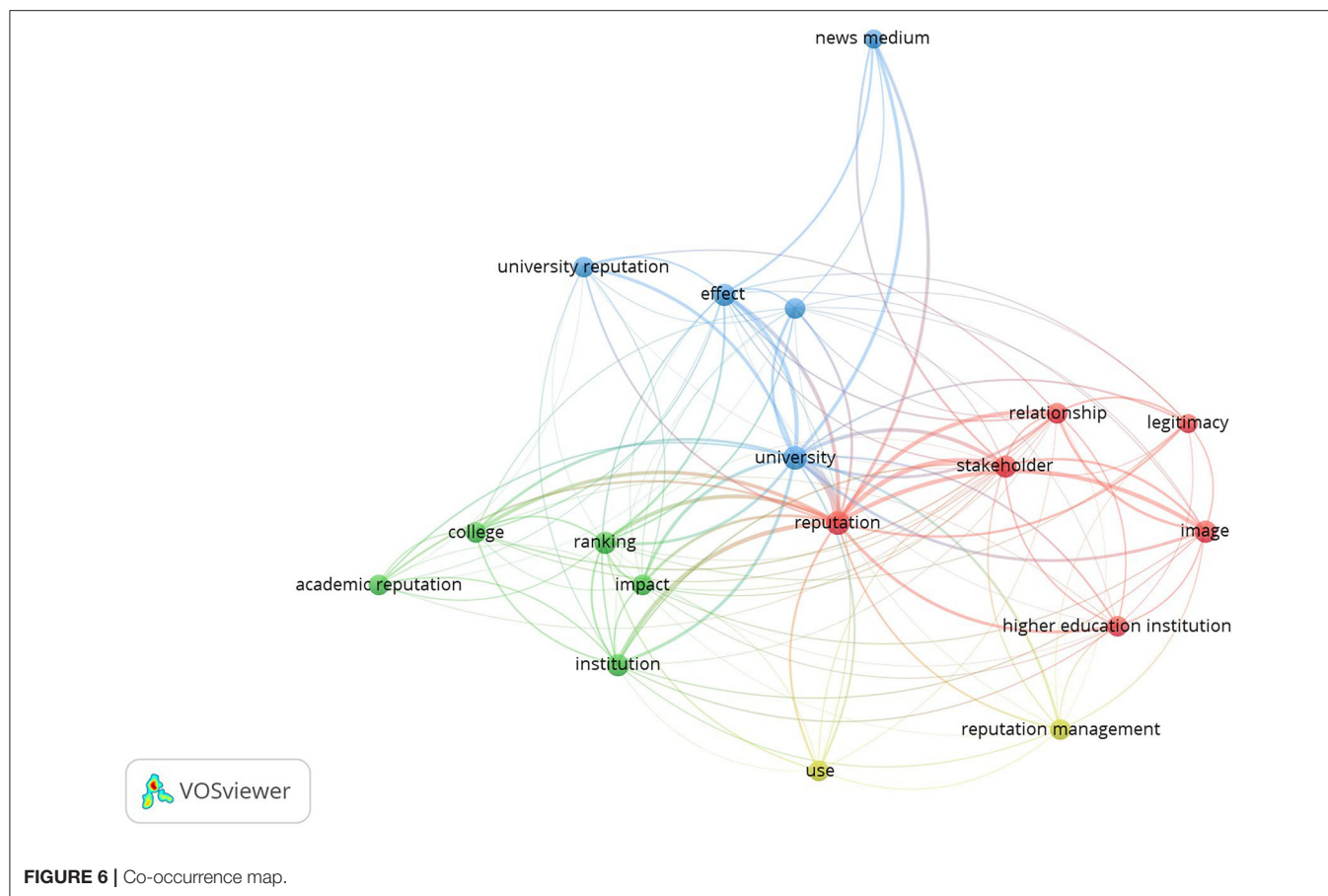
Step 6. Synthesize the Studies and Assess the Heterogeneity of the Findings

To synthesize the content of the articles found, (Table 2) below summarizes their structural characteristics in terms of the

methods used to approach the research, the types of variables or the way of analyzing reputation, the units of study used in the articles, the theories that underpinned the research and the collection tools.

With Which Variables and/or Constructs Has It Been Related?

To evaluate the heterogeneity of the findings, a descriptive analysis of the concept of reputation is carried out. First, to understand the main relationships and co-occurrence of the terms found in the articles, the co-occurrence map of the VOSviewer tool was used, where the titles and abstracts of the 62 articles were reviewed. The program helped visualize four different but interrelated clusters. Each of the terms found is represented by a node and its size corresponds to its relevance. Each node has a color; in this case, the red node will be called cluster 1, the green node cluster 2, the blue node cluster 3, and the yellow node cluster 4. The intensity of the color will reflect the relevance of the relationship (Cantos-Mateos et al., 2013). Based on this score, 65% of the most relevant terms were selected (5% more than suggested by the system to increase the number of items), with a total of 18 terms grouped as follows: cluster 1, higher education institution, image, legitimacy, relationship, reputation, stakeholder. Cluster 2, academic reputation, college, impact, institution, ranking. Cluster 3, effect, information, news medium, university, university reputation. Cluster 4, reputation management, use. Figure 6 shows the co-occurrence map.



From a detailed analysis of the composition of each of the clusters based on the thematic focus of the articles, it can be inferred that the articles in *cluster 1 (red)* focus on highlighting the importance of the relationship with stakeholders, the projected image and legitimacy; the articles in *cluster 2 (green)* analyze the impact of rankings on institutions and academic reputation; those in *cluster 3 (blue)* study the effect of information and the media on university reputation; and *cluster 4 (yellow)* includes the management and use of reputation. The following is a proposal that groups the articles reviewed in each of the four clusters found.

Cluster 1: Relationship With Stakeholders, Projected Image, and Legitimacy

In this cluster, we find studies such as the relationship of proximity, stakeholders, and reputation (Finch et al., 2015); the multidimensionality of reputation through stakeholders (Verčič et al., 2016); the use of social networks, reputation, and stakeholders (Carrillo-Durán and García, 2020); the influence of university identity, image on reputation (Steiner et al., 2013); identity and image management on reputation (Maduro et al., 2018); the relationship between image, legitimacy, and reputation (Del-Castillo-Feito et al., 2019, 2020); co-creation of value, image

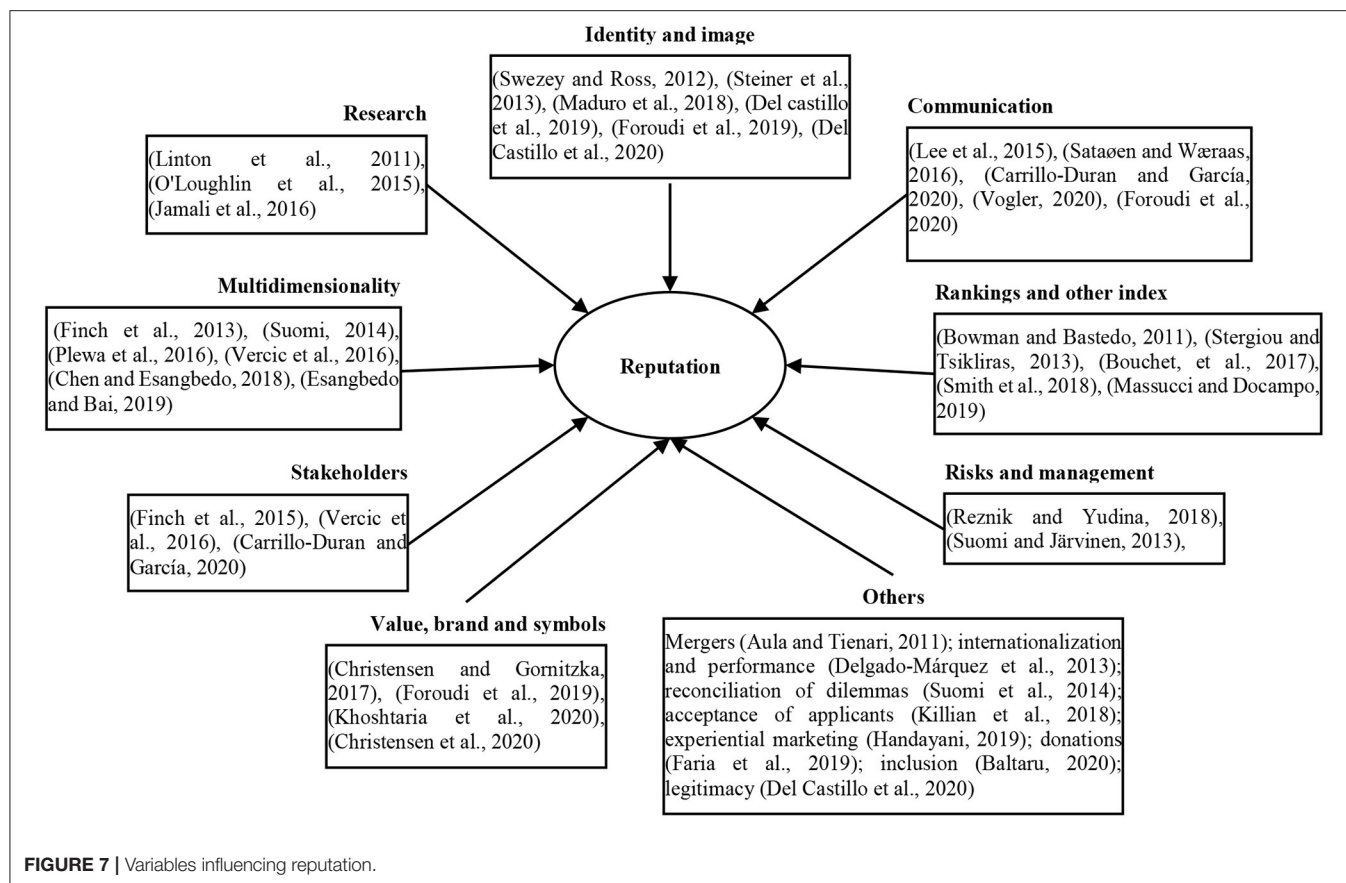
and reputation (Foroudi et al., 2019, 2020); reputation and image (Lafuente-Ruiz-de Sabando et al., 2018).

Cluster 2: The Impact of Academic Rankings and Reputation on Institutions

In this cluster is the influence of rankings on reputation (Bastedo and Bowman, 2010; Bowman and Bastedo, 2011); the Google Ngram viewer and reputation (Stergiou and Tsikliras, 2013); athletic rankings and reputation (Bouchet et al., 2017); the average h-index as a predictor of reputation as measured via the U. S. News & World Report (Smith et al., 2018); reputation as a result of citation networks via PageRank (Massucci and Docampo, 2019); the influence of ranking, credibility signals and reputation on student selection (Haas and Unkel, 2017); the impact of reputation and rankings on teaching income (Wolf and Jenkins, 2018).

Cluster 3: The Effect of Information and Media on University Reputation

The following papers are part of cluster 3: university resources, public relations and news content (Lee et al., 2015); communication strategy and reputation (Sataøen and Wæraas, 2016); the importance of media on reputation and stakeholders (Vogler, 2020a); university mergers influence



reputation (Aula and Tienari, 2011); research-related activities and reputation (Jamali et al., 2016); reputation as a source of information influences managers' (Martin et al., 2018) and students' (Brewer and Zhao, 2010; Priporas and Kamenidou, 2011; Munisamy et al., 2014; Lee et al., 2018) decisions; reputation, tribalism, use of Facebook in relationship building (Liu et al., 2017); effects of reputation in the media on third-party funding (Vogler, 2020b).

Cluster 4: The Management and Use of Reputation

Finally, this cluster is formed by reputation and risk management (Reznik and Yudina, 2018); the identification and management of reputation risks (Suomi and Järvinen, 2013); university performance, reputation and professional staff (Baltaru, 2020); university resource management - multidimensionality of reputation (Suomi, 2014; Plewa et al., 2016; Chen and Esangbedo, 2018; Esangbedo and Bai, 2019); performative, moral and professional symbols as categories of reputation management (Christensen and Gornitzka, 2017).

Relationships Found in the Review of the Articles

To deepen the relationships found in the papers reviewed, an analysis of the typology of the variable reputation or the direction of influence attributed to reputation was performed. In addition, the variables commonly studied together with university reputation were grouped by similar themes. **Figure 7**

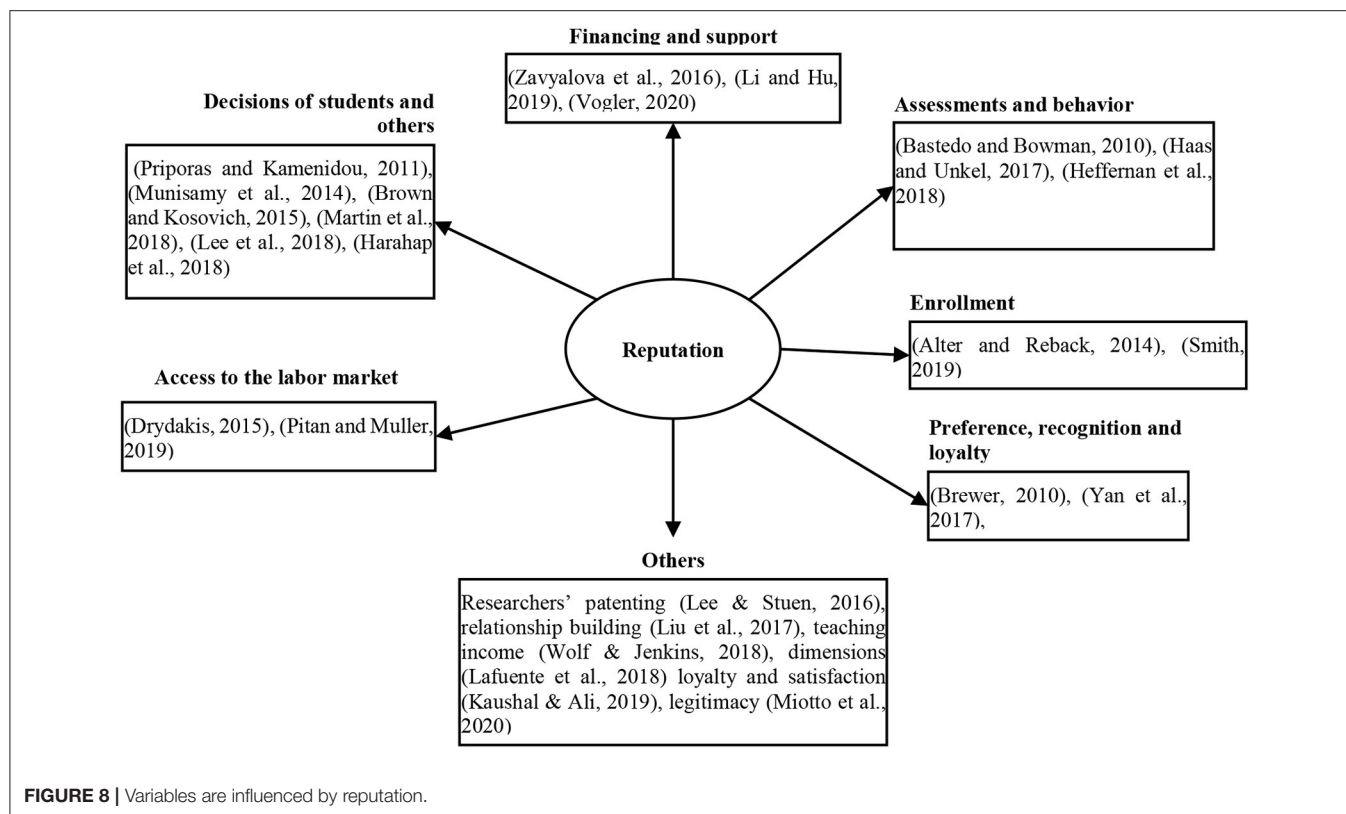
shows the variables that influence reputation and **Figure 8** shows the variables on which reputation has some type of influence.

The following are the variables on which reputation has an influence or impact:

The papers also found other variables to which reputation was related: career prospects (Munisamy et al., 2014); entry standards (Drydakis, 2015); motivation to study abroad (Lee et al., 2018); tribalism (Liu et al., 2017); voice-to-voice (Harahap et al., 2018); quality of life (Alter and Reback, 2014); personality and brand attachment (Kaushal and Ali, 2019); co-creation (Foroudi et al., 2019, 2020); proximity and strategic character (Finch et al., 2015).

How Has Reputation Been Conceptualized in Higher Education Services?

In each of the 62 articles, the concept of reputation and the authors with the highest number of citations were reviewed; and Fombrun was found to be the most cited author in the literature. Fombrun (1996) has nine direct citations and at least 16 others with various authors: Fombrun and Shanley (1990)—six citations, Fombrun et al. (2000)—four citations, Fombrun and Van Riel (1997, 2003, 2004), Van Riel and Fombrun (2007)—eight citations. They are followed by Rindova et al. (2005) who have at least 14 direct citations not counting those with other authors in 2010. Next is Suomi (Järvinen and Suomi, 2011; Suomi and Järvinen, 2013; Suomi, 2014; Suomi et al., 2014), with nine



citations in total. Then there is Alessandri et al. (2006) who presents eight citations.

Most of these authors, define reputation at the organizational level. As such, it is common to find that their “corporate” definition applies to different sectors of the economy. This behavior was observed in a large part of the articles reviewed since some researchers chose to take up the organizational definition to support their research works that were applied to the higher education sector. In this sense, it is important to mention that globalization and the intensification of competition have caused universities to lose their social and formative focus, and become producers of competitive services by adopting more market-oriented approaches (Maringe and Gibbs, 2009, p. 4). Therefore, a summary of the definitions found was made, which is listed in **Table 3** (the complete list can be found in the **Supplementary Material**).

Although it is common to find the aforementioned definitions in research works, some authors have adapted the definition of reputation and applied it to the higher education service, since they understand the characteristics and particularities that differentiate it from other services. The definitions found in the review focus on showing the importance of the interaction of stakeholders with the university (Rindova et al., 2005; Chen and Esangbedo, 2018) over time (Alessandri et al., 2006, p. 261) and the incidence of opinions of third-party experts (Roberts, 2009). They also focus on showing the social and economic capital it generates (Federkeil, 2009, p. 32), taking into account that it is a valuable asset that influences differentiation

and competitive advantage (Luque-Martínez and Del Barrio-García, 2009). Further, it also serves as a proxy for assessing university quality. Therefore, it influences university selection and evaluation (Hemsley-Brown, 2012; Munisamy et al., 2014) and the trustworthiness of its image (Van Vught, 2008, p. 169), attracting and retaining students (Munisamy et al., 2014). From a student’s perspective, public relations, marketing communication, crisis and/or risk management, and corporate branding perspectives are key (Maringe and Gibbs, 2009). A summary of the definitions of university or higher education reputation is shown in **Table 4** (see **Supplementary Material**).

Benefits and Weaknesses of Reputation

Reputation generates a huge impact both for universities and companies in other sectors. As such, we analyzed its benefits and weaknesses, considering the importance of examining both sides of the coin and identifying where the most important challenges in the conceptualization and management of reputation lie. **Table 5** shows a summary of the main benefits attributed to reputation, and the authors cited.

As regards the weaknesses of reputation referred to in the articles, the authors mention that Reputation Cannot be Improved Quickly (de Chernatony, 1999; Chun, 2005), and Lacks a Common definition regarding which no consensus has been reached yet (Miotto et al., 2020). Further, it presents a lack of clarity regarding its management and remains a challenge for universities (Šontait and Bakanauskas, 2011). It shows a degree of complexity within which the following aspects can

TABLE 3 | Definitions of reputation.

Definition	Authors who cite
Reputation ...	
...is a description of the evaluation and attitude of various people concerned about the state of a company (Fombrun and Shanley, 1990)	Harahap et al., 2018
... has been conceptualized as the public recognition and social approval of an organization (Fombrun and Shanley, 1990)	Zavyalova et al., 2016
... is a social construct defined as the generalized level of esteem for an organization held by a stakeholder (Fombrun and Shanley, 1990)	Finch et al., 2013
...is a collective system of subjective beliefs among the members of a social group (Bromley, 1993, 2000, 2002)	Munisamy et al., 2014
... is a summary of the impressions or perceptions held by external stakeholders (Bromley, 1993)	Lee et al., 2015
... can vary between stakeholders based on each group's perception of the degree to which the organization in question meets their unique expectations (Bromley, 2002)	Aula and Tienari, 2011
... "the perceptual representation of a company's past actions and future expectations that describes the overall first attractiveness for all its key constituents compared to other rivals" (Fombrun, 1996, p. 72). One of the most cited	Finch et al., 2013; Miotto et al., 2020; Vogler, 2020a
...refers to the fact that the term reputation serves to characterize the distribution of opinions (the open expression of the collective image) about a person or entity, by a stakeholder that is constituted over time. It is a valuable intangible asset (Fombrun, 1996)	Maduro et al., 2018
...relates to the general esteem in which constituents hold an organization, incorporating four key elements, which include credibility, trustworthiness, reliability, dependability, and accountability (Fombrun, 1996)	O'Loughlin et al., 2013
...a good reputation is important because of its value-creating potential and the fact that its intangible nature makes it difficult for competing organizations to copy (Roberts and Dowling, 2002)	Suomi et al., 2014
... is based on an overall, global assessment; reputation is reflected in consensus judgments and is evaluative (i.e., good vs. bad) (Roberts and Dowling, 2002)	Delgado-Márquez et al., 2013
... is a collective assessment of an organization's ability to deliver results of value to a representative group of stakeholders (Fombrun et al., 2000)	Heffernan et al., 2018; Miotto et al., 2020
... has been defined as multi-stakeholder assessments of the company's ability to meet its expectations over time (Fombrun and Van Riel, 2003)	Munisamy et al., 2014
...is one of the key antecedents of consumer organization identification (Fombrun and Van Riel, 2003)	Heffernan et al., 2018
...is a collection of perceptions and beliefs, both past and present, that reside in the consciousness of an organization's stakeholders. Reputation = Experience Expectations (Rayner, 2005, p. 1, 69)	Suomi et al., 2014
...refers to the public perceptions of the organization shared by its multiple constituents over time (Sung and Yang, 2008)	Munisamy et al., 2014
... as having three distinct dimensions. First, it includes being known: the general awareness of a subject, i.e., an organization. Second, being known for something, when an organization's reputation is linked to results relevant to a specific audience, is a more strategic approach, and third, widespread favorability (Lange et al., 2011)	Finch et al., 2015; Kaushal and Ali, 2019
...is more of an extrinsic signal, which evolves through the flow of information between users (Loureiro et al., 2017)	Kaushal and Ali, 2019
...is seen as society's opinion about the quality, advantages, or disadvantages of someone, something, person, organization, or product (Reznik and Yudina, 2018)	Reznik and Yudina, 2018
...involves the point of view of both staff (identity) and customers (image). Corporate reputation is more than the image an organization conveys. It is the perception that the different audiences with which a company interacts have about it over time (Maduro et al., 2018)	Maduro et al., 2018

be highlighted: heterogeneity in terms of stakeholders and, as a consequence, differences in their expectations (Vidaver-Cohen, 2007; Suomi and Järvinen, 2013). When reputation is not successfully managed in the organization it is exposed to numerous risks (Suomi and Järvinen, 2013). In universities specifically, where it is understood as the quality of education, reputation is difficult to evaluate before being experienced (Suomi et al., 2014).

Summary of Findings

Taking into account the above findings, an outline is made with the most relevant points in the definition of university reputation. This is done with the understanding that it is the result of assessments made by both internal and external stakeholders of the performance and results obtained in the management of its substantive functions, namely, teaching, research, and

extension during a given period. Internal stakeholders include students, graduates, teachers, researchers, administrative and managerial staff, with the student being the main beneficiary of the educational service (Maringe and Gibbs, 2009, p. 29). External stakeholders include students' families and friends, research centers, private and public business sectors, the state, rankings, and suppliers, among others. **Figure 9** shows the results graphically.

CONCLUSIONS

The methodology developed for the literature search on reputation in higher education resulted in 231 articles. Not all of them were included taking into account the exclusion criteria within the screening process. However, it did allow for observing

TABLE 4 | Definitions of reputation in universities or higher education.

Definition	Authors who cite
University reputation...	
...is a function of information sharing and organizational performance, as prestige in higher education is largely a function of instructional resources and financial performance (Brewer et al., 2001)	Bastedo and Bowman, 2010
... is the result of the accumulation of impressions received by stakeholders due to communication and interaction with universities (Rindova et al., 2005)	Aula and Tienari, 2011; Steiner et al., 2013;
... is conceptualized as a process of continuous evaluation by relevant stakeholders (Rindova et al., 2005)	Del-Castillo-Feito et al., 2020
... is considered a valuable intangible asset for organizations due to its relationship with positive performance (Rindova et al., 2005)	
... Is defined as the vision, representation, or impression that people form in their minds based on information or data about a university obtained through interaction with the elements or components of the university (Cole and Bruch, 2006)	Chen and Esangbedo, 2018
The collective representations that the university's multiple constituents have of the university over time (Alessandri et al., 2006, p. 261)	Harahap et al., 2018
The reputation of an institution of higher education is defined as the image of quality, influence, and trustworthiness it has in the eyes of others	Stergiou and Tsikliras, 2013
Reputation is the subjective reflection of the various actions an institution takes to create an external image. An institution's reputation and its quality may be related, but they need not be identical. Higher education institutions try to influence their external images in many ways, not just by maximizing their quality (Van Vught, 2008, p. 169)	
The reputation of an institution from the perspective of the consumer (student) who has many choices due to the variety of providers in the educational marketplace. They identified four key perspectives of organizational reputation applicable to the higher learning environment which are public relations, marketing communication, crisis/risk management, and corporate brand perspective (Maringe and Gibbs, 2009)	Munisamy et al., 2014
...is defined not by what universities say about themselves but by the unsolicited opinions of respected third parties (Roberts, 2009)	O'Loughlin et al., 2013
University reputation, which has different meanings for different groups and scientific fields, is a form of social capital within the higher education system that can also be transformed into economic capital (Federkeil, 2009, p. 32)	Stergiou and Tsikliras, 2013
The reputation of HEIs represents an intangible capital and a valuable asset and is recognized as playing an important role in differentiation and competitive advantage vis-à-vis the competition. This competitive environment together with the limitations of public resources for higher education makes the image an essential part of HEI strategic management (Luque-Martínez and Del Barrio-García, 2009)	Maduro et al., 2018
...serves as a critical surrogate for quality, guiding university selection and evaluation (Hemsley-Brown, 2012)	Plewa et al., 2016
...is the subjective reflection of the various actions that an institution undertakes to create an external image	Stergiou and Tsikliras, 2013
Definitions given by the same authors of the paper	
<ul style="list-style-type: none"> • Reputation is described as the sum of beliefs, ideas, and impressions a person has about an object, individual, institution, or organization based on past and current events • University reputation (UR) is an institutional status built as people constructs regarding university goals, ethics, work methods, and treatment received by students • In other words, UR refers to a natural and spontaneous character, expectations, and exchange that people have with the university 	Chen and Esangbedo, 2018

the growing interest in this topic given the impact it has on organizations, in this case, in the higher education sector.

In addition, and as expected, definitions of organizational reputation were adopted and applied to the processes of university reputation management. However, some authors chose to make adaptations of these definitions to the context of higher education institutions, emphasizing the importance of identification and relationship with stakeholders (Finch et al., 2015; Verčič et al., 2016; Zavyalova et al., 2016; Martin et al., 2018; Carrillo-Durán and García, 2020), understanding the differences between the needs and knowledge that each one has of the organization, as well as underscoring the concern over the time it takes to develop a solid reputation in the market (Brewer and Zhao, 2010; Loureiro et al., 2017), which is different and generates value and competitive advantage (Burke, 2011; Feldman et al., 2014; Munisamy et al., 2014; Marginson, 2016). As regards reputation built over time, universities must compete to gain a

position (Chapleo, 2007) in the local, national and international markets, which are becoming more complex, given the impact that rankings—which have become a benchmark of the quality of universities—have on the valuation of stakeholders (Bowman and Bastedo, 2011; Drydakis, 2016; Wolf and Jenkins, 2018).

Therefore, it was found that reputation is decisive in the student's shopping experience (Handayani, 2019; Pitan and Muller, 2019), which includes university selection, influencing, their lived experience in the training process (Sajtos et al., 2015), placement or job attainment rates (Smith et al., 2008; Laker and Powell, 2011; Finch et al., 2013), and development of entrepreneurship (Parente et al., 2015). From the institutional point of view and within the framework of the purchasing experience, reputation management also helps in areas such as retention of students (Del-Castillo-Feito et al., 2019), relationships with the business sector, agreements with other educational institutions, advancement of

TABLE 5 | Benefits of reputation.

Benefits	Authors
Reputation...	
Reduces risks, lowers costs, and offers many other benefits such as financial value, the attraction of investors and resources, sustainable competitive advantage, and organizational success	Dierickx and Cool, 1989; Fombrun and Shanley, 1990; Barney, 1991; Fombrun, 1996; Deephouse, 2000; Gardberg and Fombrun, 2002; Altbach, 2004; Deephouse and Carter, 2005; Rayner, 2005; Rindova et al., 2005; Chapleo, 2007; Pfarrer et al., 2010; Burke, 2011; Finch et al., 2013; Feldman et al., 2014; Marginson, 2016; Christensen and Gornitzka, 2017; Vogler, 2020a
Serves as a sign of product quality	Dawar and Parker, 1994; Bigné et al., 2001; Nguyen and LeBlanc, 2001b; Bolton et al., 2004; Rindova et al., 2005; Jin et al., 2008; Veloutsou and Moutinho, 2009; Loureiro and Kastenholz, 2011; Priporas and Kamenidou, 2011; Hemsley-Brown, 2012; Suomi, 2014
Reduces stakeholders' uncertainty in their decision-making processes by generating confidence in the quality, value, and differentiation of the product	Fombrun et al., 2000; Rindova et al., 2005; Lange et al., 2011; Hemsley-Brown, 2012; Munisamy et al., 2014; Miotto et al., 2020
Shows the company or university as the best place to work, thus attracting the best of employees, teachers, and students; improving their intellectual capital and increasing their tacit knowledge	Deephouse, 2000; Lemmink et al., 2003; Rayner, 2003; Gaultier-Gaillard and Louisot, 2006; Roberts, 2009; Brown and Whysall, 2010; Pfarrer et al., 2010; Fumasoli and Huisman, 2013
Generates higher levels of stakeholder confidence even in crises	Fombrun and Shanley, 1990; Fombrun, 1996; Melewar, 2003; Koufaris and Hampton-Sosa, 2004; Rayner, 2005; Schnietz and Epstein, 2005; Coombs and Holladay, 2006; Csiszar and Heidrich, 2006; Love and Kraatz, 2009; Pfarrer et al., 2010; Lange et al., 2011; Feldman et al., 2014; Liu et al., 2017
Improves the recruitment of graduates as they possess more social, cultural, and human capital	Rindova et al., 2005; Morley and Aynsley, 2007
Is a key factor in a student's choice of university	Dowling, 1994; Bourke, 2000; Conard and Conard, 2000; Nguyen and LeBlanc, 2001b; Briggs, 2006; Bowman and Bastedo, 2009; Fumasoli and Huisman, 2013; Munisamy et al., 2014
Contributes to the payment of a higher price to an organization—charging higher rates	Shapiro, 1982, 1983; Rindova et al., 2005; Sauder and Lancaster, 2006; Vidaver-Cohen, 2007; Fowles et al., 2016
Is a driver of university reforms and development work as well as research performance	Steiner et al., 2013; Ho and Peng, 2016
Can be used to measure organizational effectiveness as well as improved financial performance	Fombrun and Shanley, 1990; de Chernatony, 1999; Baden-Fuller and Ang, 2001; Roberts and Dowling, 2002; Kitchen and Laurence, 2003; Van Riel and Fombrun, 2007; Walker, 2010; Feldman et al., 2014
Increases student satisfaction as well as student loyalty	Fombrun, 1996; Bigné et al., 2001; Davies et al., 2002; Palacio et al., 2002; Roberts and Dowling, 2002; Jin et al., 2008; Sung and Yang, 2009; Caruana and Ewing, 2010; Bartikowski et al., 2011; Loureiro and Kastenholz, 2011; Plewa et al., 2016; Liu et al., 2017
Relates to the positive attitudes of customers toward the company's products	Bartikowski et al., 2011
Can positively affect students' priorities in social and academic life	Arambewela and Hall, 2009; Park, 2009; Delgado-Márquez et al., 2013
Is considered crucial for survival given the stiff competition between universities and creates barriers to entry	Rao, 1994; Alves and Raposo, 2007; Aula and Tienari, 2011; Feldman et al., 2014; Lafuente-Ruiz-de Sabando et al., 2018
Attracts positive media coverage	Rayner, 2005; Suomi et al., 2014
Influences the favorable evaluation of an organization and the positioning of the university	Dodds et al., 1991; Chapleo, 2007; Jin et al., 2008, p. 327; Curtis et al., 2009; Hemsley-Brown, 2012

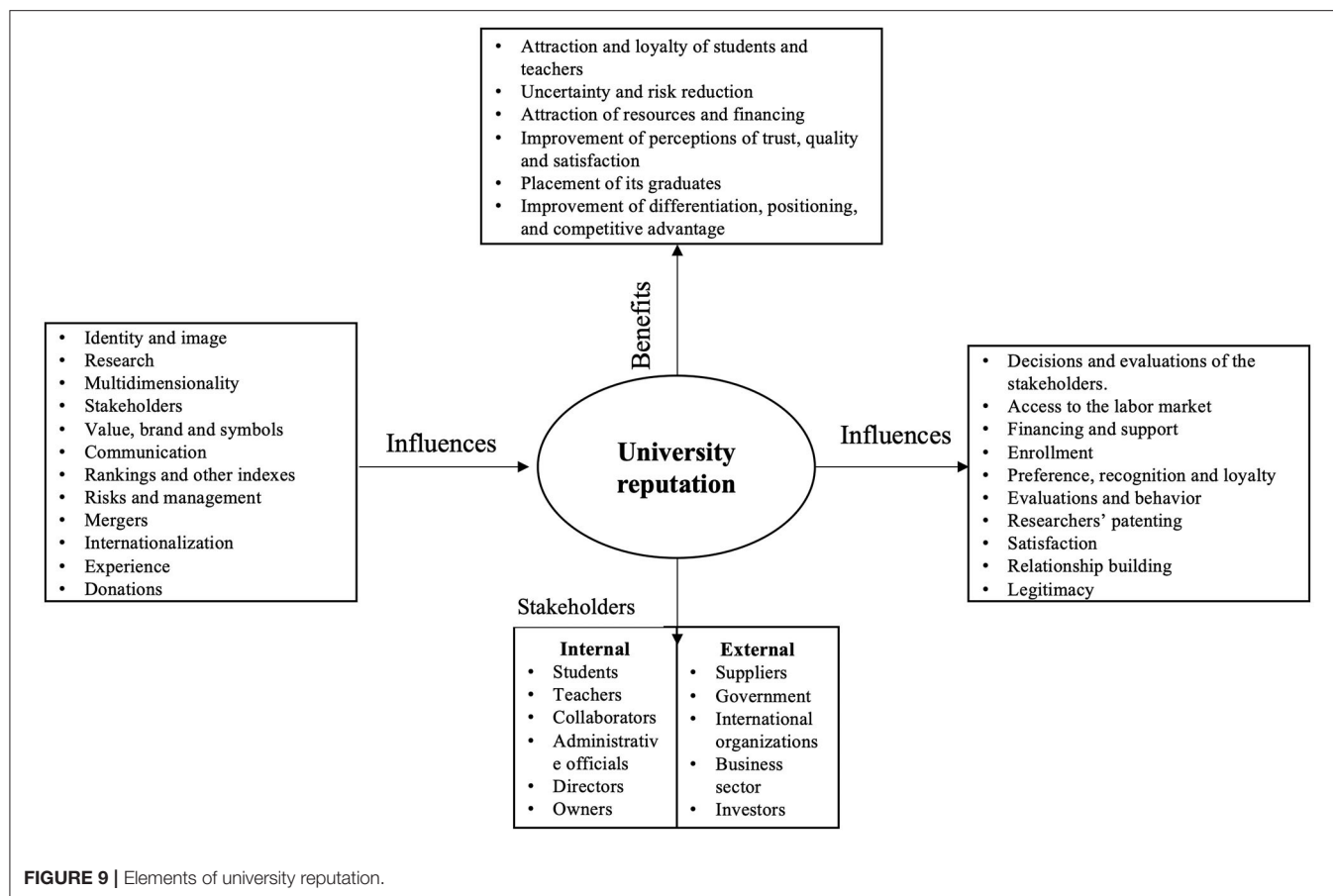
research (Morphew et al., 2016), exchanges at the national and international level (Plewa et al., 2016), and relations with the media (Deephouse, 2000), etc.

To capitalize on each of these findings, **Figure 9** shows a compendium of the points considered most relevant in the search, on the variables that influence reputation, the variables that are influenced by reputation, its benefits, and main stakeholders categorized as internal and external, following Verčič et al. (2016, p. 165). In the evaluations made by external stakeholders, a critical point is the knowledge they have about the university given its proximity which influences their opinions that may be biased but have an impact on the reputation and quality of work of a university (Steiner et al., 2013). For its part, reputation management among internal stakeholders, mainly

students, have a positive impact on their attitudes (Foroudi et al., 2019) and is a key element for the success and survival of universities (Christensen and Gornitzka, 2017), which currently operate in a complex and competitive environment, in which they must compete with other HEIs for access to different resources and meet the expectations of all their stakeholders.

DISCUSSION AND AGENDA FOR FUTURE RESEARCH

The challenges of reputation management in educational institutions are evident in the literature review addressed. Issues such as the increase in academic offerings in terms of scope



and variety of programs (Maringe and Gibbs, 2009), changes in funding structures (Steiner et al., 2013), internationalization of education (Plewa et al., 2016), globalization and mobility of students and faculty (O'Loughlin et al., 2013), as well as the focus on achieving high quality certifications as a strategy to show university differentiation and influence the images received by the various stakeholders, especially the student as the main user of the service, are crucial issues for university competitiveness. In fact, it is important to clarify that reputation and quality are related, but not necessarily identical (Van Vught, 2008). In addition, authors such as Roberts (2009) point out that, in order to achieve the main objective of the university, in terms of offering a high quality service that responds to the needs of society, it is necessary and indispensable to work together and articulate between employees and departments with mechanisms that support management to achieve a positive reputation.

This management implies that universities adapt to these new models and systems of evaluation and measurement to show indicators of academic quality (Steiner et al., 2013), which is why managers also focus their attention on improving their performance in the different rankings (O'Loughlin et al., 2013). Among the prominent rankings to measure the reputation of the most prestigious universities in the world, are the Academic Ranking of World University ARWU (also known as the

Shanghai ranking), the British ranking Times Higher Education -THE, and the Quaquerelli Symonds-QS. Each of them has different indicators and weights in their measurement. The ARWU for example, takes into account graduates and teachers with Nobel Prizes and Fields Medals, the most cited researchers, the amount of indexed articles and their respective citations. However, these rankings have been criticized for their focus on the research capacity of universities and the way in which the individual indicators used to obtain the synthetic indicator are weighted (Parellada and Álvarez, 2017). And indeed they have had an impact on the "publish or perish" message received by university faculty and professors, further evidencing the value of research (Linton et al., 2011). Despite the negative biases of this type of measurement, rankings remain an important variable that influences reputation and, in fact, is consolidated in cluster 2, found in this study.

Subsequent research work can focus on further developing and understanding the multidimensionality of the concept of university reputation, in the light of a theoretical corpus that continues to evolve based on the characteristics and particularities of higher education and the challenges posed by the social, economic, political, and environmental contexts in which it develops its substantive functions. They will also be able to validate the relationships between

the variables found, as well as to propose new variables that have not been contemplated and that may have an important and predictive impact on the performance of the construct.

LIMITATIONS

This review focused on a 10-year period, by analyzing two databases, WoS and Scopus. As such, other databases that might contain articles on university reputation were not considered. Similarly, we did not include languages other than English, given that the number of documents found in the searches was sufficiently extensive only in that language. Besides, as mentioned earlier, most of the literature is in English. Further, articles indexed in journals located in quartiles 3 and 4 were not taken into account. As such, articles that may have contributions or theoretical perspectives different from those found could have been omitted. Furthermore, it is understood that a sample of 62 articles is only a part of all the literature found on reputation in universities and that a broader more inclusive review could generate different conclusions. However, this systematic review was carried out exhaustively, analyzing each of the documents found to generate the results presented here.

REFERENCES

- Alessandri, S., Yang, S., and Kinsey, D. (2006). An integrative approach to university visual identity and reputation. *Corp. Reputation Rev.* 9, 258–270. doi: 10.1057/palgrave.crr.1550033
- Ali, R., Lynch, R., Melewar, T. C., and Jin, Z. (2015). The moderating influences on the relationship of corporate reputation with its antecedents and consequences: a meta-analytic review. *J. Bus. Res.* 68, 1105–1117. doi: 10.1016/j.jbusres.2014.10.013
- Altbach, P. G. (2004). Globalisation and the university: myths and realities in an unequal world. *Tert. Educ. Manage.* 10, 3–25. doi: 10.1080/13583883.2004.9967114
- Alter, M., and Reback, R. (2014). True for your school? How changing reputations alter demand for selective U.S. colleges. *Educ. Eval. Policy Anal.* 36, 346–370. doi: 10.3102/0162373713517934
- Alves, H., and Raposo, M. (2007). Student satisfaction index in portuguese public higher education. *Serv. Indust. J.* 27, 795–808. doi: 10.1080/02642060701453288
- Arambewela, R., and Hall, J. (2009). An empirical model of international student satisfaction. *Asia Pac. J. Mark. Log.* 21, 555–569. doi: 10.1108/13555850910997599
- Aula, H. M., and Tienari, J. (2011). Becoming world-class? Reputation-building in a university merger. *Crit. Perspect. Int. Bus.* 7, 7–29. doi: 10.1108/17422041111103813
- Aveyard, H. (2014). *Doing a Literature Review in Health and Social Care A Practical Guide, Vol. 18, 3rd Edn.* England: McGraw Hill Education.
- Baden-Fuller, C., and Ang, S. H. (2001). Building reputations: the role of alliances in the european business school scene. *Long Range Plann.* 34, 741–755. doi: 10.1016/S0024-6301(01)00088-7
- Baltaru, R. D. (2020). The rise of agentic inclusion in the UK universities: maintaining reputation through (formal) diversification. *Stud. High. Educ.* 47, 229–242. doi: 10.1080/03075079.2020.1739015
- Barney, J. (1991). Firm resources and sustained competitive advantage. *J. Manage.* 17, 99–120. doi: 10.1177/014920639101700108
- Bartikowski, B., Walsh, G., and Beatty, S. (2011). Culture and age as moderators in the corporate reputation and loyalty relationship. *J. Bus. Res.* 64, 966–972. doi: 10.1016/j.jbusres.2010.11.019

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

FJ contributed to design of the study and supervised both the development of the research and the manuscript. MA completed the majority of the literature review and wrote the first draft. Both authors contributed to the article and approved the submitted version.

FUNDING

The publication of this article was supported by the Research Department, School of Business, Universidad del Rosario.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/feduc.2022.925117/full#supplementary-material>

- Bastedo, M. N., and Bowman, N. A. (2010). U.S. News and world report college rankings: modeling institutional effects on organizational reputation. *Am. J. Educ.* 116, 163–183. doi: 10.1086/649437
- Bigné, J. E., Sánchez, M. I., and Sánchez, J. (2001). Tourism image, evaluation variables and after purchase behaviour: inter-relationship. *Tour. Manage.* 22, 607–616. doi: 10.1016/S0261-5177(01)00035-8
- Bolton, G. E., Katok, E., and Ockenfels, A. (2004). How effective are electronic reputation mechanisms? An experimental investigation. *Manage. Sci.* 50, 1587–1602. doi: 10.1287/mnsc.1030.0199
- Bouchet, A., Laird, M. D., Troilo, M., Hutchinson, M., and Ferris, G. (2017). Effects of increased commitment on reputation and status: evidence from NCAA Division I universities. *Sport Manage. Rev.* 20, 395–407. doi: 10.1016/j.smr.2016.11.002
- Bourke, A. (2000). A model of the determinants of international trade in higher education. *Serv. Indust. J.* 20, 110–138. doi: 10.1080/02642060000000007
- Bowman, N. A., and Bastedo, M. N. (2009). Getting on the front page: organizational reputation, status signals, and the impact of U.S. news and world report on student decisions. *Res. High. Educ.* 50, 415–436. doi: 10.1007/s11162-009-9129-8
- Bowman, N. A., and Bastedo, M. N. (2011). Anchoring effects in world university rankings: exploring biases in reputation scores. *High. Educ.* 61, 431–444. doi: 10.1007/s10734-010-9339-1
- Brewer, A., and Zhao, J. (2010). The impact of a pathway college on reputation and brand awareness for its affiliated university in Sydney. *Int. J. Educ. Manage.* 24, 34–47. doi: 10.1108/09513541011013033
- Brewer, D., Gates, S., and Goldman, C. (2001). *In Pursuit of Prestige: Strategy and Competition in U.S. Higher Education*. Somerset, NJ: Technical Papers.
- Briggs, S. (2006). An exploratory study of the factors influencing undergraduate student choice: the case of higher education in Scotland. *Stud. High. Educ.* 31, 705–722. doi: 10.1080/03075070601004333
- Bromley, D. (1993). *Reputation, Image, and Impression Management, 1st Edn.* Chichester: John Wiley & Sons.
- Bromley, D. (2000). Psychological aspects of corporate identity, image and reputation. *Corp. Reputation Rev.* 3, 240–252. doi: 10.1057/palgrave.crr.1540117

- Bromley, D. (2002). Comparing corporate reputations: league tables, quotients, benchmarks, or case studies? *Corp. Reputation Rev.* 5, 35–50. doi: 10.1057/palgrave.crr.1540163
- Brown, M., and Whysall, P. (2010). Performance, reputation, and social responsibility in the UK's financial services: a post-credit crunch interpretation. *Serv. Indust. J.* 30, 1991–2006. doi: 10.1080/02642060903220931
- Burke, R. J. (2011). "Corporate reputations: development, maintenance, change and repair," in *Corporate Reputation: Managing Opportunities and Threats*, 1 Edn, eds J. R. Burke, G. Martin, and C. L. Cooper. London: Gower, 1–43.
- Cantos-Mateos, G., Vargas-Quesada, B., Zulueta García, M. A., and Chinchilla-Rodríguez, Z. (2013). *Estudio Comparativo Sobre la Visualización de Redes de Co-words a Través de los Descriptores Del Science Citation Index y de Medline*. Oporto: Universidade do Porto, 173–189.
- Carrillo-Durán, M. V., and García, M. (2020). Exploring the need for stakeholders' engagement through social networking sites to build the reputation of higher education organisations. *High. Educ. Q.* 74, 442–457. doi: 10.1111/hequ.12256
- Caruana, A., and Ewing, M. T. (2010). How corporate reputation, quality, and value influence online loyalty. *J. Bus. Res.* 63, 1103–1110. doi: 10.1016/j.jbusres.2009.04.030
- Caves, R., and Porter, M. (1977). From entry barriers to mobility barriers: conjectural decisions and contrived deterrence to new competition. *Q. J. Econ.* 91, 241–261. doi: 10.2307/1885416
- Centre for Reviews and Dissemination (2008). *Systematic Reviews*. York: University of New York; New York Publishing Services Ltd.
- Chapleo, C. (2007). Barriers to Brand Building in UK Universities? *Int. J. Nonprofit Volunt. Sect. Mark.* 12:23–32. doi: 10.1002/nvsm.271
- Chen, C., and Esangbedo, M. O. (2018). Evaluating university reputation based on integral linear programming with grey possibility. *Math. Prob. Eng.* 2018, 5484326. doi: 10.1155/2018/5484326
- Chevalier, A., and Conlon, G. (2003). *Does It Pay to Attend a Prestigious University?*. Institute of Labor Economics. Available online at: <https://EconPapers.repec.org/RePEc:iza:izadps:dp848>
- Christensen, T., Gavril, S. G., Ma, L., and Ramirez, F. O. (2020). Reputation management by Chinese universities: primary profile and comparative features. *Public Adm.* 98, 1027–1043. doi: 10.1111/padm.12679
- Christensen, T., and Gornitzka, (2017). Reputation management in complex environments - a comparative study of university organizations. *High. Educ. Policy* 30, 123–140. doi: 10.1057/s41307-016-0010-z
- Chun, R. (2005). Corporate reputation: meaning and measurement. *Int. J. Manag. Rev.* 7, 91–109. doi: 10.1111/j.1468-2370.2005.00109.x
- Cole, M. S., and Bruch, H. (2006). Organizational identity strength, identification, and commitment and their relationships to turnover intention: does organizational hierarchy matter? *J. Organ. Behav.* 27, 585–605. doi: 10.1002/job.378
- Conard, M., and Conard, M. (2000). An analysis of academic reputation as perceived by consumers of higher education. *J. Mark. High. Educ.* 9, 69–80. doi: 10.1300/J050v09n04_05
- Coombs, T. W., and Holladay, S. J. (2006). Unpacking the halo effect: reputation and crisis management. *J. Commun. Manage.* 10, 123–137. doi: 10.1108/13632540610664698
- Creswell, J. (2014). *Research Design: Qualitative, Quantitative and Mixed Methods Approaches*, 4th Edn.. Thousand Oaks, CA: Sage.
- Csiszar, E., and Heidrich, G. W. (2006). The question of reputational risk: perspectives from an industry. *Geneva Pap. Risk Insur.* 31, 382–394. doi: 10.1057/palgrave.gpp.2510096
- Curtis, T., Abratt, R., and Minor, W. (2009). Corporate brand management in higher education: the case of ERAU. *J. Prod. Brand Manage.* 18, 404–413. doi: 10.1108/10610420910989721
- Davies, G., Chun, R., da Silva, R. V., and Roper, S. (2002). *Corporate Reputation and Competitiveness*. London: Routledge.
- Dawar, N., and Parker, P. (1994). Marketing universals: consumers' use of brand name, price, physical appearance, and retailer reputation as signals of product quality. *J. Mark.* 58, 81–95. doi: 10.1177/002224299405800207
- de Chernatony, L. (1999). Brand management through narrowing the gap between brand identity and brand reputation. *J. Mark. Manage.* 15, 157–179. doi: 10.1362/026725799784870432
- De Quevedo, E., De la Fuente, J. M., and Delgado, J. B. (2005). Reputación corporativa y creación de valor. marco teórico de una relación circular. *Invest. Euro. Direc. Econ. Empresa* 11, 81–97. Available online at: <http://dialnet.unirioja.es.ez.urosario.edu.co/servlet/oaiart?codigo=1357926>
- Deephhouse, D. L. (2000). Media reputation as a strategic resource: an integration of mass communication and resource-based theories. *J. Manage.* 26, 1091–1112. doi: 10.1177/014920630002600602
- Deephhouse, D. L., and Carter, S. M. (2005). An examination of differences between organizational legitimacy and organizational reputation. *J. Manage. Stud.* 42, 329–360. doi: 10.1111/j.1467-6486.2005.00499.x
- Del-Castillo-Feito, C., Blanco-González, A., and Delgado-Aleman, R. (2020). The relationship between image, legitimacy, and reputation as a sustainable strategy: students' versus professors' perceptions in the higher education sector. *Sustainability* 12, 1189. doi: 10.3390/su12031189
- Del-Castillo-Feito, C., Blanco-González, A., and González-Vázquez, E. (2019). The relationship between image and reputation in the Spanish public university. *Euro. Res. Manage. Bus. Econ.* 25, 87–92. doi: 10.1016/j.iedeen.2019.01.001
- Delgado-Márquez, B. L., Escudero-Torres, M. A., and Hurtado-Torres, N. E. (2013). Being highly internationalised strengthens your reputation: an empirical investigation of top higher education institutions. *High. Educ.* 66, 619–633. doi: 10.1007/s10734-013-9626-8
- Dierickx, I., and Cool, K. (1989). Asset stock accumulation and sustainability of competitive advantage. *Manage. Sci.* 35, 1504–1511. doi: 10.1287/mnsc.35.12.1504
- Dodds, W. B., Monroe, K. B., and Grewal, D. (1991). Effects of price, brand, and store information on buyers' product evaluations. *J. Mark. Res.* 28, 307–319. doi: 10.1177/002224379102800305
- Dowling, G. (1994). *Corporate Reputation*. New York, NY: Longman Publishing.
- Drydakis, N. (2015). Economics applicants in the uk labour market: university reputation and employment outcomes. *Int. J. Manpow.* 36, 296–333. doi: 10.1108/IJM-02-2014-0061
- Drydakis, N. (2016). The effect of university attended on graduates labour market prospects: a field study of Great Britain. *Econ. Educ. Rev.* 52:192–208. doi: 10.1016/j.econedurev.2016.03.001
- Elsevier (2020). *What is Field-Weighted Citation Impact (FWCI)?* Scopus: Access and Use Support Center.
- Elsevier (2022). *SciVal. Navigate the World of Research With a Ready-to-Use Solution*. Elsevier Solutions.
- Esangbedo, M. O., and Bai, S. (2019). Grey regulatory focus theory weighting method for the multi-criteria decision-making problem in evaluating university reputation. *Symmetry* 11, 230. doi: 10.3390/sym11020230
- Federkeil, G. (2009). *Reputation Indicators in Rankings of Higher Education Institutions*. Sense Publishers. doi: 10.1163/9789087908164_003
- Feldman, P. M., Bahamonde, R. A., and Bellido, I. V. (2014). A new approach for measuring corporate reputation. *Rev. Admin. Empres.* 54, 53–66. doi: 10.1590/S0034-759020140102
- Finch, D., Hillenbrand, C., and Rubin, H. (2015). Proximity, strategic groups and reputation: an exploratory study of reputation in higher education. *Corp. Reputation Rev.* 18, 174–194. doi: 10.1057/crr.2015.8
- Finch, D., McDonald, S., and Staple, J. (2013). Reputational interdependence: an examination of category reputation in higher education. *J. Mark. High. Educ.* 23, 34–61. doi: 10.1080/08841241.2013.810184
- Fine, G. A., and Wohl, H. (2018). Reading and reputation: sense, sensibility, and status in graduate education. *Qualit. Res.* 18, 554–564. doi: 10.1177/1468794118778613
- Fombrun, C. J. (1996). *Reputation: Realizing Value From the Corporate Image*. Harvard Business School Press.
- Fombrun, C. J., Gardberg, N. A., and Sever, J. M. (2000). The reputation QuotientSM: a multi-stakeholder measure of corporate reputation. *J. Brand Manage.* 7, 241–255. doi: 10.1057/bm.2000.10
- Fombrun, C. J., and Shanley, M. (1990). What's in a name? reputation building and corporate strategy. *Acad. Manage. J.* 33, 233–258. doi: 10.5465/256324
- Fombrun, C. J., and Van Riel, C. (1997). The reputational landscape. *Corp. Reputation Rev.* 1, 5–13. doi: 10.1057/palgrave.crr.1540008
- Fombrun, C. J., and Van Riel, C. (2003). *Fame and Fortune: How Successful Companies Build Winning Reputations* (Upper Saddle River, NJ), 1st Edn. Prentice Hall.
- Fombrun, C. J., and Van Riel, C. (2004). *Fame and Fortune: How Successful Companies Build Winning Reputations*. Upper Saddle River, NJ: Pearson.

- Foroudi, P., Nazarian, A., Ziyadin, S., Kitchen, P., Hafeez, K., Priporas, C., et al. (2020). Co-creating brand image and reputation through stakeholder's social network. *J. Bus. Res.* 114:42–59. doi: 10.1016/j.jbusres.2020.03.035
- Foroudi, P., Yu, Q., Gupta, S., and Foroudi, M. M. (2019). Enhancing university brand image and reputation through customer value co-creation behaviour. *Technol. Forecast. Soc. Change* 138, 218–227. doi: 10.1016/j.techfore.2018.09.006
- Fowles, J., Frederickson, G., and Koppell, J. (2016). University rankings: evidence and a conceptual framework. *Public Adm. Rev.* 76, 790–803. doi: 10.1111/puar.12610
- Fumasoli, T., and Huisman, J. (2013). Strategic agency and system diversity: conceptualizing institutional positioning in higher education. *Minerva* 51, 155–169. doi: 10.1007/s11024-013-9225-y
- Gardberg, N., and Fombrun, C. J. (2002). The global reputation quotient project: first steps towards a cross-nationally valid measure of corporate reputation. *Corp. Reputation Rev.* 4:303–307. doi: 10.1057/palgrave.crr.1540151
- Gaultier-Gaillard, S., and Louisot, J. P. (2006). Risks to reputation: a global approach. *Geneva Pap. Risk Insur.* 31, 425–445. doi: 10.1057/palgrave.gpp.2510090
- Goldring, D. (2015). Reputation orientation: improving marketing performance through corporate reputation building. *Mark. Intell. Plann.* 33, 784–803. doi: 10.1108/MIP-11-2013-0183
- Haas, A., and Unkel, J. (2017). Ranking versus reputation: perception and effects of search result credibility. *Behav. Inform. Technol.* 36, 1285–1298. doi: 10.1080/0144929X.2017.1381166
- Handayani, R. (2019). Building university reputation through experiential marketing in the industry revolution ERA 4.0 (survey of several private universities in the city of Bandung). *Int. J. Innov. Creat. Change* 6, 208–2018.
- Harahap, D. A., Hurriyati, R., Gaffar, V., and Amanah, D. (2018). The impact of word of mouth and university reputation on student decision to study at university. *Manage. Sci. Lett.* 8, 649–658. doi: 10.5267/j.msl.2018.4.027
- Heffernan, T., Wilkins, S., and Butt, M. (2018). Transnational higher education: the importance of institutional reputation, trust and student-university identification in international partnerships. *Int. J. Educ. Manage.* 32, 227–240. doi: 10.1108/IJEM-05-2017-0122
- Hemsley-Brown, J. (2012). The best education in the world: reality, repetition or cliché? International students' reasons for choosing an English university. *Stud. High. Educ.* 37, 1005–1022. doi: 10.1080/03075079.2011.562286
- Hiebl, M. R. W. (2015). Applying the four-eyes principle to management decisions in the manufacturing sector: are large family firms one-eye blind? *Manage. Res. Rev.* 38, 264–282. doi: 10.1108/MRR-11-2013-0254
- Ho, S., and Peng, M. (2016). Managing resources and relations in higher education institutions: a framework for understanding performance improvement. *Educ. Sci. Theo. Prac.* 16, 279–300. doi: 10.12738/estp.2016.1.0185
- Jamali, H. R., Nicholas, D., and Herman, E. (2016). Scholarly reputation in the digital age and the role of emerging platforms and mechanisms. *Res. Eval.* 25, 37–49. doi: 10.1093/revseval/rvv032
- Järvinen, R., and Suomi, K. (2011). Reputation attributes in retailing services: managerial perspective. *Man. Serv. Qual. Int. J.* 21, 410–423. doi: 10.1108/09604521111146270
- Jin, B., Yong Park, J., and Kim, J. (2008). Crosscultural examination of the relationships among firm reputation, esatisfaction, etrust, and eloyalty. *Int. Mark. Rev.* 25, 324–337. doi: 10.1108/02651330810877243
- Jung, N., and Seock, Y. (2016). The impact of corporate reputation on brand attitude and purchase intention. *Fash. Text.* 3, 1–15. doi: 10.1186/s40691-016-0072-y
- Kaushal, V., and Ali, N. (2019). University reputation, brand attachment and brand personality as antecedents of student loyalty: a study in higher education context. *Corp. Reputation Rev.* 23, 254–266. doi: 10.1057/s41299-019-00084-y
- Kitchen, P., and Laurence, A. (2003). Corporate reputation: an eight-country analysis. *Corp. Reputation Rev.* 6, 103–117. doi: 10.1057/palgrave.crr.1540193
- Koufaris, M., and Hampton-Sosa, W. (2004). The development of initial trust in an online company by new customers. *Inform. Manage.* 41, 377–397. doi: 10.1016/j.im.2003.08.004
- Lafuente-Ruiz-de Sabando, A., Zorrilla, P., and Forcada, J. (2018). A review of higher education image and reputation literature: knowledge gaps and a research agenda. *Euro. Res. Manage. Bus. Econ.* 24, 8–16. doi: 10.1016/j.iedeen.2017.06.005
- Laker, D. R., and Powell, J. L. (2011). The differences between hard and soft skills and their relative impact on training transfer. *Hum. Resour. Dev. Q.* 22, 111–122. doi: 10.1002/hrdq.20063
- Lange, D., Lee, P., and Dai, Y. (2011). Organizational reputation: a review. *J. Manage.* 37, 153–184. doi: 10.1177/0149206310390963
- Lee, J., and Stuen, E. (2016). University reputation and technology commercialization: evidence from nanoscale science. *J. Technol. Transfer* 41, 586–609. doi: 10.1007/s10961-015-9430-y
- Lee, S., Nguyen, H. N., Lee, K. S., Chua, B. L., and Han, H. (2018). Price, people, location, culture and reputation: determinants of Malaysia as study destination by international hospitality and tourism undergraduates. *J. Tour. Cult. Change* 16, 335–347. doi: 10.1080/14766825.2017.1336242
- Lee, Y., Wanta, W., and Lee, H. (2015). Resource-based public relations efforts for university reputation from an agenda-building and agenda-setting perspective. *Corp. Reputation Rev.* 18, 195–209. doi: 10.1057/crr.2015.6
- Lemmink, J., Schuijff, A., and Streukens, S. (2003). The role of corporate image and company employment image in explaining application intentions. *J. Econ. Psychol.* 24, 1–15. doi: 10.1016/S0167-4870(02)00151-4
- Linton, J. D., Tierney, R., and Walsh, S. T. (2011). Publish or perish: how are research and reputation related? *Ser. Rev.* 37, 244–257. doi: 10.1080/00987913.2011.10765398
- Liu, J. H., North, M., and Li, C. (2017). Relationship building through reputation and tribalism on companies facebook pages: a uses and gratifications approach. *Internet Res.* 27, 1149–1169. doi: 10.1108/IntR-03-2016-0078
- Loureiro, S. M. C., and Kastenholz, E. (2011). Corporate reputation, satisfaction, delight, and loyalty towards rural lodging units in Portugal. *Int. J. Hosp. Manage.* 30, 575–583. doi: 10.1016/j.ijhm.2010.10.007
- Loureiro, S. M. C., Sarmento, E. M., and Le Bellejo, G. (2017). The effect of corporate brand reputation on brand attachment and brand loyalty: automobile sector. *Cogent Bus. Manage.* 4, 1360031. doi: 10.1080/23311975.2017.1360031
- Love, E. G., and Kraatz, M. (2009). Character, conformity, or the bottom line? How and why downsizing affected corporate reputation. *Acad. Manage. J.* 52, 314–335. doi: 10.5465/amj.2009.37308247
- Lunde, T., Sjusdal, A. P., and Pappas, I. O. (2019). “Organizational culture challenges of adopting big data: a systematic literature review,” in *Digital Transformation for a Sustainable Society in the 21st Century*, eds I. O. Pappas, P. Mikalef, Y. K. Dwivedi, L. Jaccheri, J. Krogstie, and M. Mntymki (Cham: Springer International Publishing), 164–176. doi: 10.1007/978-3-030-29374-1_14
- Luque-Martinez, T., and Del Barrio-García, S. (2009). Modelling university image: The teaching staff viewpoint. *Public Relat. Rev.* 35, 325–327. doi: 10.1016/j.pubrev.2009.03.004
- Maduro, S., Fernandes, P. O., and Alves, A. (2018). Management design as a strategic lever to add value to corporate reputation competitiveness in higher education institutions. *Competi. Rev. Int. Bus. J.* 28, 75–97. doi: 10.1108/CR-04-2017-0029
- Marginson, S. (2016). *Global Stratification in Higher Education*. Cham: Springer. doi: 10.1007/978-3-319-21512-9_2
- Marín, T., and Arriolas, D. D. J. (2021). Ubicación de revistas científicas en cuartiles según SJR: predicción a partir de estadística multivariante. *Anal. Document.* 24, 455951. doi: 10.6018/analesdoc.455951
- Maringe, F., and Gibbs, P. (2009). *Marketing Higher Education: Theory and Practice*. Maidenhead: McGraw-Hill Education.
- Martin, G., Siebert, S., and Robson, I. (2018). Conformist innovation: an institutional logics perspective on how HR executives construct business school reputations. *Int. J. Hum. Resour. Manage.* 29, 2027–2053. doi: 10.1080/09585192.2016.1239118
- Massucci, F. A., and Docampo, D. (2019). Measuring the academic reputation through citation networks via PageRank. *J. Informetr.* 13, 185–201. doi: 10.1016/j.joi.2018.12.001
- Melewar, T. (2003). Determinants of the corporate identity construct: a review of the literature. *J. Mark. Commun.* 9, 195–220. doi: 10.1080/1352726032000119161
- Melewar, T. C., and Akel, S. (2005). The role of corporate identity in the higher education sector. *Corp. Commun. Int. J.* 10, 41–57. doi: 10.1108/13563280510578196
- Miotto, G., Del-Castillo-Feito, C., and Blanco-González, A. (2020). Reputation and legitimacy: key factors for Higher Education Institutions sustained

- competitive advantage. *J. Bus. Res.* 112, 342–353. doi: 10.1016/j.jbusres.2019.11.076
- Morley, L., and Aynsley, S. (2007). Employers, quality and standards in higher education: shared values and vocabularies or elitism and inequalities? *High. Educ. Q.* 61, 229–249. doi: 10.1111/j.1468-2273.2007.00353.x
- Morphew, C. C., Fumasoli, T., and Stensaker, B. (2016). Changing missions? How the strategic plans of research-intensive universities in Northern Europe and North America balance competing identities. *Stud. High. Educ.* 43, 1074–1088. doi: 10.1080/03075079.2016.1214697
- Mulrow, C. D. (1994). Rationale for systematic reviews. *BMJ* 309, 597–599. doi: 10.1136/bmj.309.6954.597
- Munisamy, S., Mohd Jaafar, N. I., and Nagaraj, S. (2014). Does Reputation Matter? Case study of undergraduate choice at a premier university. *Asia Pac. Educ. Res.* 23, 451–462. doi: 10.1007/s40299-013-0120-y
- Nguyen, N., and Leblanc, G. (2001a). Corporate image and corporate reputation in customers' retention decisions in services. *J. Retail. Consum. Serv.* 8, 227–236. doi: 10.1016/S0969-6989(00)00029-1
- Nguyen, N., and LeBlanc, G. (2001b). Image and reputation of higher education institutions in students retention decisions. *Int. J. Educ. Manage.* 15, 303–311. doi: 10.1108/EUM00000000005909
- Nicholas, D., Herman, E., and Jamali, H. R. (2015). *Emerging Reputation Mechanisms for Scholars*. Seville: European Union; European commission; Joint Research Centre Edition.
- O'Loughlin, D., MacPhail, A., and Msetfi, R. (2013). The rhetoric and reality of research reputation: fur coat and no knickers. *Stud. High. Educ.* 40, 806–820. doi: 10.1080/03075079.2013.842224
- Palacio, M. -A., Meneses, G., and Pacrez, P. (2002). The configuration of the university image and its relationship with the satisfaction of students. *J. Educ. Admin.* 40, 486–505. doi: 10.1108/09578230210440311
- Parellada, M., and Álvarez, M. (2017). Reputació y “rankings”. *Debats* 131, 15–26. doi: 10.28939/iam.debats.131-2.2
- Parente, R., Feola, R., Cucino, V., and Catolino, G. (2015). Visibility and reputation of new entrepreneurial projects from academia: the role of start-up competitions. *J. Knowl. Econ.* 6, 551–567. doi: 10.1007/s13132-015-0255-6
- Park, E. (2009). Analysis of Korean students' international mobility by 2-D model: driving force factor and directional factor. *High. Educ.* 57, 741–755. doi: 10.1007/s10734-008-9173-x
- Petticrew, M., and Roberts, H. (2006). *Systematic Reviews in the Social Sciences: A Practical Guide*. Blackwell Publishing. doi: 10.1002/9780470754887
- Pfarrer, M. D., Pollock, T. G., and Rindova, V. P. (2010). A tale of two assets: the effects of firm reputation and celebrity on earnings surprises and investors' reactions. *Acad. Manage. J.* 53, 1131–1152. doi: 10.5465/amj.2010.54533222
- Pitan, O. S., and Muller, C. (2019). University reputation and undergraduates self-perceived employability: mediating influence of experiential learning activities. *High. Educ. Res. Dev.* 38, 1269–1284. doi: 10.1080/07294360.2019.1634678
- Plewa, C., Ho, J., Conduit, J., and Karpen, I. O. (2016). Reputation in higher education: a fuzzy set analysis of resource configurations. *J. Bus. Res.* 69, 3087–3095. doi: 10.1016/j.jbusres.2016.01.024
- Prakash, G. (2021). QoS in higher education institutions: the concept, a literature review and future directions. *TQM J.* 33, 1245–1262. doi: 10.1108/TQM-09-2020-0211
- Price, D. (1965). Network of scientific papers: the pattern of bibliographic references indicates the nature of the scientific research front. *Science* 149, 510–515. doi: 10.1126/science.149.3683.510
- Priporas, C. V., and Kamenidou, I. (2011). Perceptions of potential postgraduate Greek business students towards UK universities, brand and brand reputation. *J. Brand Manage.* 18:264–273. doi: 10.1057/bm.2010.40
- Rao, H. (1994). The social construction of reputation: certification contests, legitimation, and the survival of organizations in the American automobile industry: 1895-1912. *Strat. Manage. J.* 15, 29–44. doi: 10.1002/smj.4250150904
- Rashid, S., and Mustafa, H. (2021). Antecedents of corporate reputation with employees in higher education institutions: a systematic review. *Int. J. Educ. Manage.* 35, 297–309. doi: 10.1108/IJEM-06-2020-0310
- Rayner, J. (2003). *Managing Reputational Risk: Curbing Threats, Leveraging Opportunities*, 1st Edn. Chichester: Wiley.
- Rayner, J. (2005). *Managing Reputational Risks: Curbing Threats, Leveraging Opportunities*. Chichester: John Wiley & Sons Ltd.
- Ressler, J., and Abratt, R. (2009). Assessing the impact of university reputation on stakeholder intentions. *J. Gen. Manage.* 35, 35–45. doi: 10.1177/030630700903500104
- Reznik, S. D., and Yudina, T. A. (2018). Key milestones in the development of reputation management in Russian universities. *Euro. J. Contemp. Educ.* 7, 379–391. doi: 10.13187/ejced.2018.2.379
- Rindova, V., Williamson, L., and Petkova, A. (2005). Being good or being known: an empirical examination of the dimensions, antecedents, and consequences of organizational reputation. *Acad. Manage. J.* 48, 1033–1049. doi: 10.5465/amj.2005.19573108
- Roberts, D. (2009). *Reputation Management for Education: A Review of the Academic and Professional Literature*. The Knowledge Partnership.
- Roberts, P. W., and Dowling, G. R. (2002). Corporate reputation and sustained superior financial performance. *Strat. Manage. J.* 23, 1077–1093. doi: 10.1002/smj.274
- Rocco, T. S., and Plakhotnik, M. S. (2009). Literature reviews, conceptual frameworks, and theoretical frameworks: terms, functions, and distinctions. *Hum. Resour. Dev. Rev.* 8, 120–130. doi: 10.1177/1534484309332617
- Sajtos, L., Kreis, H., and Brodie, R. (2015). Image, brand relationships and customer value. *J. Serv. Theory Pract.* 25, 51–74. doi: 10.1108/JSTP-11-2013-0261
- Sataøen, H. L., and Wæraas, A. (2016). Building a sector reputation: the strategic communication of national higher education. *Int. J. Strat. Commun.* 10, 165–176. doi: 10.1080/1553118X.2016.1176567
- Sauder, M., and Lancaster, R. (2006). Do rankings matter? The effects of U.S. news & world report rankings on the admissions process of law schools. *Law Soc. Rev.* 40, 105–134. doi: 10.1111/j.1540-5893.2006.00261.x
- Schnietz, K. E., and Epstein, M. J. (2005). Exploring the financial value of a reputation for corporate social responsibility during a crisis. *Corp. Reputation Rev.* 7, 327–345. doi: 10.1057/palgrave.crr.1540230
- Shapiro, C. (1982). Consumer information, product quality, and seller reputation. *Bell J. Econ.* 13, 20–35. doi: 10.2307/3003427
- Shapiro, C. (1983). Premiums for high quality products as returns to reputations. *Q. J. Econ.* 98, 659–679. doi: 10.2307/1881782
- Smith, H., Smarkusky, D., and Corrigan, E. (2008). Defining projects to integrate evolving team fundamentals and project management skills. *J. Inform. Syst. Educ.* 19, 99–110. Available online at: <https://aisel.aisnet.org/jise/vol19/iss1/10>
- Smith, T. E., Carter, T. E., Osteen, P. J., and Panisch, L. S. (2018). Comparing reputation vs h-index rankings of doctoral programs. *J. Appl. Res. High. Educ.* 10, 87–99. doi: 10.1108/JARHE-08-2017-0096
- Šontait, M., and Bakanauskas, A. P. (2011). *Measurement Model of Corporate Reputation at Higher Education Institutions: Customers Perspective*. Kaunas: Vytauto Didžiojo universiteto leidykla.
- Spence, M. (1973). Job market signaling. *Q. J. Econ.* 87, 355–374. doi: 10.2307/1882010
- Steiner, L., Sundström, A. C., and Sammalisto, K. (2013). An analytical model for university identity and reputation strategy work. *High. Educ.* 65, 401–415. doi: 10.1007/s10734-012-9552-1
- Stergiou, K. I., and Tsikliras, A. C. (2013). Global university reputation and rankings: Insights from culturomics. *Ethics Sci. Environ. Polit.* 13, 193–202. doi: 10.3354/esep00140
- Sung, M., and Yang, S. U. (2008). Toward the model of university image: the influence of brand personality, external prestige, and reputation. *J. Public Relat. Res.* 20, 357–376. doi: 10.1080/10627260802153207
- Sung, M., and Yang, S. U. (2009). Student-university relationships and reputation: a study of the links between key factors fostering students supportive behavioral intentions towards their university. *High. Educ.* 57:787–811. doi: 10.1007/s10734-008-9176-7
- Suomi, K. (2014). Exploring the dimensions of brand reputation in higher education a case study of a Finnish masters degree programme. *J. High. Educ. Policy Manage.* 36, 646–660. doi: 10.1080/1360080X.2014.957893
- Suomi, K., and Järvinen, R. (2013). Tracing reputation risks in retailing and higher-education services. *J. Retail. Consum. Serv.* 20, 207–217. doi: 10.1016/j.jretconser.2012.12.003
- Suomi, K., Kuoppakangas, P., Hytti, U., Hampden-Turner, C., and Kangaslahti, J. (2014). Focusing on dilemmas challenging reputation management in higher education. *Int. J. Educ. Manage.* 28, 461–478. doi: 10.1108/IJEM-04-2013-0046

- Van Riel, C., and Fombrun, C. J. (2007). *Essentials of Corporate Communication: Implementing Practices for Effective Reputation Management*. Taylor & Francis. doi: 10.4324/9780203390931
- Van Vught, F. (2008). Mission diversity and reputation in higher education. *High. Educ. Policy* 21, 151–174. doi: 10.1057/hep.2008.5
- Veh, A., Gbel, M., and Vogel, R. (2019). Corporate reputation in management research: a review of the literature and assessment of the concept. *Bus. Res.* 12, 315–353. doi: 10.1007/s40685-018-0080-4
- Veloutsou, C., and Moutinho, L. (2009). Brand relationships through brand reputation and brand tribalism. *J. Bus. Res.* 62, 314–322. doi: 10.1016/j.jbusres.2008.05.010
- Verčič, A. T., Verčič, D., and nidar, K. (2016). Exploring academic reputation is it a multidimensional construct? *Corp. Commun.* 21, 160–176. doi: 10.1108/CCIJ-01-2015-0003
- Vidaver-Cohen, D. (2007). Reputation beyond the rankings: a conceptual framework for business school research. *Corp. Reputation Rev.* 10, 278–304. doi: 10.1057/palgrave.crr.1550055
- Vogler, D. (2020a). Analyzing reputation of Swiss universities on twitter: the role of stakeholders, content and sources. *Corp. Commun. Int. J.* 25, 429–445. doi: 10.1108/CCIJ-04-2019-0043
- Vogler, D. (2020b). The effects of media reputation on third-party funding of Swiss universities. *J. Commun. Manage.* 24, 285–298. doi: 10.1108/JCOM-04-2019-0059
- VOSviewer (2022). *VOSviewer—Visualizing Scientific Landscapes*. VOSviewer.
- Walker, K. (2010). A systematic review of the corporate reputation literature: definition, measurement, and theory. *Corp. Reputation Rev.* 12, 357–387. doi: 10.1057/crr.2009.26
- Watkins, B., and Gonzenbach, W. (2013). Assessing university brand personality through logos: an analysis of the use of academics and athletics in university branding. *J. Market. High. Educ.* 23, 15–33. doi: 10.1080/08841241.2013.805709
- Weigelt, K., and Camerer, C. (1988). Reputation and corporate strategy: a review of recent theory and applications. *Strat. Manage. J.* 9, 443–454. doi: 10.1002/smj.4250090505
- Wilkins, S., and Huisman, J. (2014). Factors affecting university image formation among prospective higher education students: the case of international branch campuses. *Stud. High. Educ.* 40, 1256–1272. doi: 10.1080/03075079.2014.881347
- Wolf, A., and Jenkins, A. (2018). What's in a name? The impact of reputation and rankings on the teaching income of English universities. *High. Educ. Q.* 72, 286–303. doi: 10.1111/hequ.12162
- Zavvalova, A., Pfarrer, M. D., Reger, R. K., and Hubbard, T. D. (2016). Reputation as a benefit and a burden? How stakeholders' organizational identification affects the role of reputation following a negative event. *Acad. Manage. J.* 59, 253–276. doi: 10.5465/amj.2013.0611

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Copyright © 2022 Amado Mateus and Juarez Acosta. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.



OPEN ACCESS

EDITED BY

Ana Luísa Rodrigues,
University of Lisbon, Portugal

REVIEWED BY

Jason Fan,
The University of Melbourne, Australia
Reza Vahdani-Sanavi,
Social Sciences University of Ankara,
Turkey
Danijela Trenkic,
University of York, United Kingdom

*CORRESPONDENCE

Bruce Russell
bruce.russell@utoronto.ca

SPECIALTY SECTION

This article was submitted to
Higher Education,
a section of the journal
Frontiers in Education

RECEIVED 02 May 2022

ACCEPTED 27 June 2022

PUBLISHED 09 August 2022

CITATION

Russell B, Barron C, Kim H and Jang EE
(2022) A mixed-method investigation
into international university students'
experience with academic language
demands.
Front. Educ. 7:934692.
doi: 10.3389/feduc.2022.934692

COPYRIGHT

© 2022 Russell, Barron, Kim and Jang.
This is an open-access article
distributed under the terms of the
[Creative Commons Attribution License
\(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use, distribution or
reproduction in other forums is
permitted, provided the original
author(s) and the copyright owner(s)
are credited and that the original
publication in this journal is cited, in
accordance with accepted academic
practice. No use, distribution or
reproduction is permitted which does
not comply with these terms.

A mixed-method investigation into international university students' experience with academic language demands

Bruce Russell*, Christine Barron, Hyunah Kim and
Eunice Eunhee Jang

Ontario Institute for Studies in Education, University of Toronto, Toronto, ON, Canada

Post-secondary education institutions with English as a medium of instruction have prioritized internationalization, and as a result, many universities have been experiencing rapid growth in numbers of international students who speak English as an additional language (EAL). While many EAL students are required to submit language test scores to satisfy university admission criteria, relatively little is known about how EAL students interpret admission criteria in relation to language demands post admission and what their language challenges are. This study, situated at a large Canadian university, integrated student and faculty member focus group data with data obtained from a domain analysis across three programs of study and a reading skills questionnaire. Findings suggest that many students and faculty members tend to misinterpret language test scores required for admission, resulting in surprise and frustration with unexpected level of language demands in their programs. Also, students experience complex and challenging language demands in their program of study, which change over time. Recommendations for increased student awareness of language demands at the pre-admission stage and a more system-wide and discipline-based approach to language support post-admission are discussed.

KEYWORDS

international students, English language proficiency, university admission criteria, English language requirements, standardized language tests, language test score, academic language demands, language support

Introduction

Many post-secondary education institutions using English as a medium of instruction increasingly identify internationalization as their top priority. As a result, many of these universities have been experiencing rapid growth in numbers of international students who speak English as an additional language (EAL). In the Canadian context where this study is situated, 341,964 international students were enrolled at Canadian post-secondary institutions in 2018/2019, which was a considerable

increase from 228,924 in 2015/2016 (Statistics Canada, 2021). In addition to fulfilling university internationalization goals (Association of Universities and Colleges of Canada, 2014), international students make significant contributions to the Canadian economy, spending an excess of 15.5 billion Canadian dollars on tuition, accommodation, and discretionary spending in 2016 (Kunin, 2017). Canadian universities have been using international student revenues to compensate for reductions in government funding (Cudmore, 2005; Knight, 2008), making international students an important source of revenue for Canadian universities as domestic enrollment declines (Association of Universities and Colleges of Canada, 2014).

Although increase in international student enrollment contributes to cultural and linguistic diversity to campus life, research shows international students do not perform as well as domestic students. In a United Kingdom study (Morrison et al., 2005), data collected centrally by the Higher Education Statistics Agency on the class of degree obtained by international undergraduate students showed that domestic students in general obtained higher classes of degrees (i.e., first or upper second class honors) than international students. This finding indicates a disparity in the academic experiences between domestic and international students. Research also suggests that one possible explanation for this disparity is that EAL students face significant challenges from academic work due to a lack of support for academic language demands (Fox, 2005; Guo and Chase, 2011). Most English medium of instruction universities require EAL students to demonstrate proof of English language proficiency (ELP) for admission. One of the most common proofs of ELP is standardized English language tests, such as the Test of English as a Foreign Language (TOEFL), the International English Language Testing System (IELTS), and the Pearson Test of English (PTE). However, the extent to which these tests provide evidence for making inferences about EAL students' ELP in discipline-specific post-secondary education contexts has been heatedly debated (Chapelle et al., 2008; Zheng and De Jong, 2011; Johnson and Tweedie, 2021). The characterization of the general ELP construct by standardized tests created disparities between tested ELP and real-life academic language demands that EAL students face upon admission (Guo and Chase, 2011; Guo and Guo, 2017; Pilcher and Richards, 2017).

Another widely used proof of ELP is institutional English-for-academic-purpose (EAP) courses for EAL students who are unable to achieve the required score on one of the recognized ELP tests. In addition to extra time and expenses associated with EAP programming, its generic approach to academic English has been criticized (Sheridan, 2011; Murray, 2016; Johnson and Tweedie, 2021). As well, it has been reported that students who enter university by taking courses in EAP pre-session programs have lower academic outcomes (Eddey and Baumann, 2011; Oliver et al., 2012).

While standardized EAP tests measure English language proficiency, the lack of contextual and discipline-specific constructs in these tests (Pilcher and Richards, 2017) creates a generalized view of ELP that may be at odds with the contextual and discipline-specific language required in academic settings as reported above. This situation may be problematic for universities who depend on these test scores to determine EAL student readiness to meet academic language demands. The inadequacy of the "one-size-fits-all" view of the general ELP construct used in standardized tests and EAP programming prompted the present study to closely examine critical questions of language requirements and EAL students' preparedness to handle the academic language demands in their programs of study. The purpose of the study was to deepen our understanding of EAL students' academic experiences with language demands based on their lived experiences as well as faculty members' perspectives about EAL students' academic language needs. As faculty members teach students and grade their academic work, their perspective on student readiness to cope with the demands of academic work is important to understand the appropriacy of language requirements. As such, it was deemed to be critical to explore the understandings of both students and faculty members to examine potential discrepancies in their perspectives and their impact on EAL student academic experience.

English language requirements for university admission

In English medium of instruction universities, international EAL students must provide proof of ELP as part of admission requirements. Admission requirements are varied but can be met typically through one of the following: (a) length of residence in the country in which the university is located and attendance at a school where English is the language of instruction, (b) attendance at a school that teaches in English in a country where the dominant language is English, (c) completion of an English-for-academic-purpose course or program, or (d) a score from a standardized English language test.

Although admission requirements based on length of residence and attendance at a school where English is the language of instruction are deemed to provide alternative options for applicants, little research exists on the performance of students admitted to a university based on different admission requirements. Fox's (2005) four-year longitudinal study shows that EAL students whose admission was based on the residency requirement underperformed other EAL student groups and faced various challenges regardless of the number of years in an English-medium high school.

Still, the most common proof of ELP used by EAL applicants is a standardized test score of TOEFL, IELTS, PET, Duolingo English Test, or other tests. While cut-off scores are commonly

used to determine the adequacy of ELP, there remain significant concerns about the misuse of these tests, weak predictive validity of future academic performance, and a lack of information for test-takers, university faculty, and administration staff about what these standardized test scores mean in practice (Deakin, 1997; McDowell and Merrylees, 1998; Banerjee, 2003; Coleman et al., 2003; O'Loughlin, 2008). There are few training opportunities for university faculty and staff to determine the adequate level of language proficiency in a specific field of study (Coleman et al., 2003; Rea-Dickins et al., 2007), making the decision of what cut scores to adopt for admission problematic.

The decision of an appropriate cut score on a standardized language test for university admission is a critical consideration, and many university cut scores are sometimes at odds with recommendations of test developers. MacDonald (2019) reported that in the case of the IELTS test, 34 out of 35 Canadian universities surveyed adopted an overall band of 6.5 for direct admission for undergraduate study. IELTS test developers, on the other hand, recommend band 7.5 and above as acceptable for linguistically demanding programs and 7.0 and above as acceptable for less linguistically demanding programs (IELTS, 2019). This disparity between the cut scores recommended by test companies and those used by Canadian universities might impact the experience of international EAL students.

University test score users' insufficient knowledge about standardized test scores and academic language demands are further complicated by the under-representation of the EAP construct underlying the aforementioned standardized language tests. Research converges showing that standardized language tests used for admission do not represent the full range of language demands required in academic work (Weir et al., 2012; Brooks and Swain, 2014; Bruce and Hamp-Lyons, 2015; Pilcher and Richards, 2017). Brooks and Swain (2014) reported a mismatch between the TOEFL iBT speaking test and real-life academic learning contexts, which can potentially mislead EAL students to believe they are prepared for post-admission communicative tasks. This mismatch is not limited to speaking tests. Research on the IELTS reading test highlights its emphasis on basic textual comprehension, while lacking items measuring higher-order reading skills (Moore et al., 2012; Weir et al., 2012; Jang et al., 2019). Research in the target language domain has shown significant variation in reading skills between EAL students and students who speak English as a first language. Trenkic and Warmington (2019) compared reading skills of United Kingdom university students who spoke English as a first language and EAL students. Results showed that EAL students had a significantly smaller vocabulary range and comprehended less of what they read than students who spoke English as a first language. The authors suggested that, because of these differences, EAL students are at an academic disadvantage against first language students especially when program learning tasks require students to read independently and then be assessed through writing (Trenkic and Warmington, 2019).

Other research also points to the discrepancy in the target language construct between general language tests and discipline-specific languages used across different programs of study (Hyland and Hamp-Lyons, 2002; Hyland, 2004; Fang and Schleppegrell, 2008; Moore et al., 2012; Pilcher and Richards, 2017). Yet, Rosenfeld et al. (2003) identified language tasks that are frequently used in post-secondary courses offered in North American universities and confirmed that the TOEFL iBT prototype tasks were consistent with stakeholder perspectives. Few studies have systematically investigated the perspectives of EAL students and faculty members on the relationship of language requirements for admission and actual language demands across different fields of study. One such study, O'Loughlin (2008), found that students and university staff (e.g., admissions officers and academic staff) in two programs of study lacked understanding about the relationship of IELTS test scores and language ability, the need for future student support, and student readiness for study. The present study builds on O'Loughlin (2008) by focusing on input from students and faculty members across three programs of study. It is important to seek input from stakeholders, such as students and faculty members to fully understand academic language use across different disciplines (McNamara, 1996).

English as an additional language students' experience with academic language demands

International EAL students encounter various challenges associated with access to social interactions, if any, participating in such social interactions meaningfully (Pritchard and Skinner, 2002), a sense of isolation, financial burdens (Li and Kaye, 1998; Lloyd, 2003), overt and covert racism and stereotypes (Guo and Guo, 2017), and a lack of requisite academic language skills required for successful academic work (Robertson et al., 2000). Among these various factors, students' experience with academic language demands required for successful coursework has been researched extensively (Fitzgerald, 1995; Flowerdew and Miller, 1995; Ferris and Tagg, 1996; Mulligan and Kirkpatrick, 2000; Mendelsohn, 2002; Parks and Raymond, 2004). For example, EAL students may not be familiar with classroom discourse patterns, such as questions, responses, and appraisal, known as an initiation-response-evaluation (IRE) classroom discourse pattern (Cazden, 1988) and lecture styles (Flowerdew and Miller, 1995; Mulligan and Kirkpatrick, 2000). Mulligan and Kirkpatrick (2000) surveyed first-year EAL students and discovered that fewer than one in 10 students could understand the lecture very well and that one in 25 did not understand the lecture at all. Mendelsohn (2002) reported that EAL students' difficulty in understanding lectures in their first academic year is shown to have negative impact on their academic performance.

Another challenge for EAL students is oral language communication. Ferris and Tagg (1996) surveyed 234 faculty members at four post-secondary institutions in the United States and asked them what they thought listening and speaking challenges were for EAL students. Results suggested that faculty members were concerned with EAL students' willingness and ability to participate in class discussions and with their ability to ask or respond to questions. Other research has suggested that affective factors may impact EAL student willingness to participate in class discussions. For example, fear of making mistakes has been shown to negatively impact EAL student class participation (Jacob and Greggo, 2001). Parks and Raymond (2004) reported that while EAL students in a graduate program in a Canadian university were encouraged to interact with local students, their local peers did not always welcome EAL students due to their perceived lack of language ability.

Regarding reading comprehension challenges, research has suggested that EAL students take longer to read than first-language users (Fitzgerald, 1995), suggesting an extra burden placed on EAL students compared to first-language speakers. Other factors that may contribute to reading comprehension challenges are cultural; research suggests that lack of familiarity with background content plays a factor in comprehension and schemata activation (Steffenson and Joag-Dev, 1979; Moje et al., 2000). Research has suggested that university faculty members perceive EAL students lacking critical reading and strong writing skills (Robertson et al., 2000).

In addition to academic uses of language, university study requires social language use. In a study that focused on the first six months of university study, results suggested that due to a lack of a local support network, EAL students experience more difficulties than local students adjusting to university life (Hechanova-Alampay et al., 2002). EAL students also expressed more stress and anxiety than local students (Ramsay et al., 1999) and felt they have to initiate social interaction with local students, have difficulty talking with faculty members, and have difficulty working on group projects with local students (Rajapaksa and Dundes, 2002).

Universities typically provide various types of language support (e.g., workshops, preparation courses, writing consultations) to address EAL students' language challenges, and research generally converges on a need for program-specific support that is developed through the interdisciplinary collaboration of applied linguists and faculty in relevant disciplinary areas (Andrade, 2006; Hyatt and Brooks, 2009; Anderson, 2015). Regarding faculty members' support of EAL students, studies reveal that faculty members provide extra support to their students (Trice, 2003) while other studies conclude that faculty members feel support provision is not their responsibility (Gallagher and Haan, 2018), suggesting conflicting perspectives faculty members have on EAL student support.

While challenges that EAL students have with language demands have been well researched, many studies have focused on the perspectives of faculty, graduate contexts, EAP programming, and co-curricular staff, leaving the perspectives of post-secondary EAL students under-researched. As well, studies have lacked EAL students' and their faculty members' perceptions on the adequacy of ELP test criteria within particular programs of study. The present study seeks to address this gap by investigating the perspectives of post-secondary EAL students on their English language challenges and their interpretation of ELP test scores against language demands within three programs of study and across all years of undergraduate study. We elicited faculty member perspectives of EAL student readiness and experience with language challenges to deepen understanding of EAL student perspectives on the appropriacy of admission test criteria and student challenges with language demands. The study was guided by the following research questions:

- 1 What are EAL students' perspectives about the extent to which English language tests used for university admission represent the target language demands?
- 2 What challenges do EAL students and faculty members identify as most challenging for EAL students' academic success?
- 3 What strategies and resources do students and faculty members use to address EAL students' challenges with language demands?

Materials and methods

Study context

The university where this study is situated accepts a variety of English language tests that are typically recognized by universities in Canada and other English speaking countries; for example, Cambridge Assessment English, Canadian Academic English Language (CAEL) Test, Canadian Test of English for Scholars and Trainees (CanTEST), Duolingo English Test (DET), International English Language Test System (IELTS) Academic, and the Test of English as a Foreign Language (TOEFL). At this university, cut scores for admission to all undergraduate programs across all faculties are the same. Taking the IELTS test for example, an overall score of 6.5 with no band below 6.0 for any subsection (i.e., reading, writing, listening, speaking) is required for admission.

In 2017–2018 when this study was conducted, international student enrollment at this university was 19,187 students which was 21.3% of total undergraduate and graduate enrollment

(Planning and Budget Office, 2017–2018). Students attend this university from 166 countries and regions, and the top five countries for undergraduate students are China (65%), India (4%), the United States (3%), South Korea (3%), and Hong Kong (2%) (Planning and Budget Office, 2017–2018). In 2020–2021, the proportion of international students in the Faculty of Applied Science and Engineering was 35.3% and 41.3% in the Faculty of Arts and Science (Planning and Budget Office, 2017–2018). The three programs selected for this study were situated in these faculties, and the percentages indicate that significant numbers of international students were enrolled in these programs.

Study design

In this study, we examined the perspectives of EAL students and faculty members about academic language demands across three different disciplines of study and their responses to such challenges with an emphasis on reading skills. As part of a larger study investigating how score reporting could be enhanced on the reading section of a standardized English language test (Jang et al., 2019), the present study focused more specifically on EAL students' perspectives about academic language demands based on their lived academic experience after admission as well as faculty members' perspectives about EAL students' academic language needs.

We employed a mixed-methods inquiry design in order to triangulate different perspectives elicited through both qualitative and quantitative data collection (Teddlie and Tashakkori, 2003; Greene, 2008). In triangulating different perspectives using qualitative and quantitative data, our intent was not just to seek convergence; instead, we sought nuanced insights into both converging and diverging perspectives from their lived experiences (Mathison, 1988; Greene, 2008).

Participants

A total of 37 EAL students and 16 faculty members across three programs (Commerce, Economics, and Engineering) were recruited to participate in the study from one of the largest universities in Canada. We chose to focus on Commerce, Economics, and Engineering programs as these programs tend to attract large numbers of EAL students as reported above.

The participant recruitment process began with the research team contacting leadership in the programs of focus to introduce the project. Once the units agreed to collaborate, the programs and principal investigator sent a joint letter of invitation to students and faculty members to participate in the project. All students who were registered in the programs of focus and had submitted English proficiency test scores for admission received an invitation to participate. Students

were separated into either a first-year group or an upper-year group consisting of students in their second, third, or fourth year of their program. For students who indicated interest in participating in the project, a digital consent form was sent with more information about the project and detailed focus group instructions.

Among the 37 student participants, the majority (79%) were from mainland China. Other student participants included four students from India, two from Pakistan, two from Russia, and one from Taiwan. This student composition was reasonable given the sizable proportion of EAL students from mainland China in the international student population at this university. Ages ranged from 19 to 24 and the group was made up of 25 females and 12 males. No information was collected from students regarding their English language test scores, but all student participants had submitted a test score that met admission requirements. Faculty members who participated were mostly tenured faculty members.

Data collection

Focus groups

Each academic program had one faculty member focus group and two student focus groups (first-year and upper-year) except for the Commerce program which had three student focus groups (one first-year and two upper-year) due to strong student interest in participating in the study. Multiple focus group protocols tailored for different participant groups were developed separately (see [Supplementary Appendix A](#)). For first-year students, the protocol questions were aimed at understanding how EAL students perceived the language demands they faced in their program and how well they felt prepared for these language demands. Upper-year EAL students were asked, along with the aforementioned questions, to reflect on how they overcame any challenges they had and how their language ability to navigate university language demands grew over time. The protocol for faculty member focus groups included their general observation of EAL student language proficiency, their perceived preparedness of EAL students for their program, areas in which EAL students seemed to struggle the most, and EAL student progress in language development. Each focus group was video-recorded and lasted for 60–90 min. [Table 1](#) shows the distribution of focus group participants by academic program.

Academic reading skill questionnaire

To further understand the challenges EAL students face in reading in their program of study in relation to RQ2, we asked student focus group participants to complete a questionnaire. We focused the questionnaire on academic reading skills to examine EAL students' perceived importance of different

TABLE 1 Number and composition of focus groups.

Program	Focus groups	First-year students	Upper-year students	Faculty members	Total (by program)
Commerce	4	7	16 (2 groups)	5	28
Economics	3	5	3	5	13
Engineering	3	2	4	6	12
Total	10	14	23	16	53

reading skills for their academic work as well as their self-assessed competence in performing these skills. The skills included in the questionnaire were identified based on the relevant literature (e.g., Weir and Urquhart, 1998). A total of 10 items were intended to measure three specific reading skills on a six-point Likert scale: basic comprehension of text and structure (3 items), inferential reasoning (4 items), and critical thinking and evaluation (3 items) (see [Supplementary Appendix B](#) for the full list of items).

Course materials

In order to examine the language demands required in undergraduate courses (in addition to perceived language demands), we collected syllabi and reading materials from the faculty members who participated in focus groups. In each of the three programs, two courses were selected in each of the four program years (i.e., first year, second year, third year, and fourth year), leading to a total of 24 courses (2 courses \times 4 program years \times 3 programs of study) of which the course materials were evaluated. Within each course, official course syllabus and required readings for the typical week were analyzed to determine language demands and student assessment criteria.

Data analysis

Each data source was analyzed separately prior to integrative mixed-methods analyses. First, analysis of the focus group data employed an inductive thematic analysis in an iterative manner (Thomas, 2006). Data was first organized and analyzed in three groups: first-year EAL students, upper-year EAL students, and faculty members. The first round of inductive data analysis involved descriptive coding in order to capture emic perspectives expressed in participants' own words. Subsequently, we categorized the descriptive codes by merging overlapping codes, clarified the underlying meanings of the descriptive codes, and compared resulting themes within and across the three groups as well as between EAL students and faculty members.

We analyzed the questionnaire data focusing on discrepancies in perceived importance and self-assessed competence across three reading skill categories: basic comprehension of text and structure, inferential reasoning, and

critical thinking and evaluation. Due to the small sample size, no internal factor structure of the questionnaire data was tested in the present study. Instead, scores were calculated based on summed scores across items for each skill category. A one-way repeated measures ANOVA was conducted to compare means across three categories (e.g., basic comprehension of text and structure, inferential reasoning, and critical thinking and evaluation) for perceived importance and self-assessed competence, separately. In the case of self-assessed competence, the assumption of sphericity was violated and, therefore, the Greenhouse–Geisser correction was used to interpret the results. The interpretations of hypothesis testing were based on a significance level of 0.05. All quantitative analysis was conducted using Stata 15.1 (StataCorp, 2017).

We performed content analysis of the course materials. Faculty members from the three faculty focus groups provided samples of their course syllabi which totaled eight courses for each of the three programs of study. For each program, two courses represented each year of study. Our analytical scheme included five categories: overall reading requirements, modality and total number of assessments, volume of reading, text types (e.g., textbook, manual, journal article), and style and text genre. We performed this analysis per program and then developed a comparative matrix that included the five categories. Finally, we extracted quantitative information about the amount of overall reading requirements by text type and modality of evaluation criteria (e.g., written assignment, quiz, exam).

Results

RQ1. What are EAL students' perspectives about the extent to which English language tests used for university admission represent the target language demands?

The first research question probed student perspectives about the extent to which the English language test represented the language demands in their program of study. We identified three inter-related themes concerning discrepancy between general academic and discipline-specific language demands, a

higher level of complexity in target language demands, and an inflated view of language ability based on test scores.

Discrepancy between general language and discipline specific language demands

International students who learn English as a foreign language have limited access to authentic linguistic input and resources. Instead, they devote a considerable amount of time to mastering study materials in order to acquire the pass scores of standardized tests accepted for admission purposes in post-secondary education. As a result, international students arrive on campus with a poor understanding of academic language demands specific to their program of study.

Most focus group students expressed surprise and frustration at the mismatch between the general language demand requirements on the language test and the amount and complexity of disciplinary language requirements, specifically discipline-specific vocabulary in their program of study. One Engineering student explained:

I'm in Engineering Science. And so, for us in the first two years we have to take many different courses in the Engineering field. For example, like biology. I need to take biology. And I don't understand anything. I had lots of trouble because there are so many terms. I get lost with all those terms. (Engineering)

Students from the other disciplines also expressed their struggles with academic vocabulary. Two Commerce students reported that despite their satisfactory test scores, they found it challenging to tackle the sheer volume of technical vocabulary while reading texts. An Engineering faculty member corroborated these opinions by noticing that students may recognize vocabulary, but "it does not always mean what they think it means" because of disciplinary usage.

In addition to technical vocabulary, students found the lengths of texts they are expected to read and write were much longer compared to reading passages and writing requirements used by standardized language tests. One Economics student explained: "before I came here, the longest passage (for writing) was 300 words. But for here, 30 pages! Oh, how can I do that?" One student also commented on differences between reading text structure on the test and that in academic readings, which impacted their ability to comprehend meaning in academic work:

For reading questions in IELTS, we know the specific questions we need to answer after reading it, and there are some keywords we can search in the paragraphs. But, for the reading in university, maybe the articles are not so

structured like the readings in IELTS. So, we don't know where to find the information at all. (Engineering)

An Economics student explained that reading comprehension on the reading test is focused more on local comprehension whereas reading comprehension in his courses requires more global comprehension and explained, "Reading (on the test) is more like collecting information. Courses are asking for interpretation." An Engineering student, surprised that language demands were much more difficult than she had expected after having achieved the language score required for admission, said that she would tell incoming students: "don't be satisfied with your IELTS score" as advice to incoming students.

The content domain analysis revealed a heavy reading load for first-year students from all three programs with up to 12–16 textbook chapters per course. In addition to reading volume, the document analysis revealed that students are required to read critically and then demonstrate their comprehension of texts in written assignments. The analysis of Economics course syllabi showed that starting with second-year courses, students are required to complete writing assignments that represent 20% of the total grade, suggesting that demonstrating knowledge of course concepts through reading and writing is a substantial part of the course grade. Examination of Commerce course syllabi revealed a similar story for essay writing but with the addition of writing assignments in some third-year courses submitted as part of a group assignment that also included an oral presentation and was weighted at 35% of the total grade. Conversely, essay writing was not a requirement in any of the Engineering courses we examined.

Inflated view of own language ability based on test scores

Most students admitted that they had little knowledge of what the admission cut score meant for their preparedness for academic coursework. They tended to perceive that the level of language proficiency inferred from the cut score set for admission would be sufficient to handle academic and social language demands. This student perspective was also shared by faculty members believing that once students meet the university's admission criteria, they should be prepared for academic work. In responding to the question about what the test scores said about their English language ability, students tended to associate their perceived English language ability with test scores for specific sub-sections of the test (i.e., reading, writing, listening, speaking). That is, they tended to have had a higher level of self-assessed competence in language skills for which they received relatively higher scores, indicating students' perceived "face validity" of the test. A second-year Engineering student described his experience with his writing score by

stating that “after I came (to this university), personally I found the most difficult part is writing. Even though I got the highest (score) on writing, that’s the part I find the hardest.” Another Engineering student explained that while she achieved a high test score for reading, she was surprised to find academic reading requirements still challenging:

I did really well in listening and reading. It’s almost to a full mark. So, I was confident in reading, but, when I came here, umm so praxis course requires us to do some research to read a lot of documents. I feel like, for example, in two hours, my partner can complete a research, but I can only do like half of them. So, when I read a website or something I cannot know where is the focus. (Engineering)

An Economics student reported that even after achieving a high score on the language test, “it was not good enough for here.” Two Commerce students felt that the Speaking subtest was too narrow in focus and did not elicit their true speaking ability. Other Commerce students felt that the Speaking subtest score was impacted by topic familiarity and variation in raters’ grading severity. Conversely, two other Economics students felt that the language test in general was too basic and not hard enough although they did not elaborate on how the test could be made harder.

Many students reported that they had taken the language proficiency test several times before attaining the score required for admission, indicating inflated scores due to practice effects. Several Engineering and Commerce students took the test twice, while two Commerce students took the test three times and two Engineering students took the test four times. One Engineering observed that practice effects increased their score, but they did not feel their proficiency had increased:

You know, the first time, I didn’t do good, because I didn’t really know the instructions, the way I should do it. And, the second time, I did better because I know how to do the test. But, actually, for my English level, I don’t think I improved. (Engineering)

In general, students reported that it was harder to achieve higher scores for speaking and writing than reading and listening on the language proficiency test. Many students explained they struggled to obtain the required score for writing. According to several Commerce students and one Economics student, the required listening score was easier to attain. A few Commerce students and one Engineering student felt that achieving the required reading score was easier than achieving the required speaking and writing scores because they could easily use test-taking strategies for receptive skill tests, which are mostly multiple-choice based. Another Engineering student added that test-taking strategies to attain a higher reading score include focusing on comprehending local rather than global

meaning and added, “some people say that if you understand the paragraph, you’re doing it too slow.”

Despite achieving higher scores through test-taking strategies, students felt the higher scores did not represent increased proficiency and that the test score did not accurately measure their proficiency; one Engineering student explained:

And especially for IELTS reading, if you use the technique, you can get a high mark but it doesn’t really mean you really can read a passage and understand it fully. It just means you know how to do questions. (Engineering)

RQ2. What challenges do EAL students and faculty members identify as most challenging for EAL students’ academic success?

The second research question probed student and faculty member perspectives about challenges students have with language demands. We identified four inter-related themes concerning lack of oral language skills, lack of critical thinking and synthesis skills, struggle with cultural background knowledge, and a lessening of language challenges over time.

Lack of oral language skills

Students described difficulties speaking in class with both faculty members and local students. Several students stated that they were not adequately prepared for social language requirements as one Commerce student reported:

I felt awful...especially in terms of speaking, because we didn’t have enough practice, I felt that people didn’t understand me or they’d look at me like what am I talking about...which made it a lot easier to talk to international students rather than the native speakers. I make mistakes and they make mistakes, so we’re on the same wavelength. (Commerce)

An Economics faculty member reported that students were unable to comprehend course material in class, requested repetition (but that there was no time to repeat course material), and tried to transcribe lectures rather than extract salient information. A Commerce faculty member commented that student oral presentation skills are lacking and that students are asked to make presentations without being taught how to present. Another Commerce faculty member observed that students are challenged in negotiating the complex language demands of real-world client communication, which is a program requirement, and provided an example of such complex language use: “real-world survival (looking at families orphaned, dying of AIDS) therefore requires sensitivity, oral

language, willingness to go into the field, high communication skills in unfamiliar context.”

Examination of course syllabi revealed that oral language skills are indispensable to complete academic work. Student group assignments, consisting of projects or labs that require peer-to-peer communication, are required in all years of the Engineering program. In Commerce courses, group assignments mostly begin in second year and are weighted at as high as 35% of the total grade in some courses. On the other hand, in Economics, group assignments tended to be assigned in fourth-year courses with a much higher weight (as high as 48%) of the total course grade.

Lack of critical thinking and synthesis skills

Another critical issue with EAL students' academic language proficiency for coursework has to do with their perceived lack of higher-order reasoning skills. Engineering and Economics faculty members expressed students often read for the wrong purpose and focused more on literal meanings of texts or on sentence-level meaning rather than global-level interpretation. Engineering faculty members mentioned that students tended to rely on mathematical modeling and emulating rather than using critical reasoning and, as a result, students were not able to interpret what they had read and had difficulty explaining conceptual relationships. An Economics faculty member said that students found understanding implicit information in texts challenging and had difficulty comparing texts with different points of view:

And so when I ask them for feedback, last year, when I did this really simple, I thought, really simple press article that had two views, you need to pick one, and say why you preferred one? A lot of them, gave me feedback where they said it was hard. (Economics)

Domain analysis results suggest that as students progress through their program, there is a stronger requirement to apply critical reasoning skills in coursework. Decreased textbook utilization in favor of journal articles and other primary sources in upper years corresponds to the need for students to develop critical analytic reasoning beyond textual comprehension. This observation was further complemented by faculty member focus group discussions. Two Economics faculty members mentioned that the increased utilization of academic journal articles as course readings coincides with the expectation that students can critically review and synthesize those articles. Similarly, a Commerce faculty member noted that the utilization of case studies in upper years corresponds to an expectation for students to critically analyze the case studies and apply course concepts to them.

Although many faculty members stated that challenges in applying critical reasoning skills in general were universal regardless of their EAL student status, some acknowledged

the additional challenges faced by EAL students because of their relatively low language proficiency. Some faculty members also attributed a higher level of challenges to cultural differences related to educational background. For example, Economics faculty members reported that EAL students tend to be afraid of challenging faculty members and to not think critically about course concepts learned in lectures because they were not accustomed to do so in their previous education experience.

Corroborating these results with focus group and domain analysis data, our analysis of the reading demands questionnaire suggests that students tend to perceive higher-order reading skills as more important in their academic work than basic comprehension skills and, yet they feel less competent in those more valuable skills. Table 2 includes the means and standard deviations of three reading skills resulted from the questionnaire.

The results of a one-way repeated measures ANOVA suggest that there were statistically significant differences in the level of perceived importance among the three reading skills, $F(2,66) = 12.34$, $p < 0.001$ and the effect size of this ANOVA model was large, $\eta^2 = 0.27$. The *post hoc* pairwise comparisons using the Bonferroni test indicated that the level of perceived importance of the basic comprehension skill was significantly lower than both that of the inferential reasoning skill ($t = 4.81$, $p < 0.000$) and that of the critical thinking skill ($t = 3.48$, $p = 0.003$). However, the difference between the levels of perceived importance of the inferential reasoning skill and the critical thinking skill was not statistically significant ($t = -1.33$, $p = 0.565$).

In order to compare the level of self-assessed competence in the three reading skills, we conducted another one-way repeated measures ANOVA, which resulted in a statistically significant result, $F(2,66) = 4.33$, $p = 0.028$. The effect size of this ANOVA model was medium to large, $\eta^2 = 0.12$. Again, the *post hoc* pairwise comparisons were used to locate the differences. The *post hoc* tests revealed a statistically significant difference between the levels of self-assessed competence in the basic comprehension skill and in the critical thinking skill ($t = -2.68$, $p = 0.028$). However, neither the difference between the basic comprehension skill and the inferential reasoning skill ($t = -2.40$, $p = 0.058$) nor the difference between the inferential reasoning skill and the critical thinking skill ($t = -0.28$, $p = 1.000$) were found to be statistically significant, although the significance value of the former approaches the pre-determined alpha level.

In sum, the results from the two ANOVA tests and *post hoc* comparisons suggest that students tend to struggle with the higher-order reading skills such as critical thinking and inferential reasoning while these skills are perceived as more important than basic comprehension skills in their academic work.

TABLE 2 Means and standard deviations of three reading skills from reading questionnaire ($n = 34$).

Reading skill	Perceived importance		Self-assessed competence	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Basic comprehension of text and structure	4.84	0.78	4.76	0.76
Inferential reasoning	5.33	0.64	4.45	0.80
Critical thinking and evaluation	5.20	0.72	4.41	0.94

Struggle with cultural background knowledge

Students discussed significant challenges they experience with lectures and oral discussions due to cultural references in language use and idiomatic expressions used within and outside of coursework. Students expressed surprise at how background knowledge of Canadian or North American culture is necessary for better communication and felt unprepared and at a disadvantage to participate in class and complete assignments:

I think we lack Canadian background knowledge, making it harder to relate to some textbooks and instructors' examples. (Commerce)

When you talk about different companies, native peers already know them, but I didn't know this company ... Case-based courses based on Canadian and North American cases. ... (Commerce)

An Economics student explained that he was also not prepared for local language use by saying "I was not prepared particularly for local examples or jargon" while an Engineering student explained that her frustration with basic small talk was due to lack of comprehension of colloquial language:

Conversations were very hard to continue. I could only make basic small talk. I didn't understand jokes or slang. (Engineering)

An Economics student also explained that while he received a satisfactory score on the listening test, he was surprised to find that lecture comprehension was still challenging due to local content which he described as local language use (e.g., product brands):

Even I got satisfied marking on IELTS test, I still feel the knowledge is not enough for here. In the lecture, the professor usually use something really familiar with you because you are local people. Use some words or some examples, but I'm so "what's that? What's that?" So, I search Google for that maybe a local team, local brand. The name of coffee and I think, some nouns, they are difficult to remember. (Economics)

Commerce and Economics faculty members also reported that students have challenges with cultural differences and struggle with course content due to a lack of cultural knowledge. In echoing student frustration with comprehending jokes and slang, a Commerce faculty member felt that students struggle with the vernacular, resulting in students not understanding or misunderstanding the faculty member's humor. One faculty member mentioned how he takes into consideration the impact of cultural factors when designing course materials:

When you said the example of having them solve a problem for a client, those are the types of test questions I'd love to ask. But I do worry that they will differentially impact based on both language and cultural standards. (Economics)

Lessening of language challenges over time

Results from the upper-year student and faculty member focus groups and domain analysis revealed that student challenges with language lessened over time and that language demands decreased for them as they moved into the third and fourth years of their program. This change was partly because of smaller class sizes and the more interactive nature of their classes that involved discussions and presentations. Students felt that in their third and fourth years, they had acquired relevant vocabulary and non-verbal language use, which helped enhance their confidence, and found it easier to socialize. However, Engineering students expressed that critical reading demands increased significantly in the third and fourth years of their program and did not feel that the reading demands in their first and second year adequately prepared them.

Faculty member views showed variation about student language improvement. While many faculty members felt student language improved over time, some faculty members felt that many students' English did not make sufficient improvements. One Economics faculty member commented on students' limited language ability: "I still see a number of students in March or April and I am astounded that they got in and I'm astounded at how limited their English still is." Other faculty members noticed that even in upper-year courses, some students were reluctant to participate in class discussions and did not seem to improve. An Economics faculty member commented on lack of student participation in a third-year

course: “I think there’s ones that they really, they just find it hard. They’re not going to get better.” Another faculty member acknowledged that many students’ language improved over time but, nevertheless, he was surprised at the number of students who graduate without having improved:

And I also share this view that many of them improved over time. But what really surprises me is the number of them who never improved at all and they graduate anyway. (Economics)

Results from the domain analysis align with student and most faculty member views that student language challenges lessen over time while learning tasks become more interactive and group-based in upper year courses. Examination of student evaluation criteria in course syllabi revealed difference across the programs as well as the years of study within each program. **Figure 1** shows a general tendency in course assessment to move from independent assessment in the early years of a program to more group-based assessment in the upper years. This is especially noticeable in the Commerce program but less so in the Engineering program. First-year Commerce students’ grades are predominantly derived from more traditional exams and quizzes, emphasizing independent work. Group assignments are introduced in second year, suggesting the additional requirement of productive language skills that emphasize communication though the majority of course credit still involves exams and quizzes. Among the Economics courses investigated, evaluations somewhat mirrored Commerce, where independent exams are prominent in the first year, with more diverse assessment types being included in upper years (e.g., tutorial participation, problem sets, group projects). Like Commerce, not all fourth-year Economics courses used final exams as evaluations; one course utilized writing assignments and reflections as the main evaluation criteria. On the other hand, Engineering courses maintained similar evaluation criteria across all four years, with most assessments involving midterms and final exams—occasionally making up 100% of course grade—and a smaller proportion of grades being based on assignments, quizzes, projects, and tutorials. However, labs in Engineering courses involved more hands-on tasks involving teamwork, emphasizing the importance of knowledge demonstration and application in addition to memorization and expository knowledge.

RQ3. What strategies and resources do students and faculty members use to address EAL students’ challenges with language demands?

The third research question probed how students and faculty members responded to student challenges with language

demands. We identified four themes concerning student utilization of learning aids, student selection of courses and learning tasks, faculty member simplification of language, and a perception from faculty members that no specific strategies or resources are needed for EAL students.

Students utilizing learning aids

Students expressed that it takes them longer to complete academic work due to challenges with university language demands and struggle to find the extra time and, as a result, students described a variety of coping strategies to handle these challenges. Students reported using online videos and online translation tools to help them understand reading texts; however, students described pros and cons about the efficacy of translation tools, especially concerning accuracy and language skill development. In commenting on how some students avoid certain types of learning tasks, one Engineering faculty member wondered to what extent students could understand translation of course concepts, as students may not have had the linguistic resources in their first language to fully translate discipline-specific language and concepts.

Students reported accessing university supports to overcome challenges with language demands. While some students reported successes through university supports such as writing centers, students also reported frustrations when they attempted to access the university’s academic supports. Students felt university supports were constrained by wait times and tutors’ lack of disciplinary understanding of assignments; for example, significant amounts of appointment time were taken up explaining assignment requirements to support staff. Students also complained that access to teaching assistants was limited because of the volume of students and the relative lack of time the teaching assistants had available. Conversely, some faculty members felt that students did not attend office hours enough with faculty members or teaching assistants and did not take enough advantage of university supports like writing centers and drop-in workshops to build their language skills.

Students being selective of courses and learning tasks

Some faculty members felt that students avoided courses or learning tasks that students perceived to have heavier language demands. One Economics faculty member noticed how students tend to select courses that emphasize quantitative skills while another commented on lack of student participation in class discussion:

I definitely have selection into and out of my courses. Students who believe their comparative advantages in quantitative skills tend not to take my course. So I know that my third year course is lighter on international students than the average third year course. (Economics)

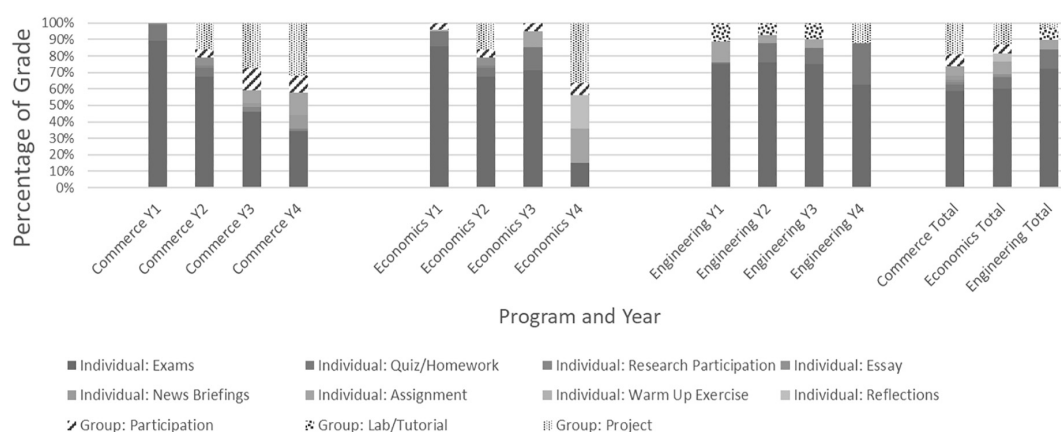


FIGURE 1
Composition of evaluation criteria by program of study and year.

Even though there are quite a bit of participation marks, they seem to disproportionately check out. They won't come. Or they, you know, they, they don't, they just don't do anything. ... So I think I'm sort of disappointed because I think they're not going to get any better. (Economics)

Some faculty members had a negative perception of student motivation characteristics. For example, some Engineering faculty members noticed that some students did not believe they needed to improve their language skills because they intended to practice engineering in their country of origin. These faculty members felt that these students tended to not spend the time they needed to improve their language skills and instead focused more on technical skills:

I think we're making some assumptions and goals of these students to learn English. And so when we offer strategies like, they should try to read in other genres and ways to kind of adjust to the work they're not that interested in that because their goal is to get through the program so they can practice in their own language. So there's multiple groups of students within that cohort as well in terms of motivation. (Engineering)

Let's say this course requires a lot of writing, a lot of presentation within those 3 months. I'm just not going to get that good at it and why don't I just concentrate on the other courses where they don't need to make any presentation. (Engineering)

However, one Engineering faculty member felt that courses even with a technical skill focus did require communication skills and that students were not making informed choices:

I also think that they don't believe that they actually need the language to do some of their technical courses and they do. (Engineering)

Faculty simplifying language

Some faculty members recognized student language challenges and made accommodations in their teaching practice. For example, some faculty members wrote exam questions in simple language, allowed dictionary use during exams, placed more emphasis on content rather than grammatical accuracy when grading, provided instructions for participating in class discussions, provided student feedback on specific writing skills (e.g., a positioning statement or formula justification), and provided lecture videos and slides to support student lecture listening skills. Other faculty members mentioned being sensitive to cultural language and background when writing exam questions.

Some Commerce faculty members scaffolded students' professional oral communication needs by providing more frequent in-class oral presentation opportunities to build student confidence and provide feedback for students. Also, a Commerce faculty member mentioned providing first-year students with scripts with sample discussion questions to help them facilitate class discussion, noting that students were challenged by cross-cultural communication but that with feedback their skills improved. Another Commerce faculty member mentioned that presentation feedback should be integrated across all courses so students could see their improvement over time and that students could benefit from a pre-session program where they could build their confidence in handling business communication. In the Engineering program, faculty members mentioned that project poster sessions were one opportunity where students could learn project-based client communication through question-and-answer sessions.

While many faculty members mentioned various ways in which they altered their teaching practice to adjust for EAL student language challenges, one faculty member wondered how much accommodation could be made while maintaining course integrity:

And, you know, it is a legitimate question how far the institution ought to go to accommodate these difficulties. I don't, I don't have the answer. (Economics)

No specific strategies or resources needed

The third research question was concerned with the strategies and resources that students and faculty members use to lessen the challenges EAL students have with language demands. While the fourth theme that emerged from the data was not a strategy or resource, it is worth noting that some faculty members felt that concerning certain challenges, no specific strategy or resource was necessary for international students. Some faculty member participants felt that a specific response to some EAL student language challenges was not necessary because, they observed, all students struggle with developing a critical perspective, using the language of the discipline, interpreting academic articles, summarizing readings, and writing effectively, and this was especially apparent in first year. An Economics faculty member commented that academic reading was challenging for both first and second language speakers:

But on that kind of preparatory reading which I think is especially crucial in the third- and fourth-year courses, I don't identify that as an international student issue at all. Plenty of domestic students or native speakers are not understanding how to read, and are not doing it or trying it sufficiently. So for that kind of reading, I think we have a challenge for all of our students and I don't, I wouldn't single out international students. (Economics)

Discussion

Earlier studies lack EAL student perceptions on the adequacy of English language test criteria to meet university language demands within particular programs of study. The present study addressed this gap by investigating the perspectives of post-secondary EAL students on their English language challenges and their interpretation of English language test scores against language demands within three programs of study and across all years of undergraduate study. This study also examined how faculty members in different programs of study perceive the language challenges EAL students experience and how EAL students and faculty members respond to these

challenges. The results of the study show the mismatch that EAL students perceive between admission criteria required on English language tests and actual language demands. The results also deepen understanding of post-secondary language requirements and suggest that program-specific language demands are not static across program years but change over time. These findings have implications for language proficiency requirements for university admission as well as post-admission support programming.

Our study sought to understand EAL students' perspectives on the extent to which academic English language tests used for university admission represent target language demands in specific programs of study. Our results suggest that both EAL students and faculty members may have undue confidence about test scores and their ability to predict academic success, resulting in tensions regarding language preparedness for EAL students and faculty members. To avoid these tensions, a better understanding of the relationship between the constructs measured by English language tests and the language skills required in academic work is needed. Previous research has called for better language test score interpretation (McDowell and Merrylees, 1998; Rea-Dickins et al., 2007; Baker et al., 2014) and the results of this study add the perspectives of EAL students and faculty members. EAL students in this study reported that despite achieving a higher score on the language test after repeated attempts, they felt their language skill had not improved, and they still reported challenges with language demands in their program of study. This result suggests that due to practice effects, students are being admitted with scores above their actual English proficiency level and have not yet achieved the threshold of language required for academic work. This finding aligns with previous studies that point out practice effects inflate test scores (Hu and Trenkic, 2021; Trenkic and Hu, 2021).

EAL students in this study also reported that they were surprised how difficult both oral and written communication was for them despite meeting the admission criteria. Research has shown that test scores for productive skills (i.e., speaking, writing) are more strongly correlated with first-year grade point average than scores on receptive skills (i.e., reading, listening) (Ginther and Yan, 2018). Other research has shown that students who have a wide discrepancy in their productive and receptive scores do not perform as well academically (Bridgeman et al., 2016). This research suggests that productive skills are important for student academic success, and our results call for careful attention to the selection of cut scores for productive skills for admission as well as tailored support for students in these skill areas post admission.

This study also sought to understand the challenges with language demands that EAL students and faculty members identify EAL students have. EAL students and faculty members reported that EAL students had concerning challenges with academic oral communication and critical reading skills. Our

domain analysis findings confirmed that these skills were required in academic work. These findings are important as they contribute to the understanding of what language skills are required across and within programs and show the limitations of admission criteria as measured on English language tests. Previous studies have suggested that constructs measured by English language tests may not represent the full range of language demands required in academic work. For example, while Brooks and Swain (2014) found an overlap between constructs on the TOEFL iBT and in real-life academic speaking contexts, findings also suggested lack of overlap with the extrapolation inference argument on the test. In another study, Moore et al. (2012) investigated the suitability of items on the reading section of the IELTS test to the requirements of real-life reading tasks; findings suggested the test lacked items that were more interpretive and global (e.g., extract meaning from multiple sources), consistent with our findings of the current study. Since the students who had satisfied admission language criteria were still reporting challenges with language, the results suggest a discrepancy between the skills measured by the language tests used for admission and actual language demands in university settings. Furthermore, these results suggest that post-admission support needs to be developed to address these critical gaps. More studies could contribute to the understanding of the relationship between admission criteria and actual language demands, and Figure 2 suggests possible areas of investigation. With deepened understanding of admission criteria as represented in English language tests and program-specific language demands, universities can better inform incoming students of language demands in pre-arrival programming and plan post-admission support that addresses specific program language demands.

A theme under the research question related to student challenges with language demands was student struggle with cultural background knowledge embedded in learning materials and instructions. Previous research suggests international students face additional burdens due to loss of social networks, discrimination, acculturation, language challenges, and a lack of internationalization in the curriculum (da Silva and Ravindran, 2016; Guo and Guo, 2017; Sohn and Spiliotopoulos, 2021) that privileges Euro-centric perspectives (Guo and Guo, 2017). Our results suggest that both EAL students and faculty members identify cultural content as a source of tension for EAL students. Considering the large number of EAL students admitted to English-medium universities to meet university goals of internationalization and globalization, we recommend that universities address questions of equitable curriculum and student fairness.

Previous research on university language requirements has tended to focus on preparedness for first-year study (Flowerdew and Miller, 1995; Mulligan and Kirkpatrick, 2000; Mendelsohn, 2002). A novel aspect of our results suggests that university academic work changes from more

independent academic work in the early years of study to more group-based learning tasks in the upper years, with expectations of highly developed communication skills for real-world interaction. This change in the demands of academic work suggests language preparedness for first-year study is not sufficient for upper-year students and that support for student language development needs to change as academic language demands become more complex and challenging over time. While most students in the study reported that language challenges lessened in their third and fourth years, faculty members reported they noticed students who were still struggling with language skills in the upper years suggesting that some students were still lacking important language skills key to academic success. While students in the focus groups seemed largely successful in meeting these language needs, future studies could investigate the behavior of students who were not successful in meeting these language needs.

Our study investigated how EAL students and faculty members respond to EAL students' challenges with language demands. Some students turn to co-curricular support to overcome language challenges, and our results suggest that some co-curricular support may be problematic as students report a lack of disciplinary focus and limited access. This situation seems to run counter to current literature, which emphasizes a more disciplinary focus to language support provided at the course level (Hyland, 2002; Andrade, 2006; Moore et al., 2012; Anderson, 2015; Pilcher and Richards, 2017). Our results also show that faculty member support of EAL students is varied and independent, a finding that aligns with other studies (Trice, 2003; Gallagher and Haan, 2018) and suggests a lack of consistency and fairness for students. To provide consistent, positive student experience and reduce extra burdens placed on faculty members, we recommend that faculty members be supported by better program policies regarding EAL student support. As reported in the literature, EAL student support that involves collaboration between applied linguists and disciplinary instructors improves EAL student experience, reduces the burden on faculty members of independent support provision (Hyatt and Brooks, 2009; Anderson, 2015), and results in positive interdisciplinary collaborations (Zappa-Hollman, 2018). Our study results suggest that while some faculty members are independently providing discipline-specific support, higher-level coordination is needed to ensure fairness and consistency in student experience.

One limitation of the present study is related to self-selection bias. Most students in our upper-year student focus groups reported that language and adjustment challenges lessened as they entered their upper years. This finding does not align with the Roessingh and Douglas (2012) study where quantitative measures of EAL student academic performance such as GPA and academic standing were used; their results suggested that

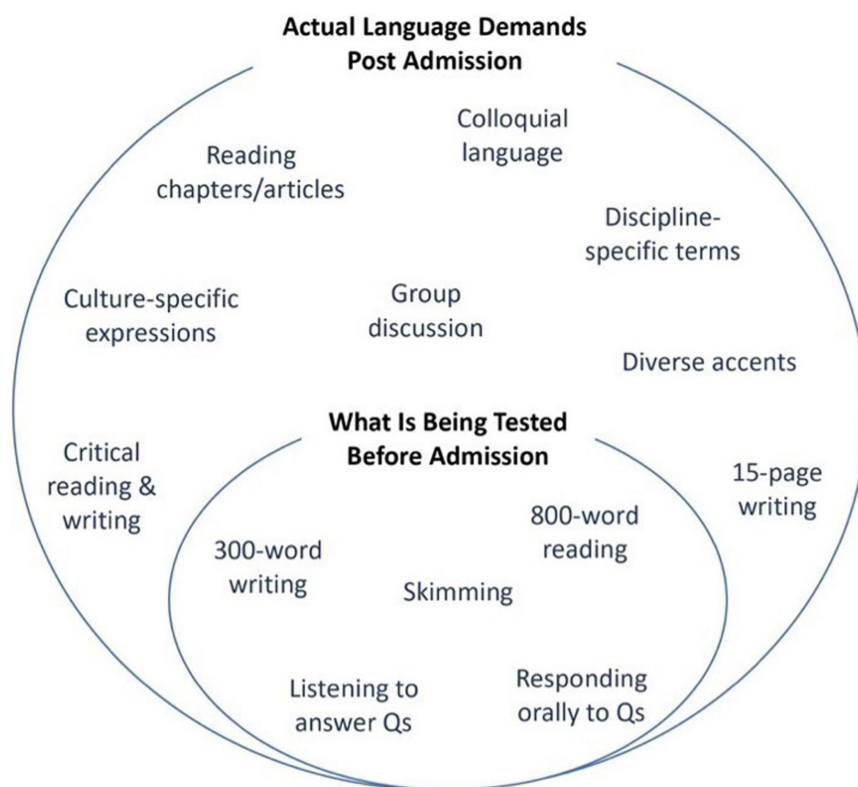


FIGURE 2
University language demands and language tested.

EAL students did not perform well on these measures against students who spoke English as a first language. Students who chose to participate in our focus groups may be strong academic performers and may not represent the academic behavior of all EAL students. As well, in a study conducted by [Trenkic and Warmington \(2019\)](#), results suggested minimal language gains over an academic year, which is a finding that points out that the gap between English as a first language speakers and EAL students does not easily narrow as students move through their program. It is also possible that students in the focus group may have been hesitant to report challenges in front of their peers and the researchers. For a fuller picture of EAL student language behavior, future studies could investigate the experiences of a more diverse performing group of EAL students.

Another methodological limitation is that the generalizability of the reading skill questionnaire results is limited due to the small sample size and, thus, further studies with larger sample sizes would ensure the replicability of our results. Also, the courses, programs, and experiences of university support we examined were limited by study participants and do not necessarily represent the full range of courses, programs, and support offered at this university. Future studies that examine language needs in a wider range of courses and the impact of a wider range of co-curricular support models

would deepen understanding of needs and contribute to the development of a systemic support framework for students.

Conclusion

The study findings suggest that even after meeting the English language requirement for university admission through English language tests, EAL students experience concerning challenges with oral language demands in and out of classrooms with faculty members and other students and have challenges performing critical reading and writing tasks. Some of these challenges are related to unfamiliarity with discipline-specific vocabulary and a lack of cultural background knowledge. In general, critical reading and writing tasks that represent the complexity of university academic work, cultural language, and discipline-specific language are elements of language that are not targeted in most English language tests. As a result of language challenges, EAL students avoid courses and learning tasks within courses that they perceive as challenging, a behavior which ultimately limits their engagement with their program of study. EAL students are surprised at these challenges and feel a lack of effective support from the university in overcoming them. Faculty member perspectives tend to

corroborate student perspectives, but variation exists among faculty member responses to student challenges, suggesting students receive varying degree of support in their courses.

If universities continue to admit large numbers of EAL students using the current admission criteria without adequate support, critical questions need to be addressed. Is the language level with which students were admitted sufficient for academic success? How can we identify students most at risk post admission? What types of language support programs can best support these students? Answers to these questions are critical for universities so they can inform EAL students at admission of language expectations and develop post-admission support for EAL students that recognizes continuous language learning within specific disciplinary contexts.

Data availability statement

The data analyzed in this study was obtained from a third party and permission to access datasets is required. Requests to access these datasets should be directed to BR, bruce.russell@utoronto.ca.

Ethics statement

The studies involving human participants were reviewed and approved by the Research Oversight and Compliance Office – Human Research Ethics Program, University of Toronto. Protocol Reference #34352. The patients/participants provided their written informed consent to participate in this study.

Author contributions

BR was responsible for writing all drafts of the manuscript, coordinating the writing of the co-authors, and leading the submission. CB analyzed the data from the document analysis (one of the data sources) and wrote about this in the results

section, contributed to the figure, and reviewed all drafts of the manuscript. HK analyzed the Academic Reading Questionnaire data and wrote about this analysis in the results section, contributed to the figure, and reviewed all drafts of the manuscript. EJ was the authors' Ph.D. supervisor and provided extensive feedback to the other authors on all sections of the manuscript. All authors contributed to the article and approved the submitted version.

Funding

This research was funded by the IELTS Partners: British Council, Cambridge Assessment English and IDP: IELTS Australia. The grant was awarded in 2016.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/feduc.2022.934692/full#supplementary-material>

References

- Anderson, T. (2015). Seeking internationalization: the state of Canadian higher education. *Can. J. High. Educ.* 45, 166–187.
- Andrade, M. S. (2006). International students in English-speaking universities: adjustment factors. *J. Res. Int. Educ.* 5, 131–154. doi: 10.1177/1475240906065589
- Association of Universities and Colleges of Canada (2014). *Canada's Universities in the World AUCC Internationalization Survey*. Available online at: <https://www.univcan.ca/wp-content/uploads/2015/07/internationalization-survey-2014.pdf> [accessed on July 25, 2022].
- Baker, B. A., Tsushima, R., and Wang, S. (2014). Investigating language assessment literacy: collaboration between assessment specialists and Canadian university admissions officers. *Lang. Learn. High. Educ.* 4, 137–157. doi: 10.1515/cercles-2014-0009
- Banerjee, J. V. (2003). *Interpreting and using Proficiency Test Scores*. Doctoral Dissertation. Lancaster, PA: Lancaster University.
- Bridgeman, B., Cho, Y., and DiPietro, S. (2016). Predicting grades from an English language assessment: the importance of peeling the onion. *Lang. Test.* 33, 307–318.

- Brooks, L., and Swain, M. (2014). Contextualizing performances: comparing performances during TOEFL iBT and real-life academic speaking activities. *Lang. Assess. Q.* 11, 353–373. doi: 10.1080/15434303.2014.947532
- Bruce, E., and Hamp-Lyons, L. (2015). Opposing tensions of local and international standards for EAP writing programmes: Who are we assessing for? *J. Engl. Acad. Purposes* 18, 64–77. doi: 10.1016/j.jeap.2015.03.003
- Cazden, C. B. (1988). *Classroom Discourse: The Language of Teaching and Learning*. Portsmouth, NH: Heinemann.
- Chapelle, C. A., Enright, M. K., and Jamieson, J. M. (Eds.). (2008). *Building a Validity Argument for the Test of English as a Foreign Language*. London: Routledge.
- Coleman, D., Starfield, S., and Hagan, A. (2003). The attitudes of IELTS stakeholders: student and staff perceptions of IELTS in Australian, UK and Chinese tertiary institutions. *IELTS Res. Rep.* 1, 161–235.
- Cudmore, G. (2005). Globalization, internationalization, and the recruitment of international students in higher education, and in the Ontario colleges of applied arts and technology. *Can. J. High. Educ.* 35, 37–60.
- da Silva, T. L., and Ravindran, A. V. (2016). Contributors to academic failure in postsecondary education: a review and a Canadian context. *Int. J. Non Commun. Dis.* 1, 9–17.
- Deakin, G. R. (1997). IELTS in context: issues in EAP for overseas students. *EA J.* 15, 7–28.
- Eddey, P. H., and Baumann, C. (2011). Language proficiency and academic achievement in postgraduate business degrees. *Int. Educ. J.* 10, 34–46.
- Fang, Z., and Schleppegrell, M. J. (2008). *Reading in Secondary Content Areas*. Ann Arbor, MI: University of Michigan Press.
- Ferris, D., and Tagg, T. (1996). Academic listening/speaking tasks for ESL students: problems, suggestions, and implications. *TESOL Q.* 30, 297–320. doi: 10.2307/3588145
- Fitzgerald, J. (1995). English-as-a-second-language learners' cognitive reading processes: a review of research in the United States. *Rev. Educ. Res.* 65, 145–190. doi: 10.2307/1170711
- Flowerdew, J., and Miller, L. (1995). On the notion of culture in L2 lectures. *TESOL Q.* 29, 345–373. doi: 10.2307/3587628
- Fox, J. (2005). Rethinking second language admission requirements: problems with language-residency criteria and the need for language assessment and support. *Lang. Assess. Q.* 2, 85–115. doi: 10.1207/s15434311laq0202_1
- Gallagher, C., and Haan, J. (2018). University faculty beliefs about emergent multilinguals and linguistically responsive instruction. *TESOL Q.* 52, 304–330. doi: 10.1002/tesq.399
- Ginther, A., and Yan, X. (2018). Interpreting the relationships between TOEFL iBT scores and GPA: language proficiency, policy, and profiles. *Lang. Test.* 35, 271–295.
- Greene, J. C. (2008). Is mixed methods social inquiry a distinctive methodology? *J. Mixed Methods Res.* 2, 7–22. doi: 10.1177/1558689807309969
- Guo, S., and Chase, M. (2011). Internationalisation of higher education: integrating international students into Canadian academic environment. *Teach. High. Educ.* 16, 305–318. doi: 10.1080/13562517.2010.546524
- Guo, Y., and Guo, S. (2017). Internationalization of Canadian higher education: discrepancies between policies and international student experiences. *Stud. High. Educ.* 42, 851–868. doi: 10.1080/03075079.2017.1293874
- Hechanova-Alampay, R., Beehr, T., Christiansen, N., and Van Horn, R. (2002). Adjustment and strain among domestic and international student sojourners: a longitudinal study. *Schl. Psychol. Int.* 23, 458–474. doi: 10.1177/0143034302234007
- Hu, R., and Trenkic, D. (2021). The effects of coaching and repeated test-taking on Chinese candidates' IELTS scores, their English proficiency, and subsequent academic achievement. *Int. J. Biling. Educ. Biling.* 24, 1486–1501. doi: 10.1080/13670050.2019.1691498
- Hyatt, D., and Brooks, G. (2009). Investigating stakeholders' perceptions of IELTS as an entry requirement for higher education in the UK. *IELTS Res. Rep.* 10, 3–50.
- Hyland, K. (2002). Genre: language, context, and literacy. *Annu. Rev. Appl. Linguist.* 22, 113–135. doi: 10.1017/S0267190502000065
- Hyland, K. (2004). *Disciplinary Discourses: Social Interactions in Academic Writing (Michigan classics ed.)*. Ann Arbor, MI: University of Michigan Press.
- Hyland, K., and Hamp-Lyons, L. (2002). EAP: issues and directions. *J. Engl. Acad. Purposes* 1, 1–12. doi: 10.1016/S1475-1585(02)00002-4
- IELTS (2019). *Guide for Educational Institutions, Governments, Professional Bodies and Commercial Organisations*. Melbourne, VIC: IELTS Australia.
- Jacob, E., and Greggo, J. (2001). Using counselor training and collaborative programming strategies in working with international students. *J. Multicult. Couns. Dev.* 29, 73–88. doi: 10.1002/j.2161-1912.2001.tb00504.x
- Jang, E. E., Kim, H., Vincett, M., Barron, C., and Russell, B. (2019). *Improving IELTS Reading Test Score Interpretations and Utilisation Through Cognitive Diagnosis Model-Based Skill Profiling*. London: British Council.
- Johnson, R. C., and Tweedie, M. G. (2021). “IELTS-out/TOEFL-out”: Is the end of general English for academic purposes near? Tertiary student achievement across standardized tests and general EAP. *Interchange* 52, 101–113.
- Knight, J. (2008). The role of cross-border education in the debate on education as a public good and private commodity. *J. Asian Public Policy* 1, 174–187. doi: 10.1080/17516230802094478
- Kunin, R. (2017). *Economic Impact of International Education in Canada – 2017 update*. Global Affairs Canada. Available online at: <https://www.international.gc.ca/education/report-rapport/impact-2017/index.aspx?lang=eng> [accessed on July 25, 2022]
- Li, R., and Kaye, M. (1998). Understanding overseas students' concerns and problems. *J. High. Educ. Policy Manage.* 20, 41–50. doi: 10.1080/1360080980200105
- Lloyd, N. (2003). *A Research Study Exploring the Attitudes and Experiences of International Students Enrolled in the Faculty of Engineering, Computing and Mathematics at the University of Western Australia*. Perth: University of Western Australia.
- MacDonald, J. (2019). Sitting at 6.5: problematizing IELTS and admission to Canadian Universities. *TESL Can. J.* 36, 160–171. doi: 10.18806/tesl.v36i1.1308
- Mathison, S. (1988). Why triangulate? *Educ. Res.* 17, 13–17. doi: 10.3102/0013189X017002013
- McDowell, C., and Merrylees, B. (1998). Survey of receiving institutions' use and attitude to IELTS. *IELTS Res. Rep.* 1, 115–139.
- McNamara, T. F. (1996). *Measuring Second Language Performance*. London: Longman Publishing Group
- Mendelsohn, D. (2002). The lecture buddy project: an experiment in EAP listening comprehension. *TESL Can. J.* 20, 64–73.
- Moje, E., Dillon, D., and O'Brien, D. (2000). Re-examining roles of learner, text, and context in secondary literacy. *J. Educ. Res.* 93, 165–180. doi: 10.1080/00220670009598705
- Moore, T., Morton, J., and Price, S. (2012). Construct validity in the IELTS Academic Reading test: a comparison of reading requirements in IELTS test items and in university study. *IELTS Res. Rep.* 11, 1–86.
- Morrison, J., Merrick, B., Higgs, S., and Le Métails, J. (2005). Researching the performance of international students in the UK. *Stud. High. Educ.* 30, 327–337. doi: 10.1080/03075070500095762
- Mulligan, D., and Kirkpatrick, A. (2000). How much do they understand: lectures, students and comprehension. *High. Educ. Res. Dev.* 19, 311–335.
- Murray, N. (2016). An academic literacies argument for decentralizing EAP provision. *ELT J.* 70, 435–443. doi: 10.1093/elt/ccw030
- Oliver, R., Vanderford, S., and Grote, E. (2012). Evidence of English language proficiency and academic achievement of non-English-speaking background students. *High. Educ. Res. Dev.* 31, 541–555. doi: 10.1080/07294360.2011.653958
- O'Loughlin, K. (2008). The use of IELTS for university selection in Australia: a case study. *IELTS Res. Rep.* 8, 3–98.
- Parks, S., and Raymond, P. (2004). Strategy use by non-native English-speaking students in an MBA program: not business as usual. *Modern Lang. J.* 88, 374–391.
- Pilcher, N., and Richards, K. (2017). Challenging the power invested in the International English Language Testing System (IELTS): why determining “English” preparedness needs to be undertaken within the subject context. *Power Educ.* 9, 3–17. doi: 10.1177/1757743817691995
- Planning and Budget Office (2017–2018). *Enrolment Report 2017–18*. Toronto, ON: University of Toronto.
- Pritchard, R., and Skinner, B. (2002). Cross-cultural partnerships between home and international students. *J. Stud. Int. Educ.* 6, 323–353. doi: 10.1177/102831502237639
- Rajapaksa, S., and Dundes, L. (2002). It's a long way home: international student adjustment to living in the United States. *J. Coll. Stud. Retent.* 4, 15–28. doi: 10.2190/5HCY-U2Q9-KVGL-8M3K
- Ramsay, S., Barker, M., and Jones, E. (1999). Academic adjustment and learning processes: a comparison of international and local students in first-year university. *High. Educ. Res. Dev.* 18, 129–144. doi: 10.1080/0729436990180110

- Rea-Dickins, P., Kiely, R., and Yu, G. (2007). Student identity, learning and progression: the affective and academic impact of IELTS on 'successful' candidates. *IELTS Res. Rep.* 7, 2–78.
- Robertson, M., Line, M., Jones, S., and Thomas, S. (2000). International students, learning environments and perceptions: a case study using the Delphi technique. *High. Educ. Res. Dev.* 19, 89–102. doi: 10.1080/07294360050020499
- Roessingh, H., and Douglas, S. R. (2012). Educational outcomes of English language learners at university. *Can. J. High. Educ.* 42, 80–97.
- Rosenfeld, M., Oltman, P., and Sheppard, K. (2003). Investigating the validity of TOEFL: a feasibility study using content and criterion-related strategies. *ETS Res. Rep. Series* 2003, 1–85. doi: 10.1002/j.2333-8504.2003.tb01910.x
- Sheridan, V. (2011). A holistic approach to international students, institutional habitus and academic literacies in an Irish third level institution. *High. Educ.* 62, 129–140. doi: 10.1007/s10734-010-9370-2
- Sohn, B. G., and Spiliotopoulos, V. (2021). *Scaffolding Peer Interaction within a Language-and-Content Integrated Business Curriculum: Meaningful Teaching Interaction at the Internationalised University: Moving From Research to Impact*. London: Routledge.
- StataCorp (2017). *Stata Statistical Software: Release 15*. College Station, TX: StataCorp LLC.
- Statistics Canada (2021). *Table 37-10-0184-01 Postsecondary international student enrolments, by country of citizenship*. Ottawa, ON: Statistics Canada, doi: 10.25318/3710018401-eng
- Steffenson, M. S., and Joag-Dev, C. (1979). A cross-cultural perspective on reading comprehension. *Read. Res. Q.* 15, 84–93.
- Teddle, C., and Tashakkori, A. (2003). "Major issues and controversies in the use of mixed methods in the social and behavioral sciences," in *Handbook of Mixed Methods in Social and Behavioral Research*, eds A. Tashakkori and C. Teddle (Thousand Oaks, CA: SAGE Publishing), 3–50.
- Thomas, D. R. (2006). A general inductive approach for analyzing qualitative evaluation data. *Am. J. Eval.* 27, 237–246. doi: 10.1177/1098214005283748
- Trenkic, D., and Hu, R. (2021). Teaching to the test: the effects of coaching on English-proficiency scores for university entry. *J. Eur. Second Lang. Associat.* 5, 1–15. doi: 10.22599/jesla.74
- Trenkic, D., and Warmington, M. (2019). Language and literacy skills of home and international university students: How different are they, and does it matter? *Bilingualism* 22, 349–365. doi: 10.1017/S136672891700075X
- Trice, A. (2003). Faculty perceptions of graduate international students: the benefits and challenges. *J. Stud. Int. Educ.* 7, 379–403. doi: 10.1177/1028315303257120
- Weir, C., Hawkey, R., Green, A., and Devi, S. (2012). The cognitive processes underlying the academic reading construct as measured by IELTS. *IELTS Res. Rep.* 9, 157–189.
- Weir, C., and Urquhart, A. (1998). *Reading in a Second Language: Process, Product and Practice*. London: Longman.
- Zappa-Hollman, S. (2018). Collaborations between language and content university instructors: factors and indicators of positive partnerships. *Int. J. Biling. Educ.* 21, 591–606. doi: 10.1080/13670050.2018.1491946
- Zheng, Y., and De Jong, J. H. A. L. (2011). *Research note: Establishing Construct and Concurrent Validity of Pearson Test of English Academic*. London: Pearson Education Ltd.



OPEN ACCESS

EDITED BY

Ana Luísa Rodrigues,
University of Lisbon, Portugal

REVIEWED BY

Sebastian Bode,
Ulm University Medical Center,
Germany
Melissa Christine Davis,
Edith Cowan University, Australia

*CORRESPONDENCE

Joana Berger-Estilita
joanamberger@gmail.com

†These authors share last authorship

SPECIALTY SECTION

This article was submitted to
Higher Education,
a section of the journal
Frontiers in Education

RECEIVED 26 June 2022

ACCEPTED 26 July 2022

PUBLISHED 16 August 2022

CITATION

Berger-Estilita J, Merlo S,
Guttormsen S, Fuchs A, Greif R and
Chiang H (2022) Pre-licensure medical
students' knowledge and views on
interprofessional learning: A qualitative
concept analysis based on real-world
data.
Front. Educ. 7:978796.
doi: 10.3389/feduc.2022.978796

COPYRIGHT

© 2022 Berger-Estilita, Merlo,
Guttormsen, Fuchs, Greif and Chiang.
This is an open-access article
distributed under the terms of the
[Creative Commons Attribution License
\(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use, distribution or
reproduction in other forums is
permitted, provided the original
author(s) and the copyright owner(s)
are credited and that the original
publication in this journal is cited, in
accordance with accepted academic
practice. No use, distribution or
reproduction is permitted which does
not comply with these terms.

Pre-licensure medical students' knowledge and views on interprofessional learning: A qualitative concept analysis based on real-world data

Joana Berger-Estilita^{1,2*}, Sofia Merlo³, Sissel Guttormsen¹,
Alexander Fuchs⁴, Robert Greif^{4,5†} and Hsin Chiang^{4†}

¹Institute for Medical Education, University of Bern, Bern, Switzerland, ²Faculty of Medicine, Centre for Health Technology and Services Research, Porto, Portugal, ³Department of Perioperative Medicine, Kantonsspital Olten, Olten, Switzerland, ⁴Department of Anaesthesiology and Pain Medicine, Inselspital, Bern University Hospital, University of Bern, Bern, Switzerland, ⁵School of Medicine, Sigmund Freud University Vienna, Vienna, Austria

Background: The several definitions of Interprofessional Education (IPE) allow for different interpretations and interchangeable terms. This study aims to determine the characteristics and attributes of the definition of IPE.

Materials and methods: In November 2019, 31 medical students (64.5% female) from a single institution took part in nine semi-structured interviews. We created a deductive three-level code system followed by an inductive code system based on several known IPE definitions. We extracted the main entities of the concept of IPE according to both code systems to create a framework. We used MaxQDA software for qualitative analysis. Verification of codes and categories was attained through sequential peer-debrief.

Results: Participants correctly named the WHO's definition of IPE, and outlined its four main dimensions according to the Interprofessional Education Collaborative report. We found new IPE attributes and demonstrated the weight of communication and role recognition. Two-thirds of medical students mentioned IPE activities that we classified as a contrary model (without collaboration or patient-centeredness) and a minimum weight was given to the importance of patient-centeredness.

Conclusion: Medical students' understanding of the concept of IPE is coherent. We deepened the understanding of previously identified definitions

of IPE, and we identified new attributes of the concept. Finally, we added “well-being” as a component of interprofessionalism.

Clinical trial registration: [<https://www.isrctn.com/>], identifier [ISRCTN41715934].

KEYWORDS

interprofessional education, interprofessional learning, healthcare professionals, conceptual framework, qualitative methods

Introduction

Interprofessional Education (IPE) is fundamental to the excellent functioning of healthcare systems (Lapkin et al., 2013). It enhances attitudes toward collaboration and teamwork during medical formation, leading to improved attitudes toward interprofessionalism upon graduation and better patient outcomes (Reeves et al., 2016). Its implementation in medical curricula is strongly recommended (Bandali et al., 2011).

Literature shows that medical students display very positive attitudes toward IPE (Ruebling et al., 2014; Chua et al., 2015; Luderer et al., 2017; Berger-Estilita et al., 2020a). Medical students in pre-clinical years have more positive attitudes, when compared to students in later stages of their training (Kozmenko et al., 2017; de Oliveira et al., 2018; Berger-Estilita et al., 2020a). Factors contributing to this decline in interprofessional attitudes include being more experienced in the healthcare field (McFadyen et al., 2010), previous IPE contact (Anderson and Thorpe, 2008), previous less positive experiences in IPE (Coster et al., 2008; Hudson et al., 2016; Visser et al., 2017) and having parents working in healthcare (Cooper et al., 2005).

The World Health Organization's Framework for Action in Interprofessional Education and Collaborative Practice (WHO, 2010) defines IPE as an activity of “students from two or more professions learn about, from, and with each other to enable effective collaboration and improve the quality of care.” However, a closer look at the literature reveals several different interpretations and interchangeable terms (Olenick et al., 2010):

- According to the Centre for Advancement of Interprofessional Education (CAIPE, 2021), IPE involves “educators and learners from two or more health professions and their foundational disciplines, who jointly create and foster a collaborative learning environment.”
- The Interprofessional Education for Collaborative Patient-Centred Practice (Wener et al., 2009) defines IPE as “learning together to promote collaboration” and further depicts three components in IPE: socialising healthcare professionals working together, developing

mutual understanding and respect for various disciplines and imparting collaborative practice competencies.

- The Canadian Interprofessional Health Collaborative (CIHC, 2010) defines IPE as “occurring when students learn with, from and about one another” adding that IPE takes place when “healthcare professionals learn collaboratively within and across disciplines to acquire knowledge, skills and values needed for working in teams” (CIHC, 2010).

In 2009, six health professions from educational associations (osteopathic and allopathic medicine, nursing, pharmacy dentistry, and public health) in the United States created a collaborative to promote IPE learning interventions and established a document disclosing the core competencies for collaborative practice. This document, known as the Interprofessional Education Collaborative (IPEC) report (IPEC, 2011, 2016), aims to prepare the future healthcare workforce for enhanced team-based patient care. Over time, the IPEC report has gained worldwide acceptance as a core document to guide curriculum design within healthcare teaching.

The IPEC report sets four different dimensions of expert panel recommendations on interprofessional core competencies, which are aligned with the WHO statements: (1) ethics and values, (2) roles and responsibilities, (3) interprofessional communication, and (4) teamwork. This report provides a framework for high-quality, integrated patient care within each country's healthcare system.

Although the abovementioned definitions have overlapping terminologies and include aspects of interprofessionalism, collaboration, shared values, and socialisation, an apparent uniformity of the definition of IPE is lacking, which might contribute to the misunderstanding of IPE. The correct understanding of the concept of IPE has implications for the adequate implementation of IPE activities in healthcare personnel formation curricula and may affect students' attitudes toward collaborative practice (Khalili et al., 2013). Therefore, the determination of a clear operational definition of IPE is the base for developing a more effective IPE design, delivery, and measurement.

This study aims to determine the characteristics and attributes of the definition of IPE and to distinguish between the defining and incorrect attributes of IPE in a medical student population. Moreover, we aim to develop a conceptual framework of IPE in a microcontext and determine the weight of each component of the IPE definition.

Materials and methods

Ethical considerations

The participants gave written informed consent to the interviews and the Bern Cantonal Ethics Committee (Req-2019-00743, 23.08.2019) waived the need for ethics approval. We used ID numbers to code students and requested no identifying data. All procedures from this investigation followed the Helsinki Declaration. This study was registered with the number ISRCTN41715934, first registration 12/12/2019.

Participants

The Medical Faculty of the University of Bern in Switzerland offers a 6-year curriculum of studying human medicine and features a 2-day optional rotation in interprofessional care. All medical students actively enrolled in the Faculty of Medicine of the University of Bern, Switzerland, during the academic year 2019/2020 were eligible for inclusion in the study ($N = 2,089$ students).

Study design

We performed a qualitative methodology approach to promote the comprehensiveness, understanding and validity of a proposed framework on the concept of IPE (**Figure 1**). Our framework was developed using the conceptual framework analysis technique from [Miles et al. \(2014\)](#). He defined a conceptual framework as “a visual or written product that explains, either graphically or in narrative form, the main objectives to be studied and the presumed relationships among them” ([Miles et al., 2014](#)). At the heart of this methodology lies an interpretative approach to social reality, offering understanding of the concept, instead of establishing causal relationships intended to provide outcomes.

This is a secondary qualitative analysis of a mixed-methods quantitative-qualitative design study based on a sequential explanatory model ([Berger-Estilita et al., 2020a](#)). Six hundred and eighty-three medical students from all 6 years of medical studies at the University of Bern, Switzerland replied to an online survey about attitudes toward interprofessional learning using a validated interprofessional attitudes scale

([Pedersen et al., 2020](#)). After completion of the online survey, students could tick a box signalling their availability to participate in semi-structured group interviews. Agreeing students were contacted to take part in nine semi-structured 1-h interviews, according to their availability. Thirty-one medical students took part, which focussed on their experience in interprofessional learning and the possible impact such learning might have on their own professional development. Students were asked about their characteristics (e.g., age, year of studies) and their understanding of IPE, according to a previously defined interview guide. The sessions were audio-recorded. HC transcribed it in intelligent verbatim format, and JB-E verified the transcripts' accuracy. The summaries of each interview were sent to all participants for content verification and approval (member-checking) ([Morse, 2015](#)). Further details of the methodology can be found elsewhere ([Berger-Estilita et al., 2020a](#)).

We used data from the semi-structured interviews to investigate medical students' perceptions of the definition of IPE. The interviewers (JB-E and HC) acted solely as facilitators, encouraging contributions from all participants and validating different views. The study was conducted in German. The analysis presented in this paper is an independent, *post-hoc* sub-study of the published group interview dataset ([Berger-Estilita et al., 2020a](#)).

Setting

All interviews took place at the Department of Anaesthesiology and Pain Therapy, Inselspital, Bern, Switzerland in November 2019.

Development of the interview guide

We used a known protocol ([Castillo-Montoya, 2016](#)) to develop a semi-structured interview guide (**Supplementary Data Sheet 1**). We first ensured that interview questions were aligned with our research questions; we then constructed an inquiry-based conversation; we asked for external feedback on interview protocols; and we piloted the interview guide amongst peers. The question route was developed to explore in-depth knowledge of the concept of IPE, its advantages and disadvantages, and the optimal time for introducing IPE in the medical curriculum.

Analysis

Development of the coding scheme for framework development

Before transcript analysis, HC and JB-E deductively created a basic category system based on the existing definitions

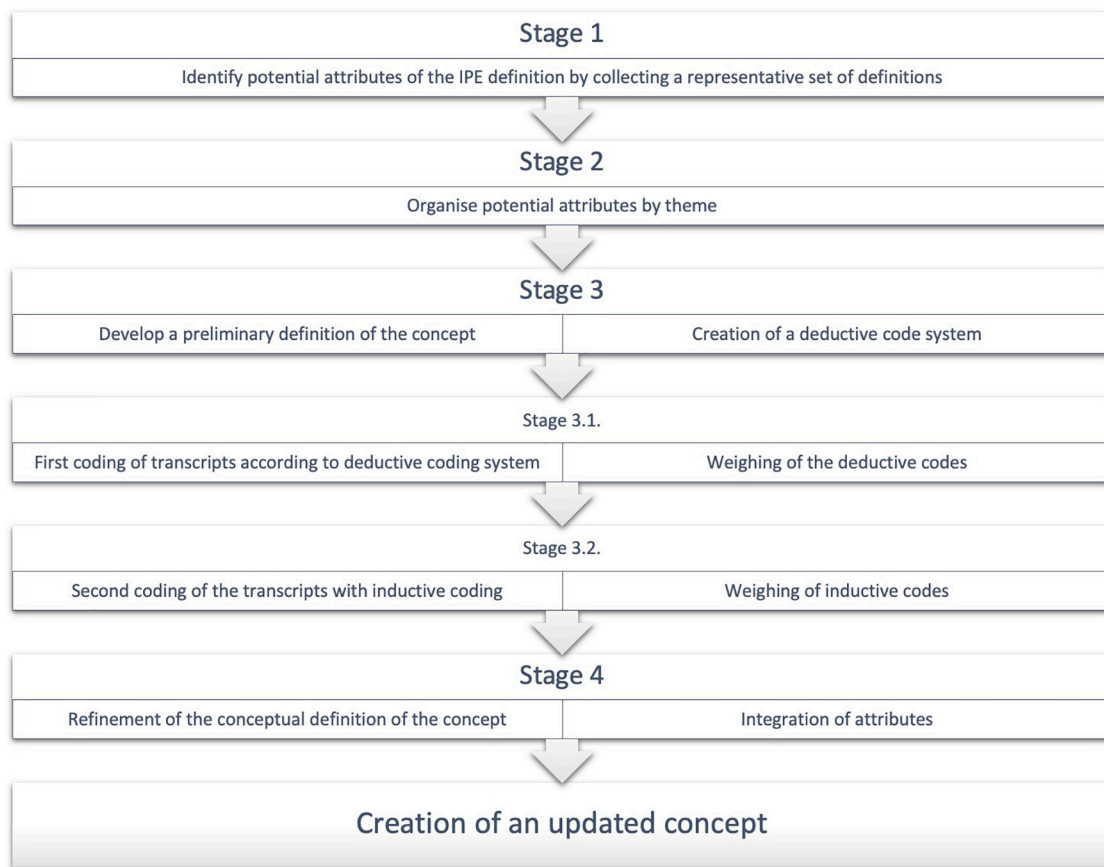


FIGURE 1

Study flowchart. Stepwise approach to the creation of an updated concept. IPE, interprofessional education.

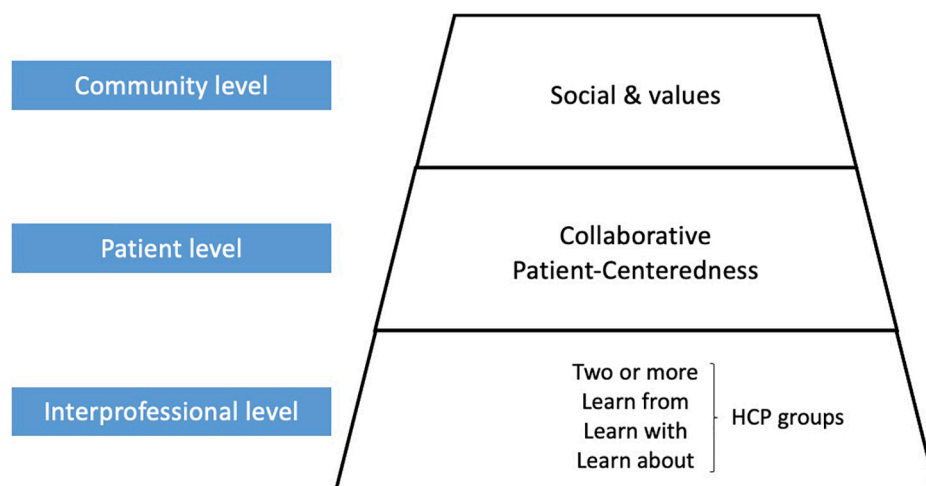


FIGURE 2

Three-level interprofessional education (IPE) framework. Deductively created three-level IPE framework, according to an increased concept complexity. HCP, healthcare professionals.

on IPE using the Podsakoff recommendations (Podsakoff et al., 2016). First, we identified all attributes from the abovementioned five representative definitions of IPE. Then, we organized those attributes by themes and sorted them in a hierarchy of increasingly complex attributes, where each attribute subsumes elements of the preceding lower level. Thus, conceptions in the category of attributes can include elements of the level below (Figure 2). We determined three levels, according to the increased complexity of the concept:

- Level One—"Interprofessional": attributes related to work with individuals of other professions.
- Level Two—"Teamwork": attributes related to knowledge of different roles, related to communication with patients, families and other health care professionals in a responsible manner, to attributes supporting a team approach and to building team dynamics, and related to patient-centred care.
- Level Three—"Societal": attributes related to working to maintain a climate of mutual respect, shared values/ethics and social interactions.

Finally, we developed a preliminary version of the concept and used this category system to code all nine interviews with the MaxQDA2020 version 18.2.0 software (Verbi, Berlin, Germany).

Two different researchers (HC, JB-E) independently coded the interviews. Difficulties and inaccuracies were noted and were discussed in consensus before deciding on the final coding system. Ambiguities and redundancies were discussed and eliminated by consensus or by consulting a third author (RG). We updated this deductively created coding system with the notes and memos generated during the transcription process (parallel memoing). This process was performed in a phased fashion. After coding three interviews independently, HC and JB-E verified agreement of the coding distribution and checked for saturation, before proceeding with the following three interviews.

The fourth stage of the Podsakoff et al. (2016) recommendations included a refinement of the conceptual definition by adding attributes explored by inductive coding. To comply with this step, JB-E, HC, and SM re-analysed transcripts using inductive thematic coding, which involved iteratively reading and rereading the data, grouping extracts into common themes and naming concepts. This coding ensured that the data generated were grounded in, or emergent from, the narratives of the interview participants. Data was processed according to the Miles et al. (2014) framework for conceptual data analysis. This included first data reduction—including segmenting, editing and summarising the data—followed by data display, and finally conclusion verification. We also

performed a qualitative "concept analysis" study according to Walker and Avant's methodology (Walker and Avant, 2005). We first determined a "standard" and "contrary" model of IPE according to Olenick et al.'s (2010) concept. We defined "standard" IPE activities as those describing groups of different professions' students participating in a learning activity where they collaborated in decision-making and developed plans of care, with a patient-centred focus. A "contrary" IPE activity would be any activity where, despite having participants from different professions, little or no evidence of collaboration or shared decision-making would be mentioned. We searched for examples of both models in the interviews. Additionally, we extracted code frequencies. During analysis, conceptual saturation was confirmed by the non-emergence of new codes or themes (Braun and Clarke, 2006). Relevant interview excerpts were selected to represent participants' perceptions relevant to the themes and explanations being constructed. We used a functionalist approach of creating equivalent translation structures (Resch and Enzenhofer, 2018) to translate direct quotations from the interviews into English. HC and SM (German-speaking) translated the citations from German to English with Google Translate. SeM (English-native speaker) performed changes to ensure that the reader could understand the target text.

Results

We interviewed students from all study years [Year 1: $n = 5$ (16%), Year 2: $n = 8$ (26%), Year 3: $n = 2$ (7%), Year 4: $n = 8$ (26%), Year 5: $n = 7$ (23%), Year 6: $n = 1$ (3%)]. There were 20 female students (64.5%). All 31 students mentioned previous interprofessional experiences (i.e., an IV cannulation workshop, a confidentiality seminar, nursing and clinical clerkships) during their studies, but only 6 (19%) took the optional 2-day rotation in interprofessional care.

Three main categories emerged from the semi-structured interviews: (1) attributes of IPE according to the three-level framework, (2) attributes of IPE according to the four dimensions of the IPEC report, (3) further attributes.

Attributes of interprofessional education according to the three-level framework

Students were aware of the intended meaning of IPE, as per WHO definition (2010). This description has been published elsewhere (Berger-Estilita et al., 2020a). The frequency and coverage of deductive codes according to the three-level framework is summarized in Table 1. Results stratified by year of studies can be found in Supplementary Table 1.

TABLE 1 Citation frequency.

Concept	Frequency (n = 386)
Interprofessional	161 (41.7)
Two or more	22 (13.7)
Learn from	28 (17.4)
Learn with	34 (21.1)
Learn about	77 (47.8)
Collaborative/Patient-centred	105 (27.2)
Collaborative	82 (78.1)
Patient-centred	23 (21.9)
Values/Social	120 (31.1)
Values	78 (65.0)
Social	42 (35.0)

Values are n (%).

Attributes of interprofessional education according to the four dimensions of the interprofessional education collaborative report

After being questioned, students could spontaneously give attributes of IPE concerning the four core competencies of the [IPEC \(2011\)](#) report.

Views on values/ethics for interprofessional practice

Participants underlined that IPE promoted mutual understanding and shared mental models, facilitating future interprofessional relationships. IPE is able to break down barriers and reduce prejudices. When learning together, participants accept that other healthcare professionals perform some skills better, and this fosters mutual respect and trust. Students mentioned that IPE enhances patient-centred care: by leading to greater work efficiency and potentiating a more positive working environment, patients may feel that healthcare professionals listen more attentively and have a more accurate overview of their problems.

Views on roles and responsibilities

Students mentioned that IPE improves the extent of knowledge of other healthcare students' roles, skills and abilities, and optimises cooperation while reducing misunderstandings. IPE makes one have a different perspective and be sensitive to how other healthcare professionals judge a situation. This clarifies the practical relevance of their work.

(...) one understands better what the different professional groups know and can do, which leads to fewer misunderstandings in everyday hospital life (Student 4, Interview 6).

Views on interprofessional communication

Interprofessional education benefits communication between healthcare students regardless of the course content. Communication promotes shared mental models, and can facilitate future interprofessional relationships and a smoother settling into clinical practice. Good communication benefits collaboration and leads to better patient care. It also embodies a patient-centred approach, with multi-way communication between the patient, nurse and doctor. All this increases satisfaction in the workplace.

The tendency is that you gain more communicative skills and have a more respectful attitude [towards others] (Student 1, Interview 1).

Views on teams and teamwork

Being conscious of what the other healthcare professions students learn leads to better cooperation and improves teamwork. IPE-experienced physicians will have a broader knowledge of available possibilities and delegate when appropriate, showing better attitudes toward collaboration. IPE reduces the effort to make teamwork efficient (facilitating interaction in hand-overs or rounds). This leads to easier integration in the workplace, enhances in-hospital social connections, and increases employee satisfaction.

[IPE leads to] efficiency. If you feel comfortable, the patients do too. It is also good that they see that working together works. Nothing is worse than everyone arguing around you (Student 4, Interview 3).

Other views

Interprofessional education can mimic a natural work environment, and students will learn clinically-relevant participants and problem-solving, making learning more motivating and purposeful. IPE also teaches how to behave in a professional context.

Cultivating interprofessionality leads to more organised and efficient teamwork and a better working atmosphere. This improves patient safety (teams make fewer mistakes) and employee well-being. More satisfied employees are less inclined to leave for other institutions. Students noted that this combination of a more stable workforce and increased productivity would lead to financial benefits ([Table 2](#)).

If nurses, doctors, physiotherapists and others involved in patient management (including secretaries) can work well together, there is a good working atmosphere. Therefore, people stay in the hospital. They are loyal to the employer (...). That saves money (Student 2, Interview 6).

TABLE 2 Subcategory other views elements and representative cites.

Subtheme with explanation	Representative cites (exemplary) from semi-structured interviews
Overarching goals of IPE	
• Learning together and gaining a more work-oriented perspective	Quote 1, Student 1, Interview 5: (...) you have the exchange between different professions very early [during medical school], so you do not come clueless to the hospital later.
• Improvement of teamwork	Quote 2, Student 2, Interview 1: You (...) become aware of the [roles of team members] and focus on working together.
• Reduction of prejudices	Quote 3, Student 3, Interview 6: If you have IP communication beforehand, future work with other healthcare groups will be simplified.
• Increase in patient-centeredness	Quote 4, Student 2, Interview 7: Not letting doctors feel superior to the nurses and correct the stereotype that "nurses only do what we do not want to because they are not good enough or the task is not challenging enough for us.
• Improvement of well-being in the workplace	Quote 5, Student 3, Interview 2: I think it is important to learn to appreciate what others do for the patient. We do not see the whole spectrum [of health care]. Especially the care or the physiotherapy or ergotherapy, too, contribute a lot - and we do not learn about that.
	Quote 6, Student 2, Interview 7: (...) you get to know people from other professions, and realise that these are people like you and me, they also have the same hobbies or like to go out on the weekend, and then you just notice that there is a different relationship, then you win something.

TABLE 3 Citation frequency and text coverage of further attributes.

	Frequency (n)	Percentage (%)
Communication	45	24.73
Role Recognition	28	15.38
Preparation for practice	27	14.84
Equivalence	15	8.24
Points of contact	13	7.14
Practical	13	7.14
A different point of view	13	7.14
Reduced mistakes	8	4.40
Efficiency	7	3.85
Organisation	4	2.20
Non-technical skills	2	1.10
Focus	2	1.10
Work climate	2	1.10
Role model	1	0.55
Attitudes	1	0.55
Acceptance	1	0.55
Total	182	100.00

Values are n (%).

Further attributes for the concept definition

We created 16 additional codes inductively, covering concepts not previously integrated into the definitions. Code frequency for the inductive codes is summarised in Table 3.

"Communication" was the most frequent inductive code, and students found it to have a central role in IPE. If health professionals are not forced to communicate, then they remain siloed. Communication between different health professionals is the starting point for exchanging ideas and coordinating teams. Many students argued that interprofessional learning should notably include communication skills. Students also related "communication" to higher attributes of IPE. They mentioned that improved communication between healthcare professionals

might lead to more satisfied team members, working with less friction, and reducing the time and energy spent on overcoming issues arising from lack of communication.

"Role recognition" was the second most frequent inductive code. Students valued the understanding of different healthcare professionals' competencies in interprofessional learning. Such role recognition facilitates task distribution by correctly assessing what each professional group can do and marks out the limits of each profession, suiting mutual expectations. Students mentioned that recognizing roles leads to the empowerment of each profession and enables better team performance and task completion.

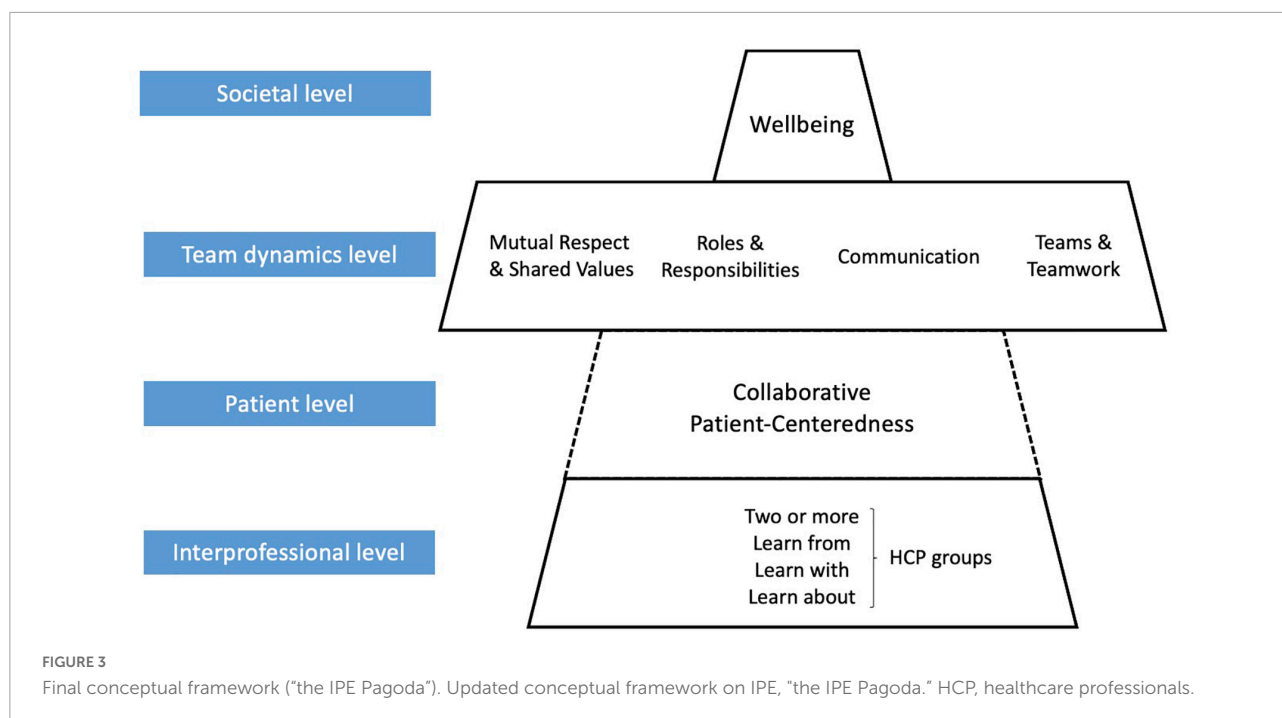
We also frequently coded segments with "Preparation for practice." Interprofessional learning seems more relevant for medical students in clinical settings, where role attribution is commonly applied. "Preparation for practice" was meant to promote early sensitisation to teamwork and facilitate future workplace interactions and skills, smoothing the transition into clinical practice. As higher interprofessional learning components, students mentioned the possibility of early networking, avoiding prejudices, and fostering horizontal leadership strategies.

Standard and contrary models

Students gave 96 examples of IPE activities. Thirty-two examples (33%) corresponded to IPE model cases (i.e., including patient-centeredness and collaboration) and 64 (67%) to contrary cases.

Conceptual framework ("the interprofessional education pagoda")

A conceptual framework for IPE definition derived from the above results is presented in Figure 3.



We determined four levels, according to the increased complexity of the concept:

- Level One—Interprofessional: as previously.
- Level Two—Patient: attributes related to role attribution of different team players, a collaboration between other healthcare professionals with the patient at the centre of care.
- Level Three—Team dynamics: attributes related to optimal teamwork, improved communication, work ethics and respectful interaction between team members (Weller et al., 2014; Rosen et al., 2018).
- Level Four—Societal (broader education outcomes): attributes related to relationships with other professions outside the work environment to improve well-being, patient care and advance learning.
- The framework structure loosely resembles a Japanese temple; therefore, it was called the "IPE pagoda."

Discussion

This qualitative study demonstrates that medical students at a university that offers one interprofessional internship could identify all the concepts present in international definitions of IPE. However, we verified that students gave different weights to different attributes. Additionally, two-thirds of medical students mentioned a "contrary" model (without collaboration or patient-centeredness) as IPE activities. These results both

support and build on recent definitions of IPE. The additional themes identified in this study expand on previous literature on this topic (Wener et al., 2009; WHO, 2010; IPEC, 2011, 2016; CAIPE, 2021). This is important because it demonstrates that IPE plays a more expansive role in pre-licensure students' medical education than previously thought (Hudson et al., 2016; Berger-Estilita et al., 2020b). Further, this is the first study in available IPE literature to confirm the four major principles of IPE as outlined by the IPEC report.

When asked, medical students could collectively name attributes of the IPEC dimensions and name other attributions outside the constructs above. We were positively surprised by these findings, as previous studies show that healthcare students may demonstrate professional socialisation (i.e., feeling and behaving like a member of that profession), which may lead to misconceptions and "tribalism" between professions (Beatie, 1995), leading to ineffective working and ultimately patient harm (Hawkes et al., 2013). We hypothesise that because medical students at Bern University have IPE in the first year of studies, they develop their professional identity parallel with other healthcare students. Such an early introduction of IPE may force medical students to contact and perceive other H as having the same basic knowledge, which will tackle lower levels of prejudice, permitting the development of better attitudes toward collaboration and mutual respect (Hawkes et al., 2013). Our findings corroborated this.

We were surprised to observe that "learning about" other HCP groups was more expressive than "learning from" or "learning with." The emphasis on "learning about" likely reflects a lack of knowledge about other healthcare professions. This

might be a consequence of the traditional “siloe” education of medical professions, which often leads to first exposure to IPE only in later stages of the training (Berger-Estilita et al., 2020a,b). Additionally, two-thirds of medical students mentioned a “contrary” model as IPE. While our sample stems from a medical programme with IPE already embedded in the curriculum, the current IPE offer might still be insufficient.

Patient-centeredness was mentioned in only one-fifth of the coded cites. Three core themes seem to emerge in different definitions of patient-centeredness (Hearn et al., 2019): patient participation and involvement, the relationship between the patient and the HCP, and the context in which health care is delivered. Patient-centredness is increasingly prioritised across medical schools and practice, but it is challenging to teach (Parent et al., 2016). Students expressed several concerns regarding this type of teaching, particularly knowing how to adequately present information to patients, being exposed to patients’ enquiries or “pimping” (Cox et al., 2011). IPE might still be underrepresented in the medical curriculum of the University of Bern, as most teaching is “disease-centred,” which reduces most probable awareness of the “patient-centred” style (Krupat et al., 1999). Our results suggest that medical students at the University of Bern have not yet fully evolved beyond the physician’s role as expert HCP and collaborator into more differentiated Canadian Medical Education Directives for Specialists (CanMEDS) competencies as advocate and manager (Frank et al., 2015). We hypothesise that as medical students become more comfortable with their role as medical experts, they can glean different impressions from clinical encounters and develop their other intrinsic functions, as recommended in the Principal Relevant Objectives and Framework for Integrative Learning and Education in Switzerland (Michaud and Jucker-Kupper, 2017). Alternatively, it may be that in their clinical training, they are forced to address the roles of other HCPs and thus broaden their view of interprofessionality. This is in alignment with other studies, that if students are allowed to work as part of a team, they can develop a more precise insight into a patient-centred approach (Scavenius et al., 2006). While such issues will need to be addressed in further studies, it seems reasonable to recommend that if medical students show little awareness of patient-centeredness, they should be more exposed to interprofessional activities during their training (Krupat et al., 1999).

The social component of IPE was often mentioned. Students considered networking beneficial, both inside and outside the workplace. By engaging in interprofessional relationships, students learn about each other’s curricula in informal settings and foster friendships. This aspect of IPE is not frequently explored in the literature. The social element repeatedly mentioned in the interviews mirrors the Social Learning Theory (Bandura, 1986). Learning is also a social and relational process, frequently occurring

around authentic and meaningful patient treatment (Friman et al., 2017). These findings support that “formal” or planned educational IPE experiences also create “informal” opportunities to socialise and be acquainted on a personal level. Therefore, these “informal arenas can stimulate and set a solid basis for interprofessional collaboration” (Reeves, 2000).

Finally, we propose to add “well-being” as a possible dimension of IPE. Well-being is “a dynamic state that refers to individuals’ ability to develop their potential, work productively and creatively, build strong and positive relationships with others, and contribute to their community” (Beddington et al., 2008). This definition is deeply related to the previous concepts of interprofessionality. Interprofessional studies show that negative interprofessional interactions between nurses and physicians increase the likelihood of nurse burnout and may be a critical factor in decreasing nurse well-being, increasing turnover, and worsening patient outcomes (Sinclair et al., 2015; Dow et al., 2019). However, well-being research on physicians and medical students is less established. Dow et al. (2019) argued that using an interprofessional approach may aid in identifying factors and establishing interventions to support the well-being of different professions better. These recommendations closely align with our findings.

Our findings underline several considerations that educators may include when considering interprofessional activities, particularly the importance of considering all levels of interprofessionality and having clear objectives for each level. Our interprofessional learning framework brings oversight to what appears to be a longitudinal process underscored by its use to improve patient outcomes, team dynamics between professionals, and individual and collective well-being. More attention must be paid to the learning environment of IPE activities to facilitate open, frank, and effective interactions.

Our study has limitations. There was a potential for selection bias as students were recruited voluntarily. In addition, the basic themes for the construction of this framework were provided only by medical students. The authors are aware that the reported findings may not represent other cohorts of medical students in Switzerland or elsewhere, as well as students from other healthcare professions. Therefore, great care must be taken in generalisations. We acknowledge that our findings might have been richer if we had also included clinicians, educators or students of other healthcare professions. This can be taken up in future studies.

Moreover, group interviews may also have introduced social desirability bias and the potential for recall bias. Finally, from the methodological perspective, we used a modified version of the original model-contrary case concept proposed by Olenick et al. (2010). By only using the model and the contrary cases, we might have used very high standards to classify medical students’ experiences with IPE, leading to a high percentage of examples rated “contrary case.”

Conclusion

The impact of this study is two-fold. Firstly, we deepened the understanding of previously identified definitions of IPE, and we identified new attributes of the definition. Secondly, by considering “well-being” as a component of interprofessional, curriculum planners may offer more objective and authentic interprofessional experiences.

Data availability statement

The original contributions presented in this study are included in the article/[Supplementary material](#), further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving human participants were reviewed and approved by the Bern Cantonal Ethics Committee (Req-2019-00743, 23.08.2019). The patients/participants provided their written informed consent to participate in this study.

Author contributions

JB-E and RG contributed to the study design. HC, SM, and JB-E performed the quality analysis. RG, AF, and SG critically reviewed the manuscript. All authors contributed to interpretation of the results and important intellectual content to the manuscript and approved the final version.

Funding

This manuscript’s publication charges were supported by a grant from the Suzanne and Hans Biäsch Foundation for Applied Psychology (Nr. 2020-23). The funders had no role in study design, data collection and analysis, decision to publish, or manuscript preparation.

References

- Anderson, E. S., and Thorpe, L. N. (2008). Early interprofessional interactions: does student age matter? *J. Interprof. Care* 22, 263–282. doi: 10.1080/13561820802054689
- Bandali, K., Niblett, B., Yeung, T. P., and Gamble, P. (2011). Beyond curriculum: embedding interprofessional collaboration into academic culture. *J. Interprof. Care* 25, 75–76. doi: 10.3109/13561820.2010.503948

Acknowledgments

We thank the Dean’s office of the Medical Faculty of the University of Bern, particularly Peter Frey, MME, to facilitate students’ contacts at the University of Bern. We also thank all the medical faculty students who participated in this study. Finally, we thank Sean McAleer (SeM) for verifying the translations of the cites for readability.

Conflict of interest

JB-E was an associate editor for BMC Medical Education. RG was the Board Director of Guidelines and ILCOR of the European Resuscitation Council, the Task Force Chair Education, Implementation, and Team of ILCOR, and member of the direction of the MME Programme of the University of Bern. SG was also a member of the direction of the MME Programme of the University of Bern.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher’s note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/feduc.2022.978796/full#supplementary-material>

SUPPLEMENTARY DATA SHEET 1
Interview guide.

- Bandura, A. (1986). *Social Foundations of Thought and Action: a Social Cognitive Theory*. Englewood Cliffs, NJ: Prentice-Hall.

- Beatie, A. (1995). “War and Peace among the Health Tribes,” in *Interprofessional Relations in Health Care*, eds K. Soothill, I. Mackay, and C. Webb (London: Edward Arnold), 11–30.

- Beddington, J., Cooper, C. L., Field, J., Goswami, U., Huppert, F. A., Jenkins, R., et al. (2008). The mental wealth of nations. *Nature* 455, 1057–1060.
- Berger-Estilita, J., Chiang, H., Stricker, D., Fuchs, A., Greif, R., and McAleer, S. (2020a). Attitudes of medical students towards interprofessional education: a mixed-methods study. *PLoS One* 15:e0240835. doi: 10.1371/journal.pone.0240835
- Berger-Estilita, J., Fuchs, A., Hahn, M., Chiang, H., and Greif, R. (2020b). Attitudes towards Interprofessional education in the medical curriculum: a systematic review of the literature. *BMC Med. Educ.* 20:254. doi: 10.1186/s12909-020-02176-4
- Braun, V., and Clarke, V. (2006). Using thematic analysis in psychology. *Qual. Res. Psychol.* 3, 77–101.
- CAIPE (2021). *The Centre for the Advancement of Interprofessional Education*. Available online at: www.caipe.org.uk (accessed January 15, 2022).
- Castillo-Montoya, M. (2016). Preparing for interview research: the interview protocol refinement framework. *Qual. Rep.* 21, 811–831.
- Chua, A. Z., Lo, D. Y., Ho, W. H., Koh, Y. Q., Lim, D. S., Tam, J. K., et al. (2015). The effectiveness of a shared conference experience in improving undergraduate medical and nursing students' attitudes towards inter-professional education in an Asian country: a before and after study. *BMC Med. Educ.* 15, 233–242. doi: 10.1186/s12909-015-0509-9
- CIHC (2010). *A national Interprofessional competency framework*. Available online at: <https://phabc.org/wpcontent/uploads/2015/07/CIHC-National-Interprofessional-Competency-Framework.pdf> (accessed January 15, 2022).
- Cooper, H., Spencer-Dawe, E., and McLean, E. (2005). Beginning the process of teamwork: design, implementation and evaluation of an inter-professional education intervention for first year undergraduate students. *J. Interprof. Care* 19, 492–508. doi: 10.1080/13561820500215160
- Coster, S., Norman, I., Murrells, T., Kitchen, S., Meerabeau, E., Sooboodoo, E., et al. (2008). Interprofessional attitudes amongst undergraduate students in the health professions: a longitudinal questionnaire survey. *Int. J. Nurs. Stud.* 45, 1667–1681. doi: 10.1016/j.jnurstu.2008.02.008
- Cox, E. D., Schumacher, J. B., Young, H. N., Evans, M. D., Moreno, M. A., and Sigrest, T. D. (2011). Medical student outcomes after family-centered bedside rounds. *Acad. Pediatr.* 11, 403–408. doi: 10.1016/j.acap.2011.01.001
- de Oliveira, V. F., Bittencourt, M. F., Navarro Pinto, ÍF., Lucchetti, A. L. G., and Lucchetti, G. (2018). Comparison of the Readiness for Interprofessional Learning and the rate of contact among students from nine different healthcare courses. *Nurse Educ. Today* 63, 64–68. doi: 10.1016/j.nedt.2018.01.013
- Dow, A. W., Baernholdt, M., Santen, S. A., Baker, K., and Sessler, C. N. (2019). Practitioner wellbeing as an interprofessional imperative. *J. Interprof. Care* 33, 603–607. doi: 10.1080/13561820.2019.1673705
- Frank, J. R., Snell, L., and Sherbino, J. (2015). *CanMEDS 2015 Physician Competency Framework*. Ottawa: Royal College of Physicians and Surgeons of Canada.
- Friman, A., Wiegand Edstrom, D., and Edelbring, S. (2017). Attitudes and perceptions from nursing and medical students towards the other profession in relation to wound care. *J. Interprof. Care* 31, 620–627. doi: 10.1080/13561820.2017.1336991
- Hawkes, G., Nunnery, I., and Lindqvist, S. (2013). Caring for attitudes as a means of caring for patients—improving medical, pharmacy and nursing students' attitudes to each other's professions by engaging them in interprofessional learning. *Med. Teach.* 35, e1302–e1308. doi: 10.3109/0142159X.2013.770129
- Hearn, J., Dewji, M., Stocker, C., and Simons, G. (2019). Patient-centered medical education: A proposed definition. *Med. Teach.* 41, 934–938. doi: 10.1080/0142159X.2019.1597258
- Hudson, J. N., Lethbridge, A., Vella, S., and Caputi, P. (2016). Decline in medical students' attitudes to interprofessional learning and patient-centredness. *Med. Educ.* 50, 550–559. doi: 10.1111/medu.12958
- IPEC (2011). *Core Competencies for Interprofessional Education: Report of an Expert Panel*. Washington, DC: IPE Collaborative.
- IPEC (2016). *Core competencies for interprofessional collaborative practice: 2016 update*. Washington, DC: IPE Collaborative.
- Khalili, H., Orchard, C., Laschinger, H. K., and Farah, R. (2013). An interprofessional socialization framework for developing an interprofessional identity among health professions students. *J. Interprof. Care* 27, 448–453. doi: 10.3109/13561820.2013.804042
- Kozmenko, V., Bye, E. J., Simanton, E., Lindemann, J., and Schellpfeffer, S. E. (2017). The optimal time to institute interprofessional education in the Medical School Curriculum. *Med. Sci. Educ.* 27, 259–266.
- Krupat, E., Hiam, C. M., Fleming, M. Z., and Freeman, P. (1999). Patient-centeredness and its correlates among first year medical students. *Int. J. Psychiatry Med.* 29, 347–356. doi: 10.2190/DVCQ-4LC8-NT7H-KE0L
- Lapkin, S., Levett-Jones, T., and Gilligan, C. (2013). A systematic review of the effectiveness of interprofessional education in health professional programs. *Nurse Educ. Today* 33, 90–102. doi: 10.1016/j.nedt.2011.11.006
- Luderer, C., Donat, M., Baum, U., Kirsten, A., Jahn, P., and Stoevesandt, D. (2017). Measuring attitudes towards interprofessional learning. Testing two German versions of the tool "Readiness for Interprofessional Learning Scale" on interprofessional students of health and nursing sciences and of human medicine. *GMS J. Med. Educ.* 34, 33–46. doi: 10.3205/zma001110
- McFadyen, A. K., Webster, V. S., MacLaren, W. M., and O'Neill, M. A. (2010). Interprofessional attitudes and perceptions: results from a longitudinal controlled trial of pre-registration health and social care students in Scotland. *J. Interprof. Care* 24, 549–564. doi: 10.3109/13561820903520369
- Michaud, P., and Jucker-Kupper, P. (2017). *PROFILES; principal objectives and framework for integrated learning and education in Switzerland*. Bern: Joint Commission of the Swiss Medical Schools.
- Miles, M., Huberman, A. M., and Saldana, J. (2014). *Qualitative Data Analysis*. Los Angeles, CA: SAGE.
- Morse, J. M. (2015). Critical analysis of strategies for determining rigor in qualitative inquiry. *Qual. Health Res.* 25, 1212–1222. doi: 10.1177/1049732315588501
- Olenick, M., Allen, L. R., and Smego, R. A. Jr. (2010). Interprofessional education: a concept analysis. *Adv. Med. Educ. Pract.* 1, 75–84. doi: 10.2147/AMEP.S13207
- Parent, K., Jones, K., Phillips, L., Stojan, J. N., and House, J. B. (2016). Teaching patient- and family-centered care: integrating shared humanity into medical education curricula. *AMA J. Ethics* 18, 24–32. doi: 10.1001/journalofethics.2016.18.1.medul-1601
- Pedersen, T. H., Cignacco, E., Meuli, J., Habermann, F., Berger-Estilita, J., and Greif, R. (2020). The German interprofessional attitudes scale: translation, cultural adaptation, and validation. *GMS J. Med. Educ.* 37:Doc32. doi: 10.3205/zma001325
- Podsakoff, P. M., MacKenzie, S. B., and Podsakoff, N. P. (2016). Recommendations for creating better concept definitions in the organizational, behavioral, and social sciences. *Organ. Res. Methods* 19, 159–203. doi: 10.1016/j.jsxm.2019.07.025
- Reeves, S., Fletcher, S., Barr, H., Birch, I., Boet, S., Davies, N., et al. (2016). A BEME systematic review of the effects of interprofessional education: BEME Guide No. 39. *Med. Teach.* 38, 656–668. doi: 10.3109/0142159X.2016.1173663
- Reeves, T. (2000). Alternative approaches for online learning environments in higher education. *J. Educ. Comput. Res.* 23, 101–111.
- Resch, K., and Enzenhofer, E. (2018). *The Sage handbook of qualitative data collection*. Los Angeles, CA: SAGE.
- Rosen, M. A., DiazGranados, D., Dietz, A. S., Benishek, L. E., Thompson, D., Pronovost, P. J., et al. (2018). Teamwork in healthcare: key discoveries enabling safer, high-quality care. *Am. Psychol.* 73:433. doi: 10.1037/amp0000298
- Ruebling, I., Pole, D., Breitbach, A. P., Frager, A., Kettenbach, G., Westhus, N., et al. (2014). A comparison of student attitudes and perceptions before and after an introductory interprofessional education experience. *J. Interprof. Care* 28, 23–27. doi: 10.3109/13561820.2013.829421
- Scavenius, M., Schmidt, S., and Klazinga, N. (2006). Genesis of the professional-patient relationship in early practical experience: qualitative and quantitative study. *Med. Educ.* 40, 1037–1044. doi: 10.1111/j.1365-2929.2006.02594.x
- Sinclair, R. R., Sliter, M., Mohr, C. D., Sears, L. E., Deese, M. N., Wright, R. R., et al. (2015). Bad versus good, what matters more on the treatment floor? Relationships of positive and negative events with nurses' burnout and engagement. *Res. Nurs. Health* 38, 475–491. doi: 10.1002/nur.21696
- Visser, C. L. F., Ket, J. C. F., Croiset, G., and Kusurkar, R. A. (2017). Perceptions of residents, medical and nursing students about Interprofessional education: a systematic review of the quantitative and qualitative literature. *BMC Med. Educ.* 17:77–96. doi: 10.1186/s12909-017-0909-0
- Walker, L. O., and Avant, K. C. (2005). *Strategies for theory construction in nursing*. Upper Saddle River, NJ: Pearson/Prentice Hall.

Weller, J., Boyd, M., and Cumin, D. (2014). Teams, tribes and patient safety: overcoming barriers to effective teamwork in healthcare. *Postgrad. Med. J.* 90, 149–154. doi: 10.1136/postgradmedj-2012-131168

Wener, P., Nelson, M., Fricke, M., MacDonald, L., Anderson, J. E., The Manitoba, et al. (2009). Contributing to the sustainability of Interprofessional

Education for Collaborative Patient-Centred Practice (IECPCP): A teaching resource manual. *J. Interprof. Care* 23, 201–203. doi: 10.1080/13561820802293105

WHO (2010). *Framework for action on interprofessional education & collaborative practice* WHO/HRH/HPN/10.3. Geneva: WHO.



OPEN ACCESS

EDITED BY

Ana Luísa Rodrigues,
University of Lisbon, Portugal

REVIEWED BY

Lizeth Roets,
University of South Africa, South Africa
Juliet Thondhlana,
University of Nottingham,
United Kingdom

*CORRESPONDENCE

Nurudeen Abdul-Rahaman
nurudeenkuberke@gmail.com

SPECIALTY SECTION

This article was submitted to
Higher Education,
a section of the journal
Frontiers in Education

RECEIVED 17 January 2022

ACCEPTED 09 August 2022

PUBLISHED 25 August 2022

CITATION

Abdul-Rahaman N, Arkorful VE and
Okereke T (2022) Academic
integration in higher education: A
review of effective institutional
strategies and personal factors.
Front. Educ. 7:856967.
doi: 10.3389/feduc.2022.856967

COPYRIGHT

© 2022 Abdul-Rahaman, Arkorful and
Okereke. This is an open-access article
distributed under the terms of the
[Creative Commons Attribution License
\(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use, distribution or
reproduction in other forums is
permitted, provided the original
author(s) and the copyright owner(s)
are credited and that the original
publication in this journal is cited, in
accordance with accepted academic
practice. No use, distribution or
reproduction is permitted which does
not comply with these terms.

Academic integration in higher education: A review of effective institutional strategies and personal factors

Nurudeen Abdul-Rahaman^{1*}, Vincent E. Arkorful² and
Tochukwu Okereke³

¹Faculty of Social Sciences, Institute of Education, National Research University Higher School of Economics, Moscow, Russia, ²Department of Government and International Studies, Hong Kong Baptist University, Kowloon Tong, Hong Kong SAR, China, ³Faculty of Public Administration, Department of Population and Development Studies, National Research University Higher School of Economics, Moscow, Russia

Globally, there has been a surge in international students, posing challenges to their host institutions. The review aimed to identify institutional strategies and personal factors that promote international students' academic integration. With an independent systematic review of titles, abstracts, and full texts, 64 studies were sampled and analyzed. The study presented findings through a narrative synthesis across all studies. The review results showed that there have been an increasing number of studies on academic integration over the last decade. Institutional strategies like staff and student interaction, student orientation programs, classroom organization, supervisory support, and learning communities are more effective in promoting healthy academic lives and the academic progress of students. Personal factors, which include financial status, language ability, and self-efficacy in students, were revealed to facilitate healthy academic lives and progress on campus. Prioritizing international students' welfare, providing language adaptation support, and increasing the accessibility of academic staff were suggested strategies for improving the academic lives of international students. The study also recommends that tertiary education systems and other stakeholders take these institutional strategies and personal factors into account when developing higher education policies. This will help international students have better academic lives and stay in school.

KEYWORDS

academic integration, higher education, internationalization, progress, wellbeing

Introduction

Internationalization of higher education programs has increased the mobility of international students at institutions of higher education around the globe (European Commission, 2015). For instance, the number of Erasmus students has increased from 1987 to 1988, when there were 3,244 of them, to 2013–2014, when there were 272,497. In 2013–2014, women had a larger percentage of 60.2% (European Commission, 2015). Internationalization is a fundamental indicator of the ranking of worldwide universities (Souto-Otero et al., 2013). It is evident that incoming and outgoing international

students are a sign of prestige and quality for many higher education institutions, while internationalization is a fundamental indicator of the ranking of worldwide universities. The increased number of international students in higher education has stimulated interest in the programs of host institutions (Li et al., 2010). This is related to these students' perceptions of multicultural support, communication difficulties, and the adaptation process (Kudo and Simkin, 2003).

Despite all the opportunities international students enjoy at their host colleges, they confront a variety of obstacles. Bracht et al. (2006) reported that international students encounter housing, administrative, and academic difficulties but also have poorer self-esteem when they choose foreign language courses without sufficient peer support. According to De-Andrés (1999), kids' self-esteem is dependent on the good or negative experiences they receive from their environment.

Again, their failure to interact with domestic students because of linguistic and cultural hurdles may cause homesickness and self-doubt over their intellectual abilities. Cacioppo and Patrick (2008) demonstrate that adaptation difficulties can cause loneliness. Many questions arise: (1) What institutional strategies are effective in promoting international students' academic wellbeing and progress on campus? (2) What personal factors facilitate academic wellbeing and progress on campus? The complete integration of international students at the institution must satisfy numerous academic and administrative system requirements (Rienties et al., 2012).

Kudo (2016) stated that it is vital to seek strategies that promote integration within the institution as well as strategies that facilitate the sharing of information during extracurricular activities. This is consistent with the finding that most interactions between international and domestic students take place outside of the classroom (Ward, 2001). In order to increase support and intercultural friendships in an international context, he emphasizes the importance of domestic and international students forming groups and using intercultural collaboration strategies. However, these friendship networks between domestic and international students will not improve their academic lives if they do not have a common language besides their native tongues in order to facilitate interactions through which knowledge can be transferred. Otherwise, linguistic obstacles may impede the integration process and the development of multicultural friendships and team spirit (Medven et al., 2013). According to Kudo et al. (2017), "when intercultural encounter causes anxiety and uncertainty, international students tend to return to their own cultural communities."

Currently, there are several studies that examine academic exchange programs and the mobility of international students as well as their benefits. However, little research has examined how to academically integrate these international students and which strategies are most effective. Even fewer have investigated

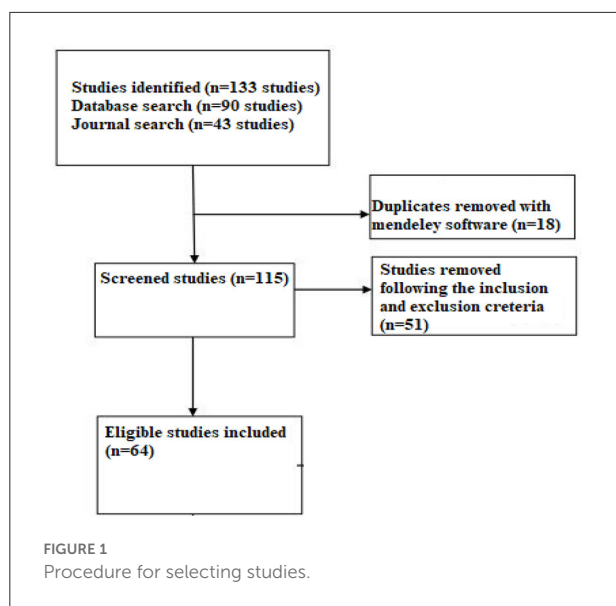
this topic in the context of higher education, where many international students struggle with academic integration. This study aims to examine this significant gap by expanding the understanding of these strategies within higher education and also, unearthing personal factors that mostly promote healthy academic lives and progress. This information can serve as a source of greater support for enriching the academic lives and progress of international students.

Academic integration

Tinto defined academic integration as academic progress, cognitive growth, and having positive learning experiences (Tinto, 2015). He again argued that both personal and institutional strategies are equally responsible for adaptation in academic pursuit among students. These personal strategies include skills, abilities, and previous education, as well as students' goals. The institutional strategies include; admission criteria, academic standards, and organizational structure among others. The ascertainment of Tinto (2015) and Lakhali et al. (2020) seemed to suggest that when both the institutional and personal come into play, a conducive platform is created for students to easily imbibe and transfer knowledge among themselves and between academic staff. Students' ability to adapt to their academic environment influence their intentions to persist or dropout (Lakhali et al., 2020).

Method

The systematic review looked at previous studies on academic integration of international students in tertiary education which were conducted in the last decade, and the strategies discovered to promote academic integration. Systematic reviews have a variety of advantages. They provide a clear and exhaustive assessment of the available evidence on a certain topic. In addition, SRs contribute to the identification of research gaps in our existing understanding of an area. They might draw attention to methodological issues in research projects that can be used to improve future work in the field and minimize bias (Eagly and Wood, 1994). Chalmers and Glasziou (2009) indicated that they can be used to identify problems for which the available data provides unambiguous answers, and hence no more research is required. In an attempt to achieve the review aim, we identified relevant studies, appraised their quality, and summarized the evidence by the use of explicit methodology. The systematic and explicit methodology distinguishes systematic reviews from traditional reviews and commentaries (Khan et al., 2003). This study examines the strategies that enhances international students' academic wellbeing and progress in tertiary education. In light of this, the study rigorously searched, gathered, synthesized, and reported selected literature from 2010 to 2021. The review



draws on empirical studies from databases, namely: the Web of Science database, Educational Resource information Centre (ERIC), Emerald, Science Direct, Wiley Online Library, and SAGE Journals. Studies were meticulously selected by searching for keywords such as “Academic integration,” “Academic persistence,” “Internationalization,” “Success,” “Completion,” “drop out,” and ninety (90) studies were collected from the above listed databases. The rigorous procedure followed in the processing of the data is presented in [Figure 1](#).

In essence, these terms are reported to have a strong connection with academic integration. This was followed by a second search using the same keywords in these journals: Journal of Higher Education; Higher Education, Quality in Higher Education; Higher Education, Research and Development; and Studies in Higher Education. From these journals, forty-three (43) more studies were added, making a total of one hundred and thirty-three (133). Following the inclusion and exclusion criteria, studies focusing on international students in higher education and studies conducted between 2010 and 2021, 115 studies were selected. The Mendeley software was further used to take out duplicate studies, resulting in sixty-four (64) studies. The inclusion and exclusion criteria were strictly followed to ensure that the sampled studies were free of selection bias and that the selected studies contained findings that offered a deep understanding of factors that promote academic integration among international students in tertiary education.

Data analysis

The thematic coding technique was used to identify common themes concerning the strategies that promote

academic integration from the sampled studies. This was aided by a random effects model in the systematic review to synthesize effects across studies. A model used to give a summary estimate of the magnitude of effect in a meta-analysis that assumes that the studies included are a random sample of a population of studies addressing the question posed in the meta-analysis.

Thematic coding is a qualitative strategy of picking similar themes in a text ([Braun and Clarke, 2012](#)). The technique aided in the identification of common themes such as “staff and student interaction,” “student orientation program,” “teaching strategies,” “preparatory or pathway courses,” “Learning Communities,” “The Classroom Organization,” “Supervisory Support,” “Financial Status,” “Common Language Acquisition,” and “Self-efficacy.” These themes were then categorized under broader umbrella themes like institutional and personal strategies.

Strategies that promote academic integration

Institutional strategies

The results suggest that institutional strategies are key to promoting academic integration of international students. The review defines institutional strategies as the institutional characteristics that influence students’ academic integration. Most of the strategies gathered in various studies were among the institutional attributes (see [Table 1](#)). These strategies are discussed below.

Staff and student interaction

The study revealed that international students adapt to tertiary programs when they get enough support from their institutions through frequent interaction with institutional staff. This creates a conducive atmosphere for international students to access help from institutional staffers, which enhances knowledge transfer. [Fergy et al. \(2011\)](#) highlighted the importance of staff knowing international students’ names, adding that the students were more academically entrenched when staff know them by their names. Also, research on student-faculty interaction by [Wirt and Jaeger \(2014\)](#) revealed that frequent meetings between international students and faculty staff improve learning outcomes. Another study claims that international students are more likely to drop out of their programs if they do not receive adequate support from their supervisors, lecturers, and administrative staff ([Willcoxson, 2010](#)). In addition, [Zaitseva et al. \(2013\)](#) found that international students praise their institutions because they feel supported by tutors and other staff members. Other scholars argue that teachers who build a good rapport with the learners produce a sound learning environment for international students ([Sidelinger and Frisby, 2019](#)). They also added that international

TABLE 1 Strategies found to promote academic integration.

Academic integration	Institutional strategies	Citations	Personal strategies	Citations
	Staff and student interaction	Willcoxson, 2010; Fergy et al., 2011; Mamiseishvili, 2012; Zaitseva et al., 2013; Wirt and Jaeger, 2014; Sidelinger and Frisby, 2019	Financial status	Perry and McConney, 2010; Adams et al., 2016; Snoubar, 2017; Jones et al., 2018
	Student orientation program	Collins and Dodsworth, 2011; Ganga and Masha, 2020; Morgan et al., 2020	English language ability	Kimmel and Volet, 2012; Liu, 2013; Song, 2013; Li, 2017; Li and Pitkänen, 2018; Crowther, 2019; Lee and Bailey, 2020; Mohamed and Bryan, 2020; Sung, 2020
	Teaching strategy	Zaitseva et al., 2013; Lee, 2017; Lakhal et al., 2020	Self-efficacy	Turner and Thompson, 2014; Wood et al., 2015; Hakyemez and Mardikyan, 2021
	Preparatory or pathway courses	Willcoxson, 2010; Bass, 2011; Arar and Masry-Herzalah, 2014; Amer and Davidovitch, 2020		
	Learning communities	Fergy et al., 2011; Smith, 2015; Garza et al., 2021		
	Classroom organization	Willcoxson, 2010; Tinto, 2015		
	Supervisory support	Cooper et al., 2010; Abiddin et al., 2011; Overall et al., 2011; Jones, 2013; McAlpine and McKinnon, 2013; Litalien et al., 2015; Winchester-Seeto et al., 2016; Gube et al., 2017		

students who can freely communicate with lecturers and faculty members may be able to reach out to them outside of the classroom and seek their assistance.

Mamiseishvili (2012) found that academic counseling services provided by faculties to international students improves their academic persistence. Academic counseling is the process in which schools offer support to students by assisting them make educational and career decisions. For instance, helping students in selecting courses, choosing a major, and utilizing opportunities like study abroad, summer schools and extracurricular activities (Bilodeau and Meissner, 2018). The Mamiseishvili study recommended the reinforcement of frequent interactions between international students and academic advisers.

Student orientation program

Orientation is the first experience students gain when they enroll in university (Ganga and Masha, 2020). According to Collins and Dodsworth (2011), through this program, new students are welcomed onto the campus, intimated with school rules and regulations, courses, requirements for graduation,

etc. This program is found to promote academic integration in the work of Morgan et al. (2020). Based on the personal experience of one of the researchers in this current study, an orientation program he participated in during his first year at the University of Science and Technology of China offered him an understanding of what was required to graduate with a master's degree in public administration. In the orientation program, a staff who was an exstudent gave a speech on how to adjust academically for successful completion of the program.

This motivated him and eventually led to his completion of the program.

Teaching strategies

The way teachers and students interact in the classroom and the institutional approaches used in the classroom are all part of the pedagogical strategy. Effective pedagogy leads to the academic integration of international students. This is highlighted and supported by the findings of Lee (2017) and Lakhal et al. (2020). In furtherance to that, Lee (2017) emphasized the need for teachers to create a friendly classroom

environment which will promote student-teacher and student-student interaction as a way to enhance knowledge transfer. This enhances knowledge transfer. These reveal that effective teaching and learning strategies used by lecturers tend to enhance student learning, hence strengthening their academic integration. Zaitseva et al. (2013) opined that timely provision of feedback to students by academic supervisors is found to enhance academic success. He further argued that timely feedback assists students in directing their time and effort toward learning what is useful and avoiding errors.

Preparatory or pathway courses

Preparatory or pathway courses are considered a way to help international students from different socio-cultural backgrounds to integrate academically into their programs of study at their institutions (Arar and Masry-Herzalah, 2014). Bass (2011) emphasized the importance of providing academic preparatory assistance to international students because the majority of those enrolled in tertiary institutions face learning challenges, some of which result from language and communication barriers. A subsequent study by Amer and Davidovitch (2020) found that giving international students proper preparation, such as language course among others before the commencement of their programs at the university, enhances their confidence level, which translates to optimal academic integration. Willcoxson (2010) confirmed that new students may drop out if they believe they will not receive the necessary foundational support to begin their studies.

Learning communities

These are academic groupings where learners exchange ideas and experiences and also acquire knowledge from teachers on expected outcomes (Shapiro and Levine, 1999). Smith (2015) found that learning communities are useful in getting students to study together and this leads to higher academic performance. In another study, Garza et al. (2021) found that the use of these learning communities assisted international students to socialize with one another and learn from each other. Interactions among students during meetings within these learning communities are thought to be beneficial in terms of academic persistence (Fergy et al., 2011).

Classroom organization

Numerous studies have revealed that classroom structure affects learning among international students. In this review, we define classroom organization as arranging sitting positions in a way that students can easily interact with one another to

enhance learning activities. For instance, Tinto (2015) stated that students' sitting arrangements in the classroom affect their performance in various courses. A well-organized classroom can enable new students to easily adapt to the academic life on campus. A prior study recommended that university faculties must provide classrooms that encourage active participation among students (Willcoxson, 2010).

Supervisory support

Scholars argued that most international graduate students' academic success depends on effective student supervision (Cooper et al., 2010; Winchester-Seeto et al., 2016). Overall et al. (2011) suggested that supervisors must encourage their international doctoral students to be patient, provide timely feedback, and guide them to complete their tasks. Other scholars maintained that student satisfaction, persistence, and academic achievement depend on frequent supervisor meetings and interactions, timely feedback on the task given, motivation, and encouragement (Gube et al., 2017). In their study, Abiddin et al. (2011) discussed the four skills required for effective supervision: communication skills, including the ability to listen and convey a sound response; the skill of recognizing when a student requires help and providing it; and having sound knowledge of the student's research area. Several studies support the contention that academic adaptation is also influenced by supervisory assistance (Jones, 2013; McAlpine and McKinnon, 2013; Litalien et al., 2015). The supervisor's support (frequent meetings, interactions, feedback, motivation, and encouragement) at the pre-entry point and throughout the supervision process is key to ensuring students are sufficiently integrated into the academic domain of the institution.

Personal factors

The review defines personal factors as students' characteristics, such as self-efficacy, self-confidence, perseverance, and tenacity, which strengthen resolution to achieve success. Several studies highlighted international students' personal attributes that impact academic integration, retention, and persistence. These factors are discussed below.

Financial status

The financial situation of international students has an enormous impact on their academic integration. For example, Adams et al. (2016) discovered that international students reported financial stress as negatively affecting their academic integration. This implies that sufficiently supporting students with educational and non-education costs, including tuition

fees and living expenses, through scholarships or other funding sources provides them with a conducive mindset for academic activities, which enhances their academic performance. In addition, revealed that Chinese students studying in the United States faced many problems, among which include financial stress, which hampered their academic progress. In an Australian study, it was reported that students' financial status impacted on their academic progress (Perry and McConney, 2010). In Turkey, the study of Snoubar (2017) reported economic problem as a challenge international students encountered which affected their academic progress. Furthermore, financial stress has been reported to contribute to international students' anxiety and negatively impact on their academic growth (Jones et al., 2018).

Language ability

Language ability emerged as one of the key personal attributes that affects students' academic integration. Students whose previous language of instruction and current language of instruction are the same may easily integrate into their institutions' academic domains (Kimmel and Volet, 2012; Crowther, 2019; Mohamed and Bryan, 2020; Sung, 2020). Liu (2013) stated that the inability to speak and write in the English language can affect students' performance. Language adaptability fosters communication among students, peers, lecturers, and supervisors, which enhances learning. Language adaptability has been proven to be highly effective in the seamless transfer of knowledge, which promotes the academic integration of students (Lee and Bailey, 2020). Additionally, language barrier was found to be a mitigating factor for Chinese students' academic integration at German universities (Li, 2017) and various Italian universities (Song, 2013). International graduate students at a Thai university indicated language issues as a factor affecting their academic integration. In Finland, the inability of Chinese students to speak the English language and the Finnish language impacted negatively on their learning (Li and Pitkänen, 2018).

Self-efficacy

Self-efficacy refers to a person's belief in his or her ability to exhibit the qualities and attributes required to achieve a specific goal (Bandura, 1997). Scholars found that international students' self-efficacy is linked to improved academic performance (Hakyemez and Mardikyan, 2021). This also accords with Tinto (2015), who stated that international students must believe in themselves to do well in their studies. To further strengthen the argument, researchers unearthed that self-efficacy is linked to academic persistence and that frequent interaction between students and teachers can boost students' self-efficacy (Wood et al., 2015). Other researchers believe that university faculties

that provide international students with academic skills such as research writing can boost their performance in research (Turner and Thompson, 2014). Also, Wood et al. (2015) found that international students from poor families have low self-efficacy, which makes it harder for them to learn.

Discussion and implications

The objective of the review was to analyze previous studies on effective strategies and personal factors that promote academic integration among international students. The study identified numerous distinct strategies that promote academic integration as well as personal factors that facilitate healthy academic lives and progress on campus. This is consistent with the findings of Tinto (2015), who reported that interaction of effective institutional strategies coupled with students' personal attributes enhances their academic wellbeing in progress in the program of study. Most of the previous focused on institutional strategies, which further demonstrates the key role institutions play in supporting international students academically. The institutional strategies identified are *staff and student interaction; student orientation programs; teaching strategies; preparatory or pathway courses; learning communities; classroom organization; and supervisory support*. This implies that to ensure sufficient academic integration, institutions, through faculties or departments, must effectively implement these practices to promote learning and knowledge sharing. This can be achieved by intensifying staff interactions with international students; organizing orientation programs with components that encompass every student's needs; organizing preparatory courses for new international students; encouraging and forming learning communities; and encouraging instructors to create an engaging, enabling learning environment that produces varied learning experiences. Furthermore, the review reveals that host supervisors contribute to student learning, although studies exploring supervisor positions in academic integration tended to be the least prevalent among the themes that emerged in the review. Their contributions include advising students on research topics, supervising students as they write and prepare manuscripts for publication, and providing timely feedback. We, therefore, suggest that institutions encourage student supervisors to intensify their support for international students to ensure their transition and progress in the academic domains of their institutions. Overall, student academic integration depends largely on the institutions' support for international students.

Additionally, other themes concerning the personal attributes of international students that promote academic integration were also explored. The review findings argue that international students who are financially sound and proficient in their language of instruction have higher chances of adapting academically. The study also revealed an association

between student self-efficacy and academic adaptation. The review recommends that universities ensure that there are funding opportunities for students in need or permit students to work on a part-time basis to help ease their financial burden and fine-tune their mindset to concentrate on their studies. Furthermore, the language of instruction of the host school should be taught to international students to enable them to adapt academically to their programs. Evidence from the literature suggests that the higher a student's sense of self-efficacy, the higher the level of adaptation in academics. As a result, universities should intensify programs and practices that enhance self-efficacy among international students. Institutions have a major role in helping students realize their potential and also ensure that these personal attributes are developed and nurtured for improved academic performance. This goes in harmony with the claims of Tinto (2015) that institutional and personal strategies complement each other to promote academic adaptation and success among students.

Conclusion

Internationalization in tertiary education has created a challenge in integrating international students academically into different institutions around the world. It has long been a source of concern for stakeholders in higher education. This systematic review approach was used to analyze strategies and personal factors that promote healthy academic lives and progress among international students. The review also highlighted the significance of institutional strategies like staff and student interaction, student orientation programs, teaching strategies, preparatory or pathway courses, learning communities, classroom organization, and supervisory support in promoting academic integration and success. Personal factors such as financial status, language ability, and self-efficacy were also discovered to facilitate academic integration and success among international students. The study suggests that institutions of higher education and other interested stakeholders take these institutional and personal

factors of integration into account when making policies for higher education.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

Author contributions

NA-R wrote the manuscript. VA did the proof reading and TO did the search and selection of articles. All authors contributed to the article and approved the submitted version.

Acknowledgments

NA-R thank Dr. Evgeniy Terentev for his guidance and support and Julie Didlick of Australia for her everlasting support throughout my education.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

- Abiddin, N. Z., Ismail, A., and Ismail, A. (2011). Effective supervisory approach in enhancing postgraduate research studies. *Int. J. Hum. Soc. Sci.* 1, 206–217. Available online at: http://www.ijhssnet.com/journals/Vol._1_No._2_February_2011/28.pdf
- Adams, D. R., Meyers, S. A., and Beidas, R. S. (2016). The relationship between financial strain, perceived stress, psychological symptoms, and academic and social integration in undergraduate students. *J. Am. Coll. Health* 64, 362–370. doi: 10.1080/07448481.2016.1154559
- Amer, A., and Davidovitch, N. (2020). The case of Druze society and its integration in higher education in Israel. *International Education Studies* 13, 68–78. doi: 10.5539/ies.v13n8p68
- Arar, K. H., and Masry-Herzalah, A. (2014). Cultural pluralism increases difficulties in learning experiences yet advances identity formation for Muslim Arab female students at higher education institutions in Israel. *J. Appl. Res. Higher Educ.* 6, 325–41. doi: 10.1108/JARHE-03-2014-0039
- Bandura, A. (1997). *Self-Efficacy: The Exercise of Control*. New York, NY: W. H. Freeman.
- Bass, G. H. (2011). Social and academic integration in an extended curriculum programme. *J. Independ. Teach. Learn.* 6, 45–54.
- Bilodeau, C., and Meissner, J. (2018). The effects of a combined academic and personal counselling initiative for post-secondary student retention. *Can. J. School Psychol.* 33, 8–25. doi: 10.1177/0829573516644554

- Bracht, O., Engel, C., Janson, K., Over, A., Schomburg, H., and Teichler, U. (2006). *The Professional Value of ERASMUS Mobility*. Kassel, Germany: International Centre for Higher Education Research, University of Kassel.
- Braun, V., and Clarke, V. (2012). *Thematic Analysis*. Worcester, MA: American Psychological Association.
- Cacioppo, J. T., and Patrick, W. (2008). *Loneliness: Human Nature and the Need for Social Connection*. New York, NY: W. W. Norton and Company.
- Chalmers, I., and Glasziou, P. (2009). Avoidable waste in the production and reporting of research evidence. *Obstet. Gynecol.* 114:1341–1345. doi: 10.1097/AOG.0b013e3181c3020d
- Collins, N., and Dodsworth, E. (2011). Reaching first-year students during orientation. *Partnership* 6. doi: 10.21083/partnership.v6i2.1473
- Cooper, L., Orrell, J., and Bowden, M. (2010). *Work Integrated Learning: A Guide to Effective Practice*. London: Routledge.
- Crowther, D. (2019). Language investment during university adjustment: the divergent path of two international Chinese freshmen. *J. Lang. Identity Educ.* 19, 275–289. doi: 10.1080/15348458.2019.1672075
- De-Andrés, V. (1999). “Self-esteem in the classroom or the metamorphosis of butterflies,” in *Affect in Language Learning*, eds J. Arnold (New York, NY: Cambridge University Press), 87–105.
- Eagly AH, Wood W. (1994). *Using Research Syntheses to Plan Future Research. The Handbook of Research Synthesis*. Russell Sage Foundation, 485–500. doi: 10.1002/(SICI)1097-0258(19970330)16:6andlt;713::AID-SIM430andgt;3.0.CO;2-4
- European Commission (2015). *Erasmus Facts, Figures and Trends. The European Union Support for Students and Staff Exchanges and University Cooperation in 2013-2014*. Brussels, Belgium: Unit B1 “Higher Education”
- Fergy, S., Marks-Maran, D., Ooms, A., Shapcott, J., and Burke, L. (2011). Promoting social and academic integration into higher education by first-year student nurses: The APPL. *J. Further High. Educ.* 35, 107–30. doi: 10.1080/0309877X.2010.540318
- Ganga, N. H., and Masha, R. K. (2020). Exploring the vertical and horizontal integration of orientation programmes towards First Year University students’ transition. *Int. J. Educ. Res.* 8, 1–15. doi: 10.1186/s13002-020-0358-4
- Garza, T., Huerta, M., Garcia, H. A., and Lau, J. (2021). Exploring sense of belonging, socioacademic integrative moments, and learning communities related to ELs’ persistence based on reenrollment decisions in community colleges. *Commun. Coll. Rev.* 49, 30–51. doi: 10.1177/0091552120964873
- Gube, J. C. C., Getenet, S. T., Satariyan, A., and Muhammad, Y. (2017). Towards “operating within” the field: Doctoral students’views of supervisors’discipline expertise. *Int. J. Doct. Stud.* 12, 1–16. doi: 10.28945/3641
- Hakyemez, T. C., and Mardikyan, S. (2021). The interplay between institutional integration and self-efficacy in the academic performance of first-year university students: a multigroup approach. *Int. J. Manag. Educ.* 19, 100430. doi: 10.1016/j.ijme.2020.100430
- Jones, M. (2013). “Issues in Doctoral Studies-Forty Years of Journal Discussion: Where have we been and where are we going?” in *Proceedings of the Informing Science and Information Technology Education Conference* (Informing Science Institute), 83–104. doi: 10.28945/1859
- Jones, P. J., Park, S. Y., and Lefevor, G. T. (2018). Contemporary college student anxiety: The role of academic distress, financial stress, and support. *J. Coll. Counsel.* 21, 252–264. doi: 10.1002/jocc.12107
- Khan, K. S., Kunz, R., Kleijnen, J., and Antes, G. (2003). Five steps to conducting a systematic review. *J. R. Soc. Med.* 96, 118–121. doi: 10.1177/014107680309600304
- Kimmel, K., and Volet, S. (2012). University students’perceptions of and attitudes towards culturally diverse group work: Does context matter? *J. Stud. Int. Educ.* 16, 157–181. doi: 10.1177/1028315310373833
- Kudo, K. (2016). Social representation of intercultural exchange in an international university. *Discourse Stud. Cult. Politics Educ.* 37, 256–268. doi: 10.1080/01596306.2015.1014881
- Kudo, K., and Simkin, K. (2003). Intercultural friendship formation: the case of Japanese students at an Australian university. *J. Intercult. Stud.* 24, 91–114. doi: 10.1080/0725686032000165351
- Kudo, K., Volet, S., and Whitted, C. (2017). Intercultural relationship development at university: A systematic literature review from ecological and person-in-context perspective. *Educ. Res. Rev.* 20, 99–116. doi: 10.1016/j.edurev.2017.01.001
- Lakhal, S., Mukamurera, J., Bédard, M. E., Heilporn, G., and Chauvet, M. (2020). Features fostering academic and social integration in blended synchronous courses in graduate programs. *Int. J. Educ. Technol. Higher Educ.* 17:5. doi: 10.1186/s41239-020-0180-z
- Lee, A. R., and Bailey, D. R. (2020). Examining South Korean university students’interactions with international students. *Asian J. Univ. Educ.* 16, 43–58. doi: 10.24191/ajue.v16i3.8622
- Lee, N. E. (2017). The part-time student experience: its influence on student engagement, perceptions, and retention. *Can. J. Study Adult Educ.* 30, 1–18.
- Li, G., Chen, W., and Duanmu, J. (2010). Determinants of international student’s academic performance: A comparison between Chinese and other international students. *J. Stud. Int. Educ.* 14, 389–405. doi: 10.1177/1028315309331490
- Li, H. (2017). Academic integration of mainland Chinese students in Germany. *Soc. Inklus.* 5, 80–92. doi: 10.17645/si.v5i1.824
- Li, H., and Pitkänen, P. (2018). Understanding the integration of mainland Chinese students. *Nordic J. Migrat. Res.* 8, 107. doi: 10.1515/njmr-2018-0008
- Litalien, D., Guay, F., and Morin, A. J. (2015). Motivation for Ph.D. studies: Scale development and validation. *Learn. Individ. Diff.* 41, 1–13. doi: 10.1016/j.lindif.2015.05.006
- Liu, B. (2013). Effect of first language on the use of English discourse markers by L1 Chinese speakers of English. *J. Pragmat.* 45, 149–172. doi: 10.1016/j.pragma.2012.11.002
- Mamishvili, K. (2012). Academic and social integration and persistence of international students at US two-year institutions. *Comm. College J. Res. Pract.* 36, 15–27. doi: 10.1080/10668926.2012.619093
- McAlpine, L., and McKinnon, M. (2013). Supervision-the most variable of variables: Student perspectives. *Stud. Cont. Educ.* 35, 265–280. doi: 10.1080/0158037X.2012.746227
- Medven, D., Franco, A., Gao, X., and Yang, F. (2013). *Challenges in Teaching International Students: Group Separation, Language Barriers and Cultural Differences*. Available online at: <http://lup.lub.lu.se/record/4215983> (accessed November 15, 2020).
- Mohamed, W., and Bryan, K. (2020). Saudi Arabian International Students’Sense of Belonging at an HBCU. *Urban Educ. Res. Policy Annu.* 7.
- Morgan, K., Lane, T., Hutchful, J., Willis, S., Clarke Jr, L., and Rivera, C. (2020). Transitioning, belonging, and the Black student experience: a phenomenological study. *J. Coll. Orient. Trans. Retent.* 27. doi: 10.24926/jcotr.v27i1.2209
- Overall, N. C., Deane, K. L., and Peterson, E. R. (2011). Promoting doctoral students’ research self-efficacy: Combining academic guidance with autonomy support. *Higher Educ. Res. Dev.* 30, 791–805. doi: 10.1080/07294360.2010.535508
- Perry, L., and McConney, A. (2010). School socio-economic composition and student outcomes in Australia: Implications for educational policy. *Aust. J. Educ.* 54, 72–85. doi: 10.1177/000494411005400106
- Rienties, B., Beausaert, S., Grohnert, T., Niemantsverdriet, S., and Kommers, P. (2012). Understanding academic performance of international students: the role of ethnicity, academic and social integration. *High. Educ.* 63, 685–700. doi: 10.1007/s10734-011-9468-1
- Shapiro, N. S., and Levine, J. H. (1999). Introducing learning communities to your campus. *About Campus* 4, 2–10. doi: 10.1177/108648229900400502
- Sidlinger, R., and Frisby, B. N. (2019). Social integration and student proactivity: precursors to improved academic outcomes in a first-year experience basic communication course. *Basic Commun. Course Annu.* 31, 8.
- Smith, R. A. (2015). Magnets and seekers: A network perspective on academic integration inside two residential communities. *J. High Educ.* 86, 893–922. doi: 10.1353/jhe.2015.0033
- Snoubar, Y. (2017). International students In Turkey: research on problems experienced and social service requirements. *J. Int. Soc. Res.* 10:50. doi: 10.17719/jisr.2017.1712
- Song, G. (2013). Academic and social integration of Chinese international students in Italy. *Asia Pac. J. Educ. Dev. (APJED)* 2, 13–25.
- Souto-Otero, M., Huisman, J., Beerkens, M., de Wit, H., and Vujjié, S. (2013). Barriers to international student mobility: Evidence from the Erasmus program. *Educ. Res.* 42, 70–77. doi: 10.3102/0013189x12466696
- Sung, C. C. M. (2020). English as a lingua franca in the international university: language experiences and perceptions among international students in multilingual Hong Kong. *Lang. Cult. Curric.* 33, 258–273. doi: 10.1080/07908318.2019.1695814
- Tinto, V. (2015). *Student Success Does Not Happen by Accident*. Keynote address at the European First-Year Experience 2015 Conference, Bergen, Norway. Available online at: http://www.uib.no/en/efye_2015/78527/professor-emeritus-vincent-tinto

Turner, P., and Thompson, E. (2014). College retention initiatives: meeting the needs of millennial freshman students. *College Stud. J.* 48, 94–104.

Ward, C. (2001). *The Impact of International Student on Domestic Students and Host Institutions: A Literature Review*. Wellington, New Zealand: Ministry of Education (Export Education).

Willcoxson, L. (2010). Factors affecting intention to leave in the first, second, and third year of university studies: a semester-by-semester investigation. *High. Educ. Res. Dev.* 29, 623–639. doi: 10.1080/07294360.2010.501071

Winchester-Seeto, T., Rowe, A., and Mackaway, J. (2016). Sharing the load: understanding the roles of academics and host supervisors

in work-integrated learning. *Asia-Pacific J. Cooperat. Educ.* 17, 101–118.

Wirt, L. G., and Jaeger, A. J. (2014). Seeking to understand faculty-student interaction at community colleges. *Commun. Coll. J. Res. Pract.* 38, 980–994. doi: 10.1080/10668926.2012.725388

Wood, J. L., Newman, C. B., and Harris, F. (2015). Self-efficacy as a determinant of academic integration: an examination of first-year Black males in the community college. *West. J. Black Stud.* 39, 3–17.

Zaitseva, E., Milsom, C., and Stewart, M. (2013). Connecting the dots: using concept maps for interpreting student satisfaction. *Qual. High. Educ.* 19, 225–247. doi: 10.1080/13538322.2013.802576



OPEN ACCESS

EDITED BY
Ana Luísa Rodrigues,
University of Lisbon, Portugal

REVIEWED BY
Ngar-sze Lau,
The Education University
of Hong Kong, Hong Kong SAR, China
Stephen McKenzie,
The University of Melbourne, Australia

*CORRESPONDENCE
Carla Serrão
carlaserrao@ese.ipp.pt

SPECIALTY SECTION
This article was submitted to
Higher Education,
a section of the journal
Frontiers in Education

RECEIVED 03 July 2022
ACCEPTED 17 August 2022
PUBLISHED 09 September 2022

CITATION
Serrão C, Rodrigues AR and Ferreira T
(2022) The effects of a
mindfulness-based program on higher
education students.
Front. Educ. 7:985204.
doi: 10.3389/feduc.2022.985204

COPYRIGHT
© 2022 Serrão, Rodrigues and Ferreira.
This is an open-access article
distributed under the terms of the
[Creative Commons Attribution License
\(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use, distribution or
reproduction in other forums is
permitted, provided the original
author(s) and the copyright owner(s)
are credited and that the original
publication in this journal is cited, in
accordance with accepted academic
practice. No use, distribution or
reproduction is permitted which does
not comply with these terms.

The effects of a mindfulness-based program on higher education students

Carla Serrão^{1,2*}, Ana Rita Rodrigues^{3,4} and Tiago Ferreira^{3,4}

¹School of Education, Polytechnic of Porto, Porto, Portugal, ²Center for Research and Innovation in Education (inED), Porto, Portugal, ³Department of Social and Behavioural Sciences, University of Maia, Maia, Portugal, ⁴Center for Psychology at University of Porto, Porto, Portugal

Background: Entering higher education is a process with multiple challenges that requires the mobilization of personal, social and instrumental resources. As a result, students tend to experience greater stress, anxiety, and depression. In this regard, mindfulness-based interventions (MBIs) can serve as a useful tool to help students deal with these demands.

Objective: This study aimed to evaluate the effect of a Mindfulness in Education program in reducing stress, anxiety, and depression symptoms among students.

Methods: Forty-four students of higher education from four degrees in the fields of Social and Cultural Sciences participated and finished surveys before and after the 12-weeks intervention, measuring stress, depression, anxiety, mindfulness, and self-compassion. Twenty-three students (82.61% female; Mage = 20.35 DPage = 3.24) participated in Mindfulness in Education. These participants were paired with 21 students (90.48% female; Mage = 18.67, DPage = 0.73), which constituted the control condition.

Results: The results showed a session \times condition interaction that was statistically significant for depression ($p < 0.012$) and stress ($p < 0.026$). In the follow-up exploration, the experimental condition revealed a statistically significant and moderate change in the severity of the symptoms of depression [$t(14) = -2.315$, $p = 0.036$, $\zeta = 0.304$, 95% CI (-0.023, -0.499)] but not at the stress level [$t(14) = -1.443$, $p = 0.171$, $\zeta = 0.223$, 95% CI (-0.006, -0.364)].

Conclusion: Outcomes were promising, adding to evidence that MBIs can play an important role in helping students manage stress and depression. However, it is still necessary to investigate the mechanisms underlying this type of interventions.

KEYWORDS

higher education, mindfulness, stress, depression, anxiety

Introduction

The transition from high school to college or university can be a stressful event. In higher education, students are confronted with multiple academic, social and institutional challenges (e.g., Hindman et al., 2015; Bamber and Kraenzle Schneider, 2016), new lifestyle, friends, roommates, exposure to pedagogical challenges and alternative ways of thinking. Therefore, social, personal and emotional adaptation to this new context is a demanding process which requires students to mobilize a set of essential personal, social and instrumental resources. As a result, students tend to experience increased stress, anxiety (e.g., Bayram and Bilgel, 2008; DeRoma et al., 2009; Gallego et al., 2014; Goyal et al., 2014; Beiter et al., 2015; Habibirwe et al., 2018; Bamber and Morpeth, 2019), depression (e.g., Goyal et al., 2014; Beiter et al., 2015) and substance use (Ibrahim et al., 2013; Pedrelli et al., 2015) which may result in a significant deterioration of psychosocial functioning and maladaptive behaviors, such as excessive alcohol consumption and the use of substances (e.g., Mekonen et al., 2017), as well as an increased risk of drop-out (Eisenberg et al., 2009; Keyes et al., 2012). Thus, the mental health of higher education students has been a public health issue of growing concern (Baik et al., 2019).

In response to this scenario, Higher Education Institutions (HEIs) around the world have developed a set of actions. For example, providing psychological support services (e.g., Eells and Rando, 2010; Santos, 2011), tutoring and training programs, peer counseling, strong supportive therapeutic relationships (e.g., Monti et al., 2014; Dickson and Gullo, 2015), programs which facilitate transition and adaptation (Patton et al., 2006; Jdaitawi et al., 2011), and mindfulness-based programs (De Bruin et al., 2015; Lynch et al., 2018; Bamber and Morpeth, 2019; Mantzios and Egan, 2019; Serrão and Peixoto, 2020).

Mindfulness is characterized by attitudes of attention, conscientiousness, non-judgment in relation to the present experience and greater connectivity in relation to the context (Kabat-Zinn, 1994); it corresponds to a form of consciousness focused on the present, in which each thought, emotion or sensation is noticed and accepted as it is (Kabat-Zinn, 1990; Segal et al., 2002). Mindfulness-based interventions (MBIs) consist of formal and informal meditative practices which allow individuals to develop metacognitive skills which are activated when attention is anchored in the present moment. From a psychological perspective, these practices consist of a process of self-regulation of attention, focused on the perception of immediate experiences, and integrate attitudes of curiosity, openness, and acceptance of those same experiences (Bishop et al., 2004). In higher education, the development of MBIs has been gradual (Bamber and Morpeth, 2019) and some previous studies provide evidence that these programs may have beneficial psychological effects. For example, they could increase subjective wellbeing (e.g., Baer et al., 2006; Gawrysiak et al., 2017), decrease internal shame and increase optimism

(e.g., Serrão and Peixoto, 2020), as well as decrease stress (e.g., Palmer and Rodger, 2009; Eroglu et al., 2014; Gallego et al., 2014; Bamber and Kraenzle Schneider, 2016; Shearer et al., 2016). Consequently, MBIs may be an important addition to the already existing tools intended to promote students' adaptation to the demands of higher education (e.g., Hindman et al., 2015; Bamber and Kraenzle Schneider, 2016; Barnes et al., 2017).

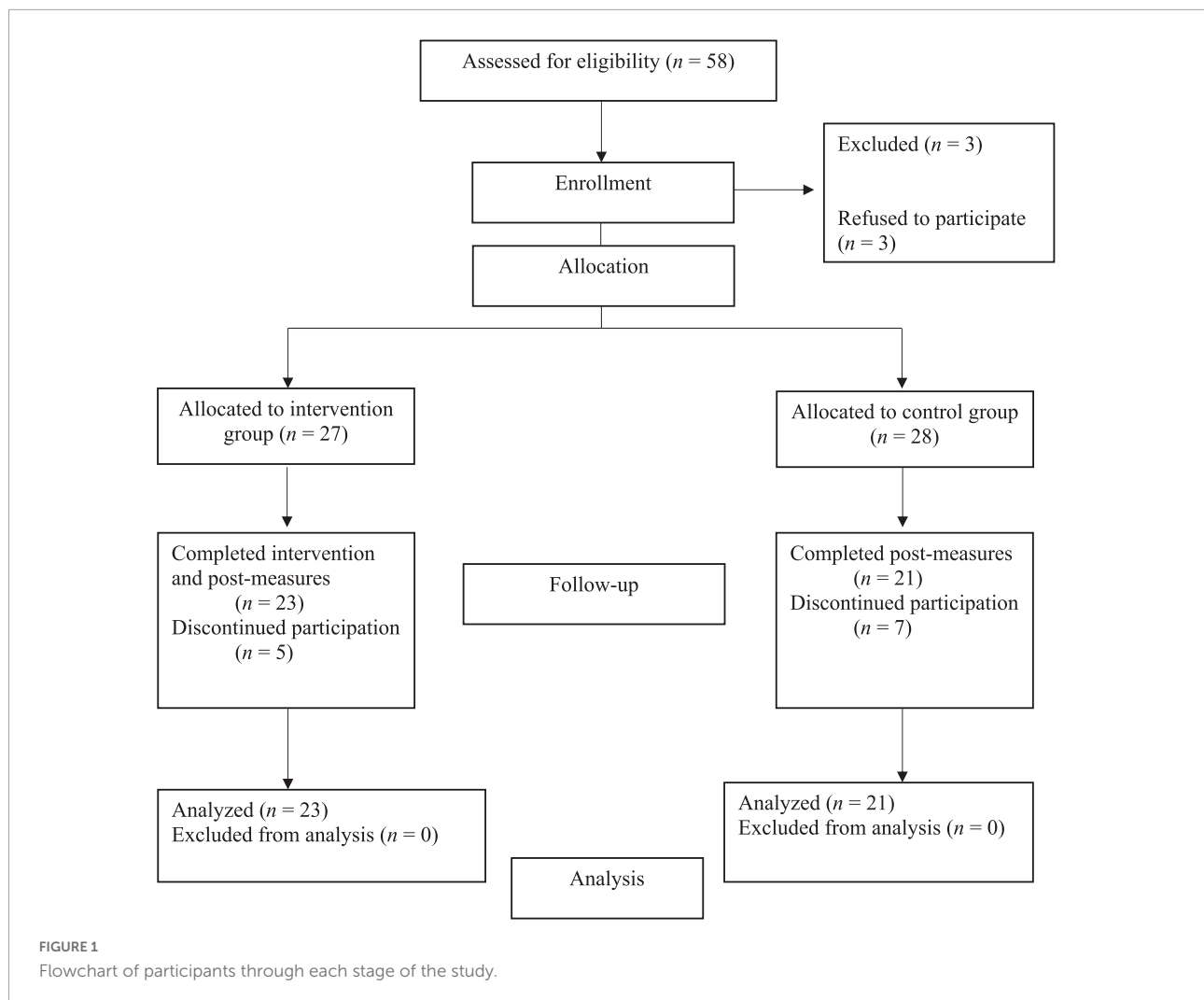
The MBIs used on college or university students differ in their type of intervention, design and length. However, Mindfulness-Based Stress Reduction (MBSR; Eroglu et al., 2014) and Mindfulness-Based Cognitive Therapy (MBCT; Gallego et al., 2014) are the most used and are generally extracurricular courses.

In this study, the mindfulness program (Mindfulness in Education; MiE) was introduced as part of the core curriculum in first-year courses to teach students self-care skills during this important developmental period. No particular program, such as MBCT or MBSR, was used. Instead, a program was created with a predominant focus on the psycho-educational dimension of depression, stress, anxiety, mindfulness and compassion. A longer-than-normal course was also designed, consisting of a total of 12 weeks rather than the standard 8 weeks. Therefore, the current study aims to evaluate the effects of the MiE program on helping Social and Cultural Sciences students to cope with stress, anxiety and depression, since these are the most frequent problems which these students experience. We hypothesize that students in the intervention group will report decreased levels of stress, generalized anxiety and depression from the pre- to post-intervention when compared to the control group; and students in the intervention group will report higher mindfulness and self-compassion from the pre-intervention to the post-intervention.

Materials and methods

Participants

Forty-four first-year students from four higher education degrees in the fields of Social and Cultural Sciences took part in this study. As part of their curriculum, 23 students (82.61% female; Mage = 20.35, SDage = 3.24) attended a MiE program. Of these, five (21.74%) reported familiarity with mindfulness practices (e.g., meditation, yoga) prior to the program, and thirteen (56.52%) reported having had psychological or psychiatric treatment in the past. These participants were paired with 21 students (90.48% female; Mage = 18.67, SDage = 0.73), who attended a different course on Philosophy for Children. The participants' flow diagram is presented in **Figure 1**. **Table 1** presents participants' demographic characteristics (e.g., familiarity with mindfulness practices, and previous psychological or psychiatry treatment). These two groups did not differ in their demographic characteristics.



Measures and instruments

The *Perceived Stress Scale* (PSS-10; Cohen et al., 1983; Portuguese version by Trigo et al., 2010), assesses the extent to which life events are perceived as stressors. The scale comprised ten items, where the subject is invited to indicate how often he/she felt or thought in a certain way during the last month, according to a five-point Likert scale (0 = “Never” to 4 = “Very Often”). Total scores correspond to the sum of the 10 items; higher scores indicate higher levels of stress (cut-off point = 25). In the present study, PSS-10 reliability was also adequate [$\alpha = 0.914$, 95% CI (0.872, 0.943)].

The *Patient Health Questionnaire* (PHQ-9; Kroenke et al., 2001; Portuguese version by Ferreira et al., 2018) is a simple questionnaire which assesses the health and mood of the participants in a quick way, checking if they have any of the main signs and symptoms of depression. It is a scale designed to assess depression and is composed of nine items, evaluated on a four-point Likert scale: 0 (“Never”) to 3 (“Almost Every

Day”), with a score ranging between zero and 27 points. Total scores are obtained through the sum of all items. It should also be noted that a score equal to or higher than nine points is estimated as a positive indicator of depression. Both the original version ($\alpha = 0.86$ to 0.89 ; Kroenke et al., 2001) and the Portuguese version ($\alpha = 0.869$; Ferreira et al., 2018) revealed adequate reliability. In this study, the reliability of the PHQ-9 was also adequate [$\alpha = 0.839$, 95% CI (0.766, 0.900)]. This scale objectively determines the severity of the initial symptoms and monitors the changes in symptoms and the effects of treatment over time, for this reason we chose to include it in the present study.

The *Generalized Anxiety Disorder* (GAD-7; Spitzer et al., 2006; Portuguese version of Sousa et al., 2015) is a self-report scale which consists of seven items, assessed on a Likert scale from zero (“Never”) to three (“Almost Every Day”), designed to measure the severity of the various symptoms of Generalized Anxiety Disorder. The total score can range from zero to 21 points and is obtained through the sum of the scores of all

items; the higher the score, the higher the severity of anxiety symptoms. A score equal to or higher than nine points is estimated as a positive indicator of anxiety. In the present study, GAD-7 reliability was also adequate [$\alpha = 0.899$, 95% CI (0.840, 0.938)].

The *Five Facets Mindfulness Questionnaire* (FFMQ; Baer et al., 2006, Portuguese version by Gregório and Pinto-Gouveia, 2011) is a self-report instrument to assess the general tendency of being mindful in daily life. It is composed of thirty-nine items, evaluated on a Likert scale from one (“Never or Very Rarely True”) to five (“Often or Always True”). The present scale measures five subdimensions of mindfulness: (a) observing (eight items); (b) describing (eight items); (c) acting with awareness (eight items); (d) non-judging (eight items) and (e) non-reacting (seven items). The scores of the subscales range between eight and forty points, except for the non-reactive subscale which varies between 7 and 35 points; the higher the score, the higher the levels of mindfulness. In the present study, good reliability was also obtained [$\alpha = 0.908$, 95% CI (0.865, 0.939)].

The *Self-Compassion Scale* (SCS; Neff, 2003; Portuguese version of Castilho and Gouveia, 2011) is a self-report measure consisting of a total of 26 items divided into six subscales: Self-Kindness (five items); Self-Criticism (five items); Human Condition (four items); Isolation (four items); Mindfulness (four items) and Over-Identification (four items). Each item is rated on a five-point Likert scale (1 = “Almost Never” and 5 = “Almost Always”). The total score is obtained through the sum of the scores of all items,

and it is also possible to obtain the average score for each subscale (partial results). Higher scores indicate higher levels of self-pity/self-compassion. In the present study, SCS reliability was also adequate [$\alpha = 0.944$, 95% CI (0.917, 0.965)].

Setting, design and procedure

At the beginning of the first year, and within the scope of study plans for four undergraduate courses, the Polytechnic of Porto’s School of Education gives students the opportunity to choose the curricular option which they would like to attend, based on an offer of four courses: MiE, Philosophy for Children, Education for Free Time or English.

The MiE program was carried out in person at the Polytechnic of Porto’s School of Education. MiE took place between February and May, once per week. At the baseline, alongside the presentation of the goals and contents of the course, the commitment to formal and informal daily meditation practices was highlighted. Students were informed that they were expected to attend at least two-thirds of all sessions and to spend 10–20 min completing daily practice. After this presentation, students were invited to participate in the present study.

The MiE program transpired over 12 weeks. However, the Easter holiday period and Academic Week break were respected, therefore there were no weekly sessions during that time. Students were invited to keep their daily practice autonomous, using the audios available for this purpose.

Participants of both groups gave their consent and completed baseline and post-program assessments in person at the Higher School of Education. The study was approved by the Center for Research and Innovation in Education (inED).

Mindfulness in education program

MiE was designed specifically for implementation at this college. It was adapted from MBCT (Teasdale et al., 1995), MBSR (Kabat-Zinn, 1982) and Mindful Self-Compassion (MSC; Neff and Germer, 2013). The MiE program includes 12 weekly group sessions. The sessions lasted an average of 2 h, except for session six—a retreat—which lasted for 5 h. Mindfulness meditation was the most trained and taught skill in MiE and aimed to progressively train in “Full Attention to Breathing” (Didonna, 2009). The main objective of this practice is having awareness of bodily sensations, thoughts and emotions that arise from moment to moment, continually returning the focus of attention to the breath whenever the mind wanders in a non-judgmental and non-reactive way.

The main training components were composed of several types of formal (sitting meditation) and informal (during

TABLE 1 Demographic characteristics.

Variables	MiE (n = 23)	Control (n = 21)	
Age in years, M (SD)	20.35 (3.24)	18.67 (0.73)	$t(24.43) = -2.42$, $p = 0.023$, $d = 0.71$
Gender			
Male, n (%)	4 (17.39%)	2 (9.52%)	$\chi^2(1, 44) = 0.59$, $p = 0.44$
Female, n(%)	19 (82.61%)	19 (90.48%)	
Marital status			
Single, n(%)	22 (95.65%)	21 (100%)	$\chi^2(1, 44) = 1.32$, $p = 0.25$
Married, n(%)	1 (4.35%)	0	
Psychological or psychiatric treatment			
Past, n(%)	13 (56.52%)	7 (33.33%)	$\chi^2(1, 44) = 2.33$, $p = 0.13$
Present, n(%)	3 (13.04%)	1 (4.76%)	$\chi^2(1, 44) = 0.96$, $p = 0.33$
Meditation or yoga practice			
Past, n(%)	5 (21.74%)	1 (4.76%)	$\chi^2(1, 44) = 0.31$, $p = 0.58$
Present, n(%)	1 (4.35%)	1 (4.76%)	$\chi^2(1, 44) = 0.01$, $p = 0.92$

MiE, Mindfulness in Education.

daily life) mindfulness and self-compassion practices (e.g., mindfulness of breath, body scan, and loving-kindness meditation), cognitive skills and homework (recording audio with a version of each meditation). All sessions started with a formal practice of 10 min of attention to breathing. There were experiential exercises and discussion periods in each session in addition to homework assignments to help participants learn how to be kinder and more mindful. The goal was to provide participants with several skills to increase mindfulness and self-compassion, and decrease depression, anxiety, and stress symptoms.

Table 2 shows an outline of the program.

Instructors

The sessions were guided by two psychology teachers, both certified and trained in third-generation cognitive-behavioral therapies, with experience and training in a several types of MBIs, namely MBCT, MBSR, MSC, and Compassionate Integrity Training ([Compassionate Integrity Training, n.d.](#)). The instructors were the first and second authors of this paper.

Data analysis

The analysis was performed using R (version 3.5.3; [R Core Team, 2019](#)). Robust methods were used in order to control the effect of deviations from normality ([Wilcox, 2011](#); [Field and Wilcox, 2017](#)). R package WRS2 ([Mair and Wilcox, 2020](#)) was used to compute two-way between-within subjects ANOVA on the trimmed means of depression, anxiety, stress, mindfulness, and self-compassion. The WRS2 package was also used to compute *post hoc* Yuen's tests on trimmed means for dependent samples. Robust standardized difference ([Algina et al., 2006](#)) was used as a measure of effect size. R package *ggstatsplot* ([Patil and Powell, 2018](#)) was used to depict results.

The Reliable Change Index (RCI) was computed for the PSS-10, PHQ-9, and GAD-7 according to the proposal by [Christensen and Mendoza \(1986\)](#). The PSS revealed an RCI of 7.68, the PHQ-9 of 5.75 and GAD-7 of 5.17.

Results

Descriptive statistics are presented in **Table 3**. The mean PHQ-9 depressive symptoms score for the participants in the MiE condition was 10.30 ($SD = 6.28$) at the baseline, indicating elevated symptom levels typical of clinical ranges. Similarly, the mean GAD-7 generalized anxiety symptoms score for the participants in the MiE condition was 10.26 ($SD = 5.00$) at the baseline, indicating elevated symptoms levels typical of clinical or borderline clinical ranges.

Depression

There were no significant main effects of condition [$F(1, 23.897) = 0.163, p = 0.690$] and session [$F(1, 23.586) = 0.580, p = 0.454$] on depression severity. There was a significant

TABLE 2 Mindfulness in education program.

Session	Outline
Baseline	Group presentation Definition of basic operating rules (privacy/confidentiality) and clear guidelines Doubts, clarification and presentation of contents and objectives of the program Provision of consent form Assessment: self-report questionnaires.
1	Breathing meditation Introduction to mindfulness Homework and home practice prescription.
2	Breathing meditation, check-in and homework review Mindfulness origins Nine Foundational Attitudes of Mindfulness according to Kabat-Zinn Sitting meditation (practice and discussion) Homework and home practice prescription.
3	Breathing meditation, check-in and homework review Automatic pilot vs. present mind Meditation types: examples of formal and informal meditation Sitting meditation (practice and discussion) Homework and home practice prescription.
4	Breathing meditation, check-in and homework review Mindfulness-based Interventions Sitting meditation (practice and discussion) Homework and home practice prescription.
5	Breathing meditation, check-in and homework review Exploration: Stress, Anxiety, Depression and Mindfulness Body Scan (practice and discussion) Homework and home practice prescription.
6	Retreat: A silence day of meditation (approximately 5 h) of different forms of guided meditation (e.g., sitting meditation, walking meditation, art meditation and eating meditation) Exploration: the experience of the retreat (feelings, sensations, thoughts).
7	Breathing meditation, check-in and homework review Mindful movements (outline, practice and discussion) Sitting meditation (practice and discussion) Homework and home practice prescription.
8	Breathing meditation, check-in and homework review Exploration: Health and Mindfulness Sitting meditation (practice and discussion) Homework and home practice prescription.
9	Breathing meditation, check-in and homework review Introduction to Compassion and Self-compassion Sitting meditation (practice and discussion) Homework and home practice prescription.
10	Breathing meditation, check-in and homework review Exploration: Compassionate response to oneself and others Sitting meditation (practice and discussion) Homework and home practice prescription.
11	Breathing meditation, check-in and homework review Communication: mindful and empathetic listening Sitting meditation (practice and discussion) Homework and home practice prescription.
12	Breathing meditation, check-in and homework review Exploration: challenges and obstacles to daily practice Review of meditations and attitudes of mindfulness, experience of Mindfulness in Education and next steps/directions. Closing: sharing.

TABLE 3 Descriptive statistics.

Variable		MiE	Control	
Depression, <i>M</i> (<i>SD</i>)	Baseline	10.30 (6.28)	7.95 (4.61)	$t(42) = -1.40, p = 0.168, d = 0.43$
	Post-program	8.35 (5.36)	9.33 (5.54)	
Stress, <i>M</i> (<i>SD</i>)	Baseline post-program	22.61 (8.03)20.26 (7.9)	20.05 (7.45)22.86 (8.53)	$t(42) = -1.09, p = 0.280, d = 0.33$
Anxiety, <i>M</i> (<i>SD</i>)	Baseline post-program	10.26 (5.00)9.00 (5.95)	9.00 (5.95)11.14 (5.94)	$t(42) = -0.76, p = 0.450, d = 0.23$
Mindfulness, <i>M</i> (<i>SD</i>)	Baseline post-program	120.35 (21.29)127.13 (18.24)	122.67 (18.98)120.05 (18.11)	$t(39) = 0.42, p = 0.676, d = 0.13$
Self-Compassion, <i>M</i> (<i>SD</i>)	Baseline post-program	75.17 (19.78)83.22 (18.26)	76.57 (19.62)77.24 (20.51)	$t(40) = 0.17, p = 0.866, d = 0.05$

interaction between session and condition on depression severity [$F(1, 23.586) = 7.409, p = 0.012$]. *Post hoc* analysis (see Figure 2) revealed a statistically significant and large decrease in the severity of depression in the MiE condition [$t_{Yuen}(14) = 2.315, p = 0.036, \delta_R = 0.554, 95\% \text{ CI } (0.217, 1.021)$] but not in the control condition [$t_{Yuen}(12) = -1.488, p = 0.162, \delta_R = -0.338, 95\% \text{ CI } (-0.749, 0.041)$] which displayed a moderate increase in depression.

Stress

There were no significant main effects of condition [$F(1, 23.852) = 0.075, p = 0.787$] and session [$F(1, 22.467) = 0.008, p = 0.931$] in the level of stress. There was a significant interaction between session and condition in the level of the stress [$F(1, 22.467) = 5.662, p = 0.026$]. *Post hoc* analysis (see Figure 3) did not reveal any statistically significant changes in the level of the stress in the MiE condition [$t_{Yuen}(14) = -1.443, p = 0.171, \delta_R = 0.313, 95\% \text{ CI } (-0.091, 0.757)$].

Anxiety

There were no significant main effects of condition [$F(1, 22.271) = 0.130, p = 0.722$] and session [$F(1, 21.860) = 0.026, p = 0.873$]. In the same way, there were no significant interactions between session and condition on anxiety severity [$F(1, 21.860) = 3.905, p = 0.061$]. *Post hoc* analysis (see Figure 4) did not reveal any statistically significant changes on anxiety severity in the MiE condition [$t_{Yuen}(14) = -1.319, p = 0.208, \delta_R = 0.249, 95\% \text{ CI } (-0.161, -0.756)$].

Mindfulness and self-compassion

There were no significant main effects of condition [$F(1, 23.639) = 0.031, p = 0.861$] and session [$F(1, 17.309) = 1.256, p = 0.278$] in the level of mindfulness. There was no significant interaction between session and condition in the level of mindfulness [$F(1, 17.309) = 4.037, p = 0.060$]. *Post hoc* analysis

did not reveal any statistically significant changes in the level of mindfulness in the MiE condition [$t_{Yuen}(14) = -1.738, p = 0.104, \delta_R = -0.233, 95\% \text{ CI } (-0.797, -0.184)$]. However, it should be noted that, in the experimental condition, in contrast to the control condition, there was an average increase of about seven points between baseline [$\mu = 120.348, 95\% \text{ CI } (112.911-129.232)$] and post-intervention [$\mu = 127.130, 95\% \text{ CI } (119.092-134.240)$] for the mindfulness variable. In the same way, there were no significant main effects of condition [$F(1, 23.600) = 0.320, p = 0.577$] and session [$F(1, 18.934) = 4.120, p = 0.057$] in the level of self-compassion. *Post hoc* analysis did not reveal any statistically significant changes in the level of self-compassion in the MiE condition [$t_{Yuen}(14) = -1.877, p = 0.081, \delta_R = -0.694, 95\% \text{ CI } (-1.685, -0.151)$]. There was an average increase of about eight points between baseline [$\mu = 75.174, 95\% \text{ CI } (65.826-81.379)$] and post-intervention [$\mu = 83.217, 95\% \text{ CI } (76.922-90.418)$] for the self-compassion variable.

Improved, recovered and deteriorated

Table 4 shows the percentage of improved, recovered and deteriorated participants in both conditions according to the Reliable Change Index (RCI). As noted, the calculation of the RCI points to an improvement and clinical recovery in stress, depression and higher anxiety in the MiE condition. In addition, it appears that it is in the control condition that there are more participants who deteriorated over time, in terms of stress, anxiety, and depression.

Discussion

The mental health of university students has been a public health concern for some time. Previous studies (e.g., Bayram and Bilgel, 2008; DeRoma et al., 2009; Gallego et al., 2014; Goyal et al., 2014; Beiter et al., 2015; Habibirwe et al., 2018; Bamber and Morpeth, 2019) suggest that higher education students tend to experience increased levels of stress, anxiety, and depression as a result of multiple academic, social and institutional challenges (Hindman et al., 2015; Bamber and Kraenzle Schneider, 2016).

TABLE 4 Percentage of improved, recovered and deteriorated participants according to the Reliable Change Index (RCI).

	Improved		Recovered		Deteriorated	
	MiE	Control	MiE	Control	MiE	Control
Stress, <i>n</i> (%)	5 (21.74%)	0	3 (13.04%)	0	2 (8.70%)	5 (23.81%)
Depression, <i>n</i> (%)	5 (21.74%)	1 (4.76%)	4 (17.39%)	1 (4.76%)	2 (8.70%)	3 (14.29%)
Anxiety, <i>n</i> (%)	5 (21.74%)	1 (4.76%)	2 (8.70%)	0	3 (13.04%)	4 (19.05%)

RCI, PSS-10 > 7.68; PHQ-9 > 5.75; GAD-7 > 5.17. Cut-off, PSS-10 = 25; PHQ-9 = 9; GAD-7 = 9.

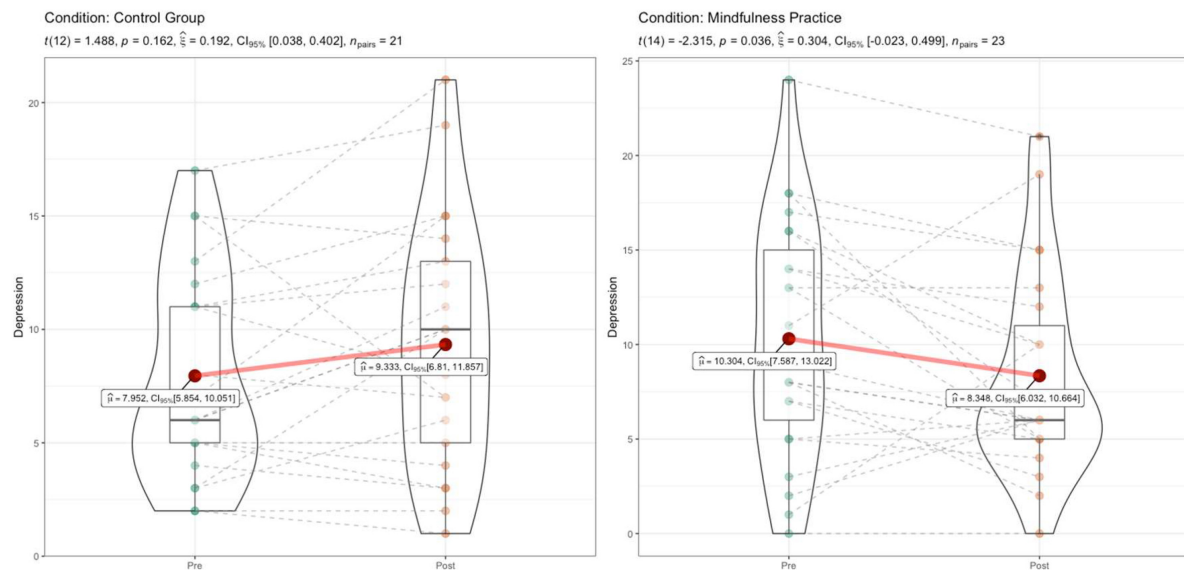


FIGURE 2

Evolution of experimental and control conditions between moment T1 and Moment T2 in the depression variable.

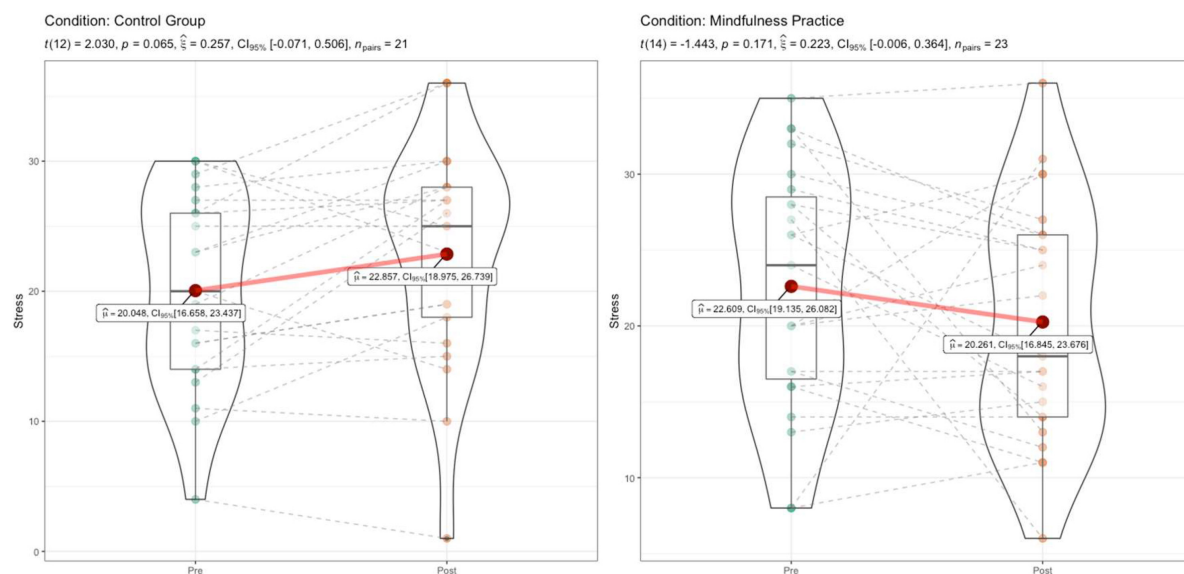
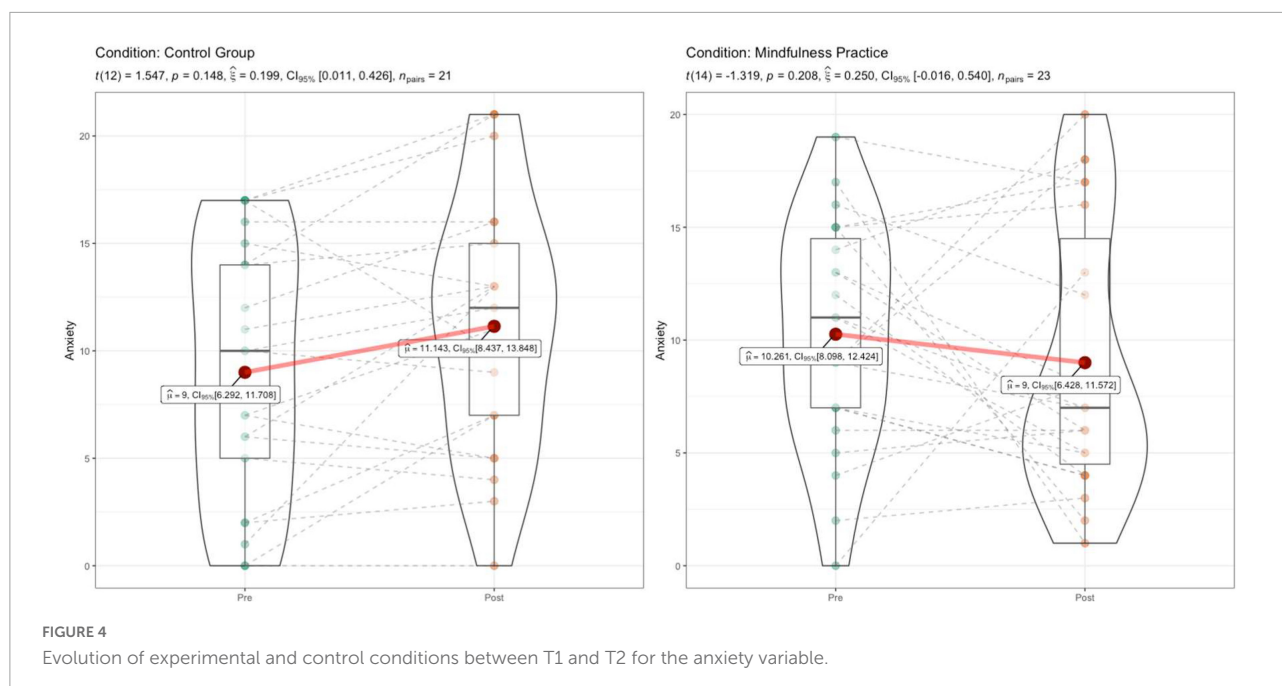


FIGURE 3

Evolution of the experimental and control condition between moments T1 and T2, in the stress variable.



The present study aimed to evaluate the effects of MiE on stress, generalized anxiety, depression, mindfulness and self-compassion in first-year students. It also aimed to train students in terms of self-care skills, essential in this period of development, thus determining whether MBIs can be protective to promote good adaptation of students to the different demands of higher education.

In accordance with prior research (e.g., Palmer and Rodger, 2009; Erogul et al., 2014; Gallego et al., 2014; Bamber and Kraenzle Schneider, 2016; Shearer et al., 2016), students in the MiE condition reported significantly reduced perceived stress and depression. These results appear to be consistent with earlier systematic reviews (e.g., McConville et al., 2017; Halladay et al., 2019). However, there are no statistically significant differences in terms of anxiety, mindfulness and self-compassion. Compared to previous studies (e.g., Benjet et al., 2019), at the baseline, students reported higher rates of psychiatric or psychological treatment in the past, which may indicate some type of emotional or behavioral problems, namely depression or anxiety. This may explain the results obtained, particularly the fact that students in the MiE condition did not differ significantly in measures of generalized anxiety compared to the control condition. One reason for this result could be the number of sessions in the program, since there are authors (e.g., Bamber and Morpeth, 2019) who suggest that programs with around thirty sessions show better results in terms of reducing anxiety. Another aspect to note is the fact that MBIs increase the mindfulness daily practice as a habit and a routine (Halladay et al., 2019). This aspect may also explain the results obtained in terms of anxiety as, although home practice has always been encouraged and reinforced in all MiE sessions, it may be the case

that student engagement has decreased over time. In addition, although MIBs are effective in decreasing symptoms in a variety of disorders, the psychological mechanisms are not entirely understood, particularly amongst individuals with generalized anxiety symptoms (e.g., Hoge et al., 2015). Nevertheless, it should be noted that the experimental condition showed a decrease in the mean values of generalized anxiety (measured by the GAD-7) compared to the control condition.

Another objective of this study was to ascertain whether participation in MiE would lead to changes in the levels of mindfulness, as measured by the FFMQ. Contrary to what was seen in other studies, the results indicated the absence of significant effects of the intervention (e.g., Erogul et al., 2014; De Bruin et al., 2015; Song and Lindquist, 2015; Lynch et al., 2018; Serrão and Alves, 2019). Facing this unexpected result, some hypotheses are raised. As we can see at the baseline, participants of the MiE group had a high average level of mindfulness, which may have explained the results of the present study, since these could have overestimated their mindfulness skills (e.g., De Bruin et al., 2015; Serrão and Peixoto, 2020), particularly non-judgmental, observe, non-reactive skills, at an early stage. The hypothesis we put forward is that with the development of the MiE the participants gained a better understanding of each of the attitudes, which may have led to a greater awareness of the skills they hold and what they need train and learn.

The present findings suggest that the mindfulness-based meditative practices, when included in academic curriculum programs, appear to be a promising response to mental health care as they provide opportunities for the development of skills to deal with and manage stressful events. The reduction of psychological stress in higher education students seems to have

a clear effect in terms of preventing diseases and promoting mental health (Gallego et al., 2014). It seems, however, that some students do not benefit from these practices, suggesting that caution is required in the use of these programs in general (e.g., Baer and Kuyken, 2016; Baer et al., 2019; Halladay et al., 2019). In addition, some potential harmful effects may also be underestimated/neglected, which are likely to be more common than thought (Britton and Sydnor, 2015; Baer et al., 2019). These programs, although promising, do not seem to replace psychotherapeutic interventions targeting specific populations and are eventually even contraindicated (Arch and Ayers, 2013). In addition, findings support the higher risk of psychological distress amongst students and the need for urgent intervention by higher education policy to integrated approaches to the mental health promotion (Schofield et al., 2016).

Although the results of this study are encouraging, they must be analyzed with caution, given the sample size and the characteristics of the study developed. Thus, additional research should be carried out, identifying, for example, the mechanisms of action and their interactions with the different symptoms, using a larger number of students, complementary qualitative measures and including psychophysiological markers and neurocognitive measures, since these measures are more sensitive to subtle changes in anxiety, stress, and depression.

Finally, it is suggested that studies are carried out which make it possible to identify the psychosocial characteristics that predict a good response from students to this type of interventions and generate differentiated responses to mental health care in the context of higher education. It is also important, based on the use of more consistent monitoring methods, to assess, for example, the relationship between the effect of these interventions and the daily time devoted by each participant, both to formal and informal practices.

Limitations

Several limitations should be mentioned. Firstly, the findings are limited by small sample size. Secondly, mindfulness is a complex construct which may not be fully captured by self-report tools. Thirdly, the absence of the follow-up moment, it being impossible to see whether the results have changed over time. Finally, it is also important to mention the fact that there are no concrete indicators of the time spent by each student in the formal practice of mindfulness throughout the entire intervention.

Conclusion

In higher education, students are confronted with multiple academic, social and institutional challenges. MBIs as part of the core curriculum in first-year courses could teach students

self-care skills during this important developmental period. The results of this study suggest that the mindfulness-based meditative practices, when included in academic curriculum programs, appear to be a promising response to mental health care as they provide opportunities for the development of skills to deal with and manage stressful events.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by INED. The patients/participants provided their written informed consent to participate in this study.

Author contributions

CS and AR contributed to conception and design of the study, project administration—supervision and coordination, were involved in the data collection, wrote the first draft of the manuscript, manuscript preparation, manuscript revision, reviewing, editing, and manuscript final version approval. TF organized the database and performed the statistical analysis. All authors contributed to manuscript revision, read, and approved the submitted version.

Funding

This work was supported by the National Funds Through the FCT—Fundação para a Ciência e a Tecnologia, I.P., within Centre for Research and Innovation in Education, inED (reference UIDB/05198/2020), FCT (reference UIDB/00050/2020), and EU FEDER through COMPETE 2020 program (POCI-01-0145-FEDER-007294).

Acknowledgments

We would like to thank all students for participating in this study.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated

organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

- Algina, J., Keselman, H. J., and Penfield, R. D. (2006). Confidence interval coverage for Cohen's effect size statistic. *Educ. Psychol. Measur.* 66, 945–960. doi: 10.1177/0013164406288161
- Arch, J. J., and Ayers, C. R. (2013). Which treatment worked better for whom?: Moderators of group cognitive behavioural therapy versus adapted mindfulness based stress reduction for anxiety disorders. *Behav. Res. Ther.* 51, 434–442. doi: 10.1016/j.brat.2013.04.004
- Baer, R., Crane, C., Miller, E., and Kuyken, W. (2019). Doing no harm in mindfulness-based programs: Conceptual issues and empirical findings. *Clin. Psychol. Rev.* 71, 101–114. doi: 10.1016/j.cpr.2019.01.001
- Baer, R., and Kuyken, W. (2016). *Is Mindfulness Safe?*. Oxford: Oxford Mindfulness Centre.
- Baer, R., Smith, G., Hopkins, J., Krietemeyer, J., and Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. *Assessment* 13, 27–45. doi: 10.1177/1073191105283504
- Baik, C., Larcombe, W., and Brooker, A. (2019). How universities can enhance student mental well-being: the student perspective. *High. Educ. Res. Dev.* 38, 674–687. doi: 10.1080/07294360.2019.1576596
- Bamber, M. D., and Kraenzle Schneider, J. (2016). Mindfulness-based meditation to decrease stress and anxiety in college students: A narrative synthesis of the research. *Educ. Res. Rev.* 18, 1–32. doi: 10.1016/j.edurev.2015.12.004
- Bamber, M. D., and Morphet, E. (2019). Effects of mindfulness meditation on college student anxiety: A meta-analysis. *Mindfulness* 10, 203–214. doi: 10.1007/s12671-018-0965-5
- Barnes, N., Hattan, P., Black, D. S., and Schuman-Olivier, Z. (2017). An examination of mindfulness-based programs in US medical schools. *Mindfulness* 8, 489–494. doi: 10.1007/s12671-016-0623-8
- Bayram, N., and Bilgel, N. (2008). The prevalence of socio-demographic correlations of depression, anxiety and stress among a group of university students. *Soc. Psychiatry Psychiatr. Epidemiol.* 43, 667–672. doi: 10.1007/s00127-008-0345-x
- Beiter, R., Nash, R., McCrady, M., Rhoades, D., Linscomb, M., Clarahan, M., et al. (2015). The prevalence and correlations of depression, anxiety, and stress in a sample of college students. *J. Affect. Disord.* 173, 90–96. doi: 10.1016/j.jad.2014.10.054
- Benjet, C., Gutiérrez-García, R. A., Abrego-Ramírez, A., Borges, G., Covarrubias-Díaz, A., Durán, M. D. S., et al. (2019). Psychopathology and self-harm among incoming first-year students in six Mexican universities. *Salud Públ. México* 61, 16–26. doi: 10.21149/9158
- Bishop, S. T., Lau, M., Shapiro, S. L., Carlson, L., Anderson, N. D., Carmody, J., et al. (2004). Mindfulness: A proposed operational definition. *Clin. Psychol.* 11, 230–241. doi: 10.1093/clipsy/bph077
- Britton, W. B., and Sydnor, A. (2015). “Neurobiological models of meditation: implications for training young people,” in *Teaching Mindfulness Skills to Kids and Teens*, eds C. Willard and A. Salzmann (New York, NY: Guilford Press), 402–426.
- Castilho, P., and Gouveia, J. P. (2011). Auto-Compaixão: Estudo da validação da versão portuguesa da Escala da Auto-Compaixão e da sua relação com as experiências adversas na infância, a comparação social e a psicopatologia [Self-Compassion: Study of the validation of the Portuguese version of the Self-Compassion Scale and its relationship with adverse childhood experiences, social comparison and psychopathology]. *Psychologica* 54, 203–230. doi: 10.14195/1647-8606_54_8
- Christensen, L., and Mendoza, J. (1986). A method of assessing change in a single subject: An alteration of the RC index. *Behav. Ther.* 17, 305–308.
- Cohen, S., Kamarck, T., and Mermelstein, R. (1983). A global measure of perceived stress. *J. Health Soc. Behav.* 24, 385–396. doi: 10.2307/2136404
- Compassionate Integrity Training (n.d.). *Compassionate Integrity Training*. <https://www.compassionateintegrity.org/about-the-program/>
- De Bruin, E. I., Meppelink, R., and Bögels, S. M. (2015). Mindfulness in higher education: Awareness and attention in university students increase during and after participation in a mindfulness curriculum course. *Mindfulness* 6, 1137–1142. doi: 10.1007/s12671-014-0364-5
- DeRoma, V. M., Leach, J. B., and Leverett, J. P. (2009). The relationship between depression and college academic performance. *Coll. Stud. J.* 43, 325–335.
- Dickson, J. M., and Gullo, M. J. (2015). The role of brief CBT in the treatment of anxiety and depression for young adults at a UK university: A pilot prospective audit study. *Cogn. Behav. Ther.* 8, 1–9. doi: 10.1017/S1754470X15000240
- Didonna, F. (2009). “Mindfulness and obsessive-compulsive disorder: Developing a way to trust and validate one's internal experience,” in *Clinical Handbook of Mindfulness*, ed. F. Didonna (New York, NY: Springer), 189–219. doi: 10.1007/978-0-387-09593-6
- Eells, G. T., and Rando, R. A. (2010). “Components of an effective college mental health service,” in *Mental Health Care in the College Community*, eds J. Kay and V. Schwartz (West Sussex: John Wiley & Sons), 43–55. doi: 10.1002/9780470686836.ch4
- Eisenberg, D., Downs, M. F., Golberstein, E., and Zivin, K. (2009). Stigma and help seeking for mental health among college students. *Med. Care Res. Rev.* 66, 522–541. doi: 10.1177/1077558709335173
- Erogul, M., Singer, G., McIntyre, T., and Stefanov, D. G. (2014). Abridged mindfulness intervention to support wellness in first-year medical students. *Teach. Learn. Med.* 26, 350–356. doi: 10.1186/s41155-018-0099-7
- Ferreira, T., Sousa, M., Meira, L., Cunha, C., Santos, A., Silva, S., et al. (2018). Brief assessment of depression: Psychometric properties of the Portuguese version of the Patient Health Questionnaire (PHQ-9). *Psychol. Pract. Res. J.* 1, 1–15. doi: 10.33525/pprj.v1i2.36
- Field, A. P., and Wilcox, R. R. (2017). Robust statistical methods: A primer for clinical psychology and experimental psychopathology researchers. *Behav. Res. Ther.* 98, 19–38. doi: 10.1016/j.brat.2017.05.013
- Gallego, J., Aguilar-Parra, J. M., Cangas, A. J., Langer, Á. I., and Mañas, I. (2014). Effect of a mindfulness programme on stress, anxiety and depression in university students. *Span. J. Psychol.* 17, 1–6. doi: 10.1017/sjp.2014.102
- Gawrysiak, M., Grasseti, S., Greeson, J., Shorey, R., Pohlig, R., and Baime, M. (2017). The many facets of mindfulness and the prediction of change following mindfulness-based stress reduction (MBSR). *J. Clin. Psychol.* 74, 523–535. doi: 10.1002/jclp.22521
- Goyal, M., Singh, S., Sibinga, E. M., Gould, N. F., Rowland-Seymour, A., Sharma, R., et al. (2014). Meditation programs for psychological stress and well-being: a systematic review and meta-analysis. *JAMA Int. Med.* 174, 357–368. doi: 10.1001/jamainternmed.2013.13018
- Gregório, S., and Pinto-Gouveia, J. (2011). Facetas de mindfulness: características psicométricas de um instrumento de Avaliação [Facets of mindfulness: psychometric characteristics of an Assessment tool]. *Psychologica* 54, 259–279. doi: 10.14195/1647-8606_54_10
- Habibirwe, P., Porovecchio, S., Bramboiu, I., Ciobanu, E., Croitoru, C., Cazacu, I., et al. (2018). Depression, anxiety and stress among college students in three European countries. *Eur. J. Public Health* 28:cky214.026. doi: 10.1093/eurpub/cky214.026
- Halladay, J. E., Dawdy, J. L., McNamara, I. F., Chen, A. J., Vitoroulis, I., McInnes, N., et al. (2019). Mindfulness for the mental health and well-being of post-secondary students: a systematic review and meta-analysis. *Mindfulness* 10, 397–414. doi: 10.1007/s12671-018-0979-z
- Hindman, R. K., Glass, C. R., Arnkoff, D. B., and Maron, D. D. (2015). A comparison of formal and informal mindfulness programs for stress reduction in university students. *Mindfulness* 6, 873–884. doi: 10.1007/s12671-014-0331-1
- Hoge, E. A., Bui, E., Goetter, E., Robinaugh, D. J., Ojserkis, R. A., Fresco, D. M., et al. (2015). Change in decentering mediates improvement in anxiety in

- mindfulness-based stress reduction for generalized anxiety disorder. *Cogn. Ther. Res.* 39, 228–235. doi: 10.1007/s10608-014-9646-4
- Ibrahim, A. K., Kelly, S. J., Adams, C. E., and Glazebrook, C. (2013). A systematic review of studies of depression prevalence in university students. *J. Psychiatr. Res.* 47, 391–400. doi: 10.1016/j.jpsychires.2012.11.015
- Jdaitawi, T., Taamneh, A., Gharaibeh, N., and Rababah, M. (2011). The effectiveness of emotional intelligence training program on social and academic adjustment among first-year university students. *Int. J. Bus. Soc. Sci.* 2, 251–258.
- Kabat-Zinn, J. (1982). An outpatient program in behavioral medicine for chronic pain patients based on the practice of mindfulness meditation: Theoretical considerations and preliminary results. *Gen. Hospital Psychiatry* 4, 33–47. doi: 10.1016/0163-8343(82)90026-3
- Kabat-Zinn, J. (1990). *Full Catastrophe Living: Using the Wisdom of Your Body and Mind to Face Stress, Pain, and Illness*. New York, NY: Delacorte.
- Kabat-Zinn, J. (1994). *Wherever You Go, There You Are: Mindfulness Meditation in Everyday Life*. New York, NY: Hyperion.
- Keyes, C. L., Eisenberg, D., Perry, G. S., Dube, S. R., Kroenke, K., and Dhingra, S. S. (2012). The relationship of level of positive mental health with current mental disorders in predicting suicidal behavior and academic impairment in college students. *J. Am. Coll. Health* 60, 126–133. doi: 10.1080/07448481.2011.608393
- Kroenke, K., Spitzer, R., and Williams, J. (2001). The PHQ-9: validity of a brief depression severity measure. *J. Gen. Int. Med.* 16, 606–613. doi: 10.1046/j.1525-1497.2001.016009606.x
- Lynch, S., Gander, M. L., Nahar, A., Kohls, N., and Walach, H. (2018). Mindfulness-based coping with university life: A randomized wait-list controlled study. *Sage Open* 8, 1–7. doi: 10.1177/258244018758379
- Mair, P., and Wilcox, R. (2020). Robust statistical methods in R using the WRS2 package. *Behav. Res. Methods* 52, 464–488. doi: 10.3758/s13428-019-01246-w
- Mantzios, M., and Egan, H. (2019). An experiential reflection of a mindful lecturer: exploring enhancement of active learning in higher education. *High. Educ. Pedagogies* 4, 304–306. doi: 10.1080/23752696.2019.1629826
- McConville, J., McAleer, R., and Hahne, A. (2017). Mindfulness training for health profession students – The effect of mindfulness training on psychological well-being, learning and clinical performance of health professional students: A systematic review of randomized and non-randomized controlled trials. *Explore* 13, 26–45. doi: 10.1016/j.explore.2016.10.002
- Mekonen, T., Fekadu, W., Chane, T., and Bitew, S. (2017). Problematic alcohol use among university students. *Front. Psychiatry* 19:86. doi: 10.3389/fpsy.2017.00086
- Monti, F., Tonetti, L., and Ricci Bitti, P. E. (2014). Comparison of cognitive-behavioural therapy and psychodynamic therapy in the treatment of anxiety among university students: an effectiveness study. *Br. J. Guid. Counsel.* 42, 233–244. doi: 10.1080/03069885.2013.878018
- Neff, K. (2003). The development and validation of a scale to measure self-compassion. *Self Identity* 2, 223–250. doi: 10.1080/15298860309027
- Neff, K. D., and Germer, C. K. (2013). A pilot study and randomized controlled trial of the Mindful Self-Compassion program. *J. Clin. Psychol.* 69, 28–44. doi: 10.1002/jclp.21923
- Palmer, A., and Rodger, S. (2009). Mindfulness, stress, and coping among university students. *Can. J. Counsel. Psychother.* 43, 198–212.
- Patil, I., and Powell, C. (2018). *ggstatsplot: 'ggplot2' Based Plots with Statistical Details*. Switzerland: Zenodo, doi: 10.5281/zenodo.2074621
- Patton, L. D., Morelon, C., Withehead, D. M., and Hossler, D. (2006). “Campus-based retention initiatives: Does the emperor have clothes?,” in *Reframing Persistence Research to Improve Academic Success*, eds E. P. St. John and M. Wilkerson (San Francisco, CA: Jossey-Bass), 9–24.
- Pedrelli, P., Nyer, M., Yeung, A., Zulauf, C., and Wilens, T. (2015). College students: mental health problems and treatment considerations. *Acad. Psychiatry* 39, 503–511. doi: 10.1007/s40596-014-0205-9
- R Core Team (2019). *R: A Language and Environment for Statistical Computing*. Vienna: R Foundation for Statistical Computing.
- Santos, L. (2011). *Saúde Mental e Comportamentos de Risco em Estudantes Universitários [Mental Health and Risk Behaviours in University Students]*. Doctoral dissertation. Aveiro: Universidade de Aveiro.
- Schofield, M. J., O'Halloran, P., McLean, S. A., Forrester-Knauss, C., and Paxton, S. J. (2016). Depression among university students. *Aust. Psychol.* 51, 135–144. doi: 10.1111/ap.12129
- Segal, Z., Williams, J., and Teasdale, J. (2002). *Mindfulness-Based Cognitive Therapy for Depression: A New Approach to Preventing Relapse*. New York, NY: Guilford.
- Serrão, C., and Alves, S. (2019). Effects of mindfulness-based cognitive therapy on a group of postgraduate students: An exploratory study. *Alter. Complement. Ther.* 25, 1–7. doi: 10.1089/act.2018.29206.cse
- Serrão, C., and Peixoto, C. (2020). Impacto de práticas breves de mindfulness no otimismo, vergonha interna e stresse percebido de estudantes do ensino superior [Impact of brief mindfulness practices on optimism, internal shame and perceived stress in higher education students]. *Sensos-e* 7, 85–96. doi: 10.34630/sensose.v7i2.3676
- Shearer, A., Hunt, M., Chowdhury, M., and Nicol, L. (2016). Effects of a brief mindfulness meditation intervention on student stress and heart rate variability. *Int. J. Stress Manag.* 23, 232–254. doi: 10.1037/a0039814
- Song, Y., and Lindquist, R. (2015). Effects of mindfulness-based stress reduction on depression, anxiety, stress and mindfulness in Korean nursing students. *Nurse Educ. Today* 35, 86–90. doi: 10.1016/j.nedt.2014.06.010
- Sousa, T., Viveiros, V., Chai, M., Vicente, F., Jesus, G., Carnot, M., et al. (2015). Reliability and validity of the Portuguese version of the Generalized Anxiety Disorder (GAD-7) scale. *Health Qual. Life Outcomes* 13, 1–8. doi: 10.1186/s12955-015-0244-2
- Spitzer, R., Kroenke, K., Williams, J., and Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch. Int. Med.* 166, 1092–1097. doi: 10.1001/archinte.166.10.1092
- Teasdale, J., Segal, Z., and Williams, J. (1995). How does cognitive therapy prevent depressive relapse and why should attentional control (mindfulness) training help? *Behav. Res. Ther.* 33, 25–39. doi: 10.1016/0005-7967(94)E0011-7
- Trigo, M., Canudo, N., Branco, F., and Silva, D. (2010). Estudo das propriedades psicométricas da Perceived Stress Scale (PSS) na população portuguesa [Study of the psychometric properties of the Perceived Stress Scale (PSS) in the Portuguese population]. *Psychologica* 53, 353–378. doi: 10.14195/1647-8606_53_17
- Wilcox, R. R. (2011). *Introduction to Robust Estimation and Hypothesis Testing*. Cambridge, MA: Academic Press.



OPEN ACCESS

EDITED BY
Ana Luísa Rodrigues,
University of Lisbon, Portugal

REVIEWED BY
Tzu-Chiang Lin,
National Kaohsiung University of
Science and Technology, Taiwan
Magdalena Ramos Navas-Parejo,
University of Granada, Spain

*CORRESPONDENCE
Anabel Ramos-Pla
anabel.ramos@udl.cat

SPECIALTY SECTION
This article was submitted to
Higher Education,
a section of the journal
Frontiers in Education

RECEIVED 18 August 2022
ACCEPTED 16 September 2022
PUBLISHED 30 September 2022

CITATION
del Arco I, Mercadé-Melé P,
Ramos-Pla A and Flores-Alarcia Ó
(2022) Bibliometric analysis of the
flipped classroom pedagogical model:
Trends and strategic lines of study.
Front. Educ. 7:1022295.
doi: 10.3389/feduc.2022.1022295

COPYRIGHT
© 2022 del Arco, Mercadé-Melé,
Ramos-Pla and Flores-Alarcia. This is
an open-access article distributed
under the terms of the [Creative
Commons Attribution License \(CC BY\)](#).
The use, distribution or reproduction
in other forums is permitted, provided
the original author(s) and the copyright
owner(s) are credited and that the
original publication in this journal is
cited, in accordance with accepted
academic practice. No use, distribution
or reproduction is permitted which
does not comply with these terms.

Bibliometric analysis of the flipped classroom pedagogical model: Trends and strategic lines of study

Isabel del Arco¹, Pere Mercadé-Melé², Anabel Ramos-Pla^{1*}
and Òscar Flores-Alarcia¹

¹Faculty of Education, Psychology and Social Work, Department of Pedagogy, University of Lleida, Lleida, Spain, ²Faculty of Economics, Department of Applied Economics, University of Málaga, Málaga, Spain

The Flipped Classroom (FC) emerged at the beginning of the 20th century as an alternative pedagogical model to the traditional classroom. It consists of inverting (flipping) some teaching-learning procedures, transferring some activities outside the classroom and reformulating the roles of the teacher and the student. The aim of this study is to identify the main existing trends and emerging strategic lines of research with respect to the FC pedagogical model. To this end, a bibliometric study was carried out by analyzing the international scientific production found in the Web of Science (WoS) database. A total of 2,194 articles were reviewed during the period from 2007 to 2021. The results showed an increase in publications on FC from 2013 onwards, reaching a significant peak in the scientific literature in the last 2 years. Scientific evidence is presented on the didactic virtue of the model, together with the increase in the degree of student satisfaction and motivation. New lines for the future are suggested, such as: providing evidence of the improvement in academic performance and solid and profound learning results in its application to different fields of knowledge, educational contexts, or with different types of students. Also, to investigate the co-responsibility of students by stimulating autonomy and self-regulation.

KEYWORDS

flipped classroom, teaching models, higher education, academic performance, role of the teacher

Introduction

At the start of the 20th Century, a new pedagogic model emerged, which proposed a different view of the education process, in tune with the new digital society of knowledge. This is the Flipped Classroom (FC) model, which transfers the first stages of the teaching and learning process (know and understand), as defined by the Taxonomy from Bloom, out of the classroom, as these stages require simpler skills (Anderson and Krathwohl, 2001; Campión, 2019). In the same manner, time is left for the classroom, where the teacher and students come into play, for the next stages in the same teaching-learning process, which require more complex skills (application, analysis, evaluation,

and creation) (Parra Giménez, 2017). From an integrated approach, higher level skills are acquired in the classroom while the lower skill ones are acquired outside of it, with the application of the FC model.

The interest on the implementation of this model in different disciplines (mathematics, engineering, social sciences, health sciences, humanities, etc...), and on different education levels and stages (primary education, secondary education, and university) (Hao, 2016; Ramos-Pla et al., 2021a,b), came from different education research studies which tried to combine scientific evidence on the educational results obtained (Akçayir and Akçayir, 2018).

Some studies have provided evidence that the level of academic motivation, satisfaction, and performance of the students significantly improved as compared to traditional classes (those in which the teachers do the explanations in class and the students must carry out activities outside the classroom) (Roehl et al., 2013; Gilboy et al., 2015; Hung, 2015; O'Flaherty and Phillips, 2015; Flores et al., 2016; del Arco et al., 2019, 2021; Bicen and Beheshti, 2022). Other studies point out to the FC model as a clear alternative in the area of education due to its incorporation of technologies, which provide innovative and dynamic opportunities where the student is the protagonist of learning (Forsey et al., 2013; Serrano Pastor and Casanova López, 2018; Jorge-Vázquez et al., 2020; Ramos-Pla et al., 2021a,b). Others, from the point of view of the teacher, analyze the resistance to change in light of the challenges brought on by the re-design of teaching according to the FC model (Ash, 2012; Bennett et al., 2015; Sánchez et al., 2020).

Also, it is interesting to point out how the inverted approach has been considered a cost-effective formula to cater to students in a more individualized manner in the classroom.

It seems that the advantages and challenges of this pedagogic model have led to its analysis in the past few years. With the confinement of global education, due to the health-based pandemic in the past year, the flipped classroom has gained an important prominence. At this point, it is important to ask ourselves, what has been the path of the flipped model in the scientific literature? In what fields of knowledge had the flipped model preferably focused on? And, aside from the studies conducted, what emergent themes that are incorporated to what has been already studied?

Thus, the objective of the present study was to identify the main existing trends in the scientific literature, and the emergent strategic research lines on this subject.

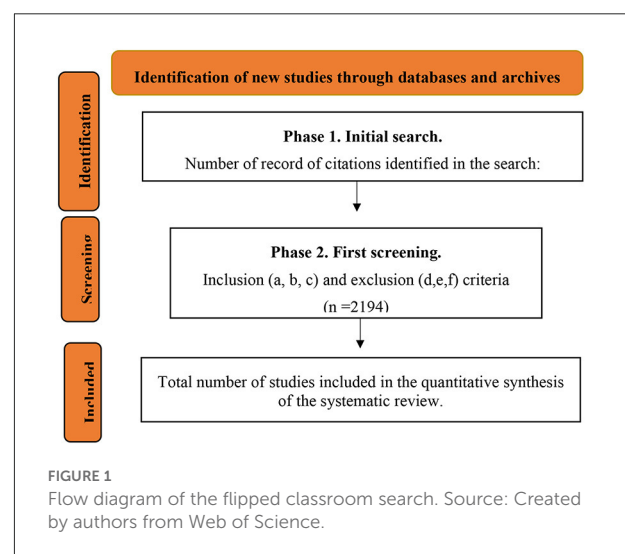
The pedagogic model of the flipped classroom

The pedagogic model of the Flipped Classroom (FC) began to be studied and implemented in classrooms in the year 2000 (Lage et al., 2000). However, it was starting in 2009 that it began to gain popularity among teachers (Bergmann and Sams,

TABLE 1 Search protocol.

Study period	2007–2021
Database	Web of Science
Keyword	Flipped classroom
Inclusion criteria	a. Journal articles. b. Publications in the last few years (2007–2021). c. Document in any language.
Exclusion criteria	d. Conference proceedings, book chapters, or other type of publications. e. Restricted access to the publication. f. Duplicated articles.
Last date accessed	October 2021

Source: Created by authors from Web of Science.



2009, 2012; Awidi and Paynter, 2019). The main reason for this is that the FC model tends to have a very positive effect on the performance of the students (Enfield, 2013; Velegol et al., 2015; Betihavas et al., 2016; Lai and Hwang, 2016; Akçayir and Akçayir, 2018; Cho and Lee, 2018; Hew and Lo, 2018; Lundin et al., 2018; Tang et al., 2018; Namaziandost and Çakmak, 2020). Also, it is recognized that the FC model is implemented worldwide in diverse disciplines in different levels of education (Ackerman and Maslin-Ostrowski, 2004; Freeman et al., 2014; Hao, 2016; Lo and Hew, 2017; Akçayir and Akçayir, 2018; Chang et al., 2019; Tomas et al., 2019; Albahuth, 2020).

The FC model is an alternative approach which flips the traditional classroom to provide an answer to the new methodological formats (Cheng et al., 2019; del Arco et al., 2019). Thus, the key concepts are studied before coming to class, and teachers guide the learning in the classroom, modifying the use that is normally made of the classroom (Hamdan et al., 2013; del Arco et al., 2022). In this manner, the students are co-responsible and manage their own learning process and rhythm (Lai and Hwang, 2016; Akçayir and Akçayir, 2018). This allows the students to develop competencies such as cooperative

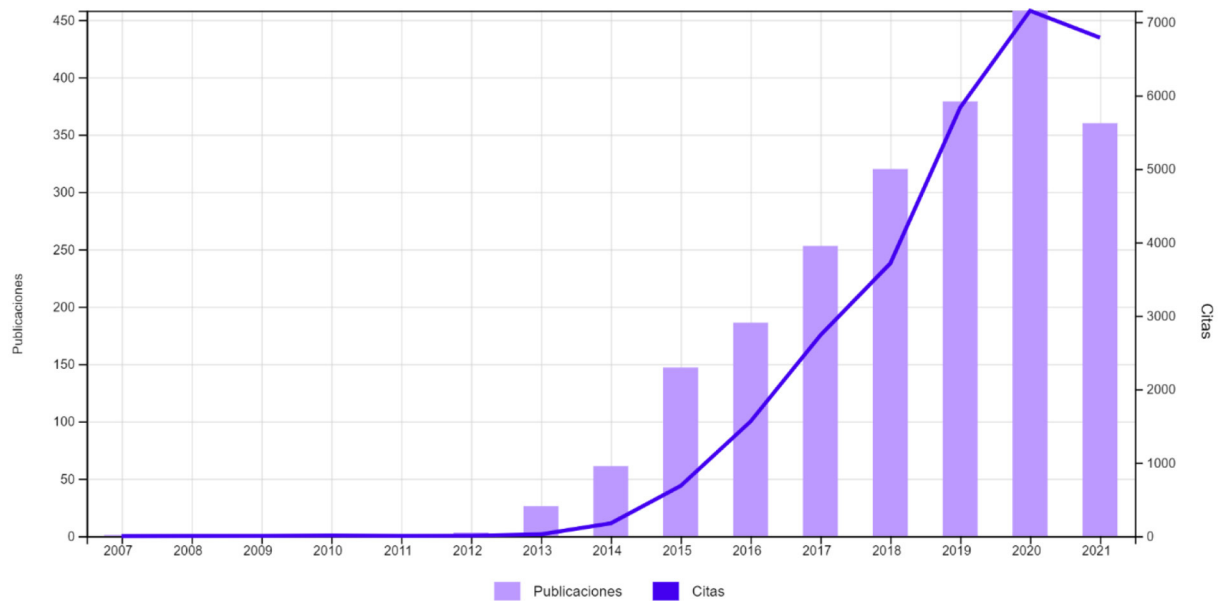


FIGURE 2
Number of publications and citations. Source: Web of Science.

TABLE 2 Publications and citations from 2015 to October, 2021.

Years	N. of publications	Citations
2015	147	684
2016	186	1,561
2017	253	2,734
2018	320	3,713
2019	379	5,836
2020	458	7,154
2021	360	6,788

Source: Created by authors from Web of Science.

learning, the selection of information, critical thinking, and the self-assessment of learning (del Arco, 2015).

Authors such as Abeysekera and Dawson (2015), Flores et al. (2016), Akçayir and Akçayir (2018) and del Arco et al. (2019), recognize that FC is a pedagogic model, as it encompasses a set of approaches, and also, they underline that:

- Knowledge is transmitted outside of the classroom.
- Class time is used to conduct dynamic activities, and to detect conceptual errors.
- Students must perform activities before, during, and after class.
- The assessment is key in the FC model, and it must be comprehensive, responsible, reflective, shared, and competence-based. Thus, the key objective of the

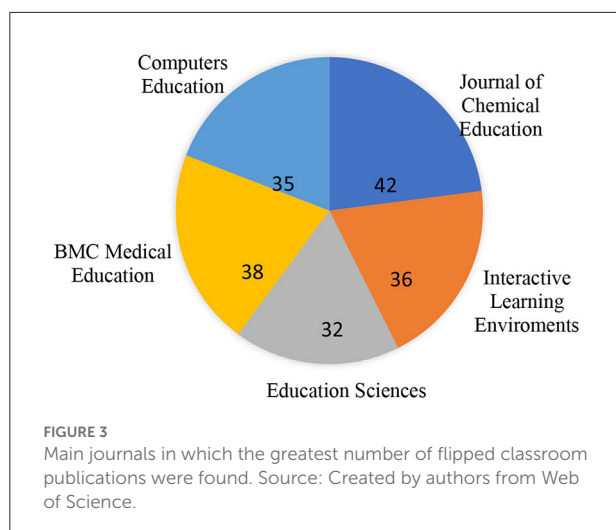
TABLE 3 Main areas of research.

Areas of research	Number of articles	% de 2194
Education Educational Research	1,821	83.00%
Computer Science	491	22.38%
Psychology	406	18.51%
Behavioral Sciences	381	17.37%
Health Care Sciences Services	211	9.62%
Engineering	169	7.70%
Communication	132	6.02%
Business Economics	111	5.06%
Nursing	107	4.88%
Information Science Library Science	85	3.87%
Mathematics	71	3.24%
Science Technology Other Topics	70	3.19%
General Internal Medicine	69	3.14%
Chemistry	59	2.69%
Linguistics	58	2.64%

Source: Created by authors from Web of Science.

assessment is to establish a relationship with the learning process and the promotion of quality questions, as well as learning through mistakes (Tourón and Santiago, 2015).

Also, in the study by Hamdan et al. (2013), it was indicated that pedagogic models in which knowledge is transferred outside of the classroom, such as a FC model.



Normally, traditional models do not adapt to the needs or interests of students (Betihavas et al., 2016; Talbert, 2017). However, pedagogic models such as the one analyzed in the present study, allow for an alternative type of learning, in which the students are placed at the center of the teaching-learning process (Bergmann and Sams, 2012; Abeysekera and Dawson, 2015; O'Flaherty and Phillips, 2015; Gillette et al., 2018; Strelan et al., 2020).

It should also be added that the FC model is adapted to the prevailing online learning modality and use of new technologies (Herrera Mueses et al., 2019; Namaziandost and Çakmak, 2020; Stöhr et al., 2020), especially due to the COVID-19 pandemic. In this sense, online learning allows for distance learning, where technology is the medium of the learning process (Nguyen, 2015; Contreras et al., 2017; Hew and Lo, 2018; Han and Rokenes, 2020). del Arco et al. (2019) described the benefits provided by the use of technological tools in the FC model:

- Establishment of moments of cooperation and reflection.
- Management of activities that are corrected quickly by the teachers.
- Development of activities with automatic correction.
- Proposing resources in different formats.

Although synchronous and asynchronous classes can be combined in online learning, the situation due to the COVID-19 pandemic provided evidence of the need to conduct comprehensive teaching-learning processes, which combine the previously-mentioned class modalities (Chen et al., 2014; Namaziandost and Çakmak, 2020; Stöhr et al., 2020).

On the other hand, studies also exist which describe the limitations and challenges of the FC model (Schlairet et al., 2014; Lai and Hwang, 2016; Sun et al., 2017; Han and Rokenes, 2020):

- A greater amount of time invested by the teachers to design classes through the use of the model presented.
- Behaviors that are not very regulated by some students.
- Failure of some students in organizing themselves to work and understand the contents outside of the classroom.

Ultimately, although the FC model has a series of limitations just as in other models, it allows the increase in the productivity of the face-to-face time, as well as the increase in the motivation and satisfaction of students (Talbert, 2017; Awidi and Paynter, 2019; Strelan et al., 2020). Also, if the FC model is combined with active methodologies such as challenge-based learning (CBL) or cooperative learning, the efficiency of the teaching-learning process increases substantially (Hmelo-Silver, 2004; AbuSeileek, 2012; Betihavas et al., 2016; Lai and Hwang, 2016; Sohrabi and Iraj, 2016; Cheng et al., 2019; González-Gómez et al., 2019; Namaziandost and Çakmak, 2020). Thus, active methodologies such as the ones previously cited, are also associated to the better performance of students.

Methodological design

Unit of analysis

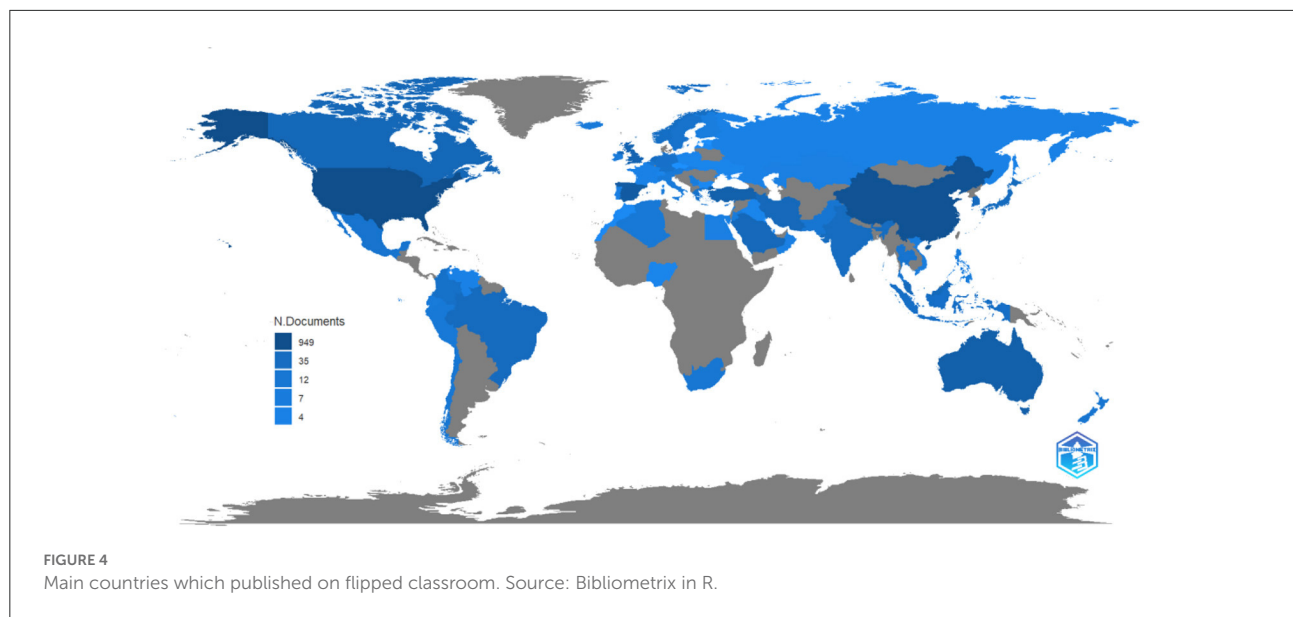
The results of a descriptive, cross-sectional-retrospective bibliometric analysis are presented, conducted through the analysis of scientific documents published on the flipped classroom model during the 2007–2021 period. This period of time was selected because before 2007, practically no scientific production on this subject existed.

Bibliometry was utilized, as this science is based on statistical procedures applied to a review of the scientific literature and the authors who produced them. These statistical procedures focus on the normal statistical behavior through time, of the different bibliometric indicators considered (Pacheco-Mendoza and Alhuay-Quispe, 2019).

Procedure

In our analysis, a search was conducted for articles on the subject: TS = flipped classroom in the main collection of Web of Science (on 16 October 2021), as this database is the oldest and most prestigious on bibliographic references and journal citations, and one of the most utilized for bibliometric analyses.

A total of 4,657 publications were found. Next, these were filtered according to type of document, considering articles published in journals in the period between 2007 and 2021 in any language. The exclusion criteria eliminated all the publications from conference proceedings, book chapters, reviews, duplicated articles, as well as the publications with restricted access, which made difficult obtaining the article. Starting with the application of the inclusion and exclusion criteria, a total of 2,194 articles



were obtained, which were the subjects of analysis in the present study (Table 1).

Figure 1 shows a flow diagram which describes the different phases of refinement, following the PRISMA 2020 flow diagram guidelines for systematic reviews (Page et al., 2021).

Results

Evolution of the flipped classroom publications and citations during the 2007–2021 period

Figure 2 shows the number of publications in the different years, as well as the number of citations. An increase in the number of publications on the flipped classroom was observed starting in 2013, with a maximum number of 458 publications reached in 2020. The same was observed for the citations. More specifically, starting in 2015, an exponential increase was observed. We can say that the progression in 2021 was similar to that in 2020.

Table 2 shows a data extraction starting in 2015, when a greater production was found. It must be noted that the mean number of citations per publication was 28,706 citations, which corresponds to an H-index of 74.

Area of research and journals with the greatest number of flipped classroom publications and geographical distribution

The analysis of the areas of research in which a greater number of publications related to the Flipped Classroom

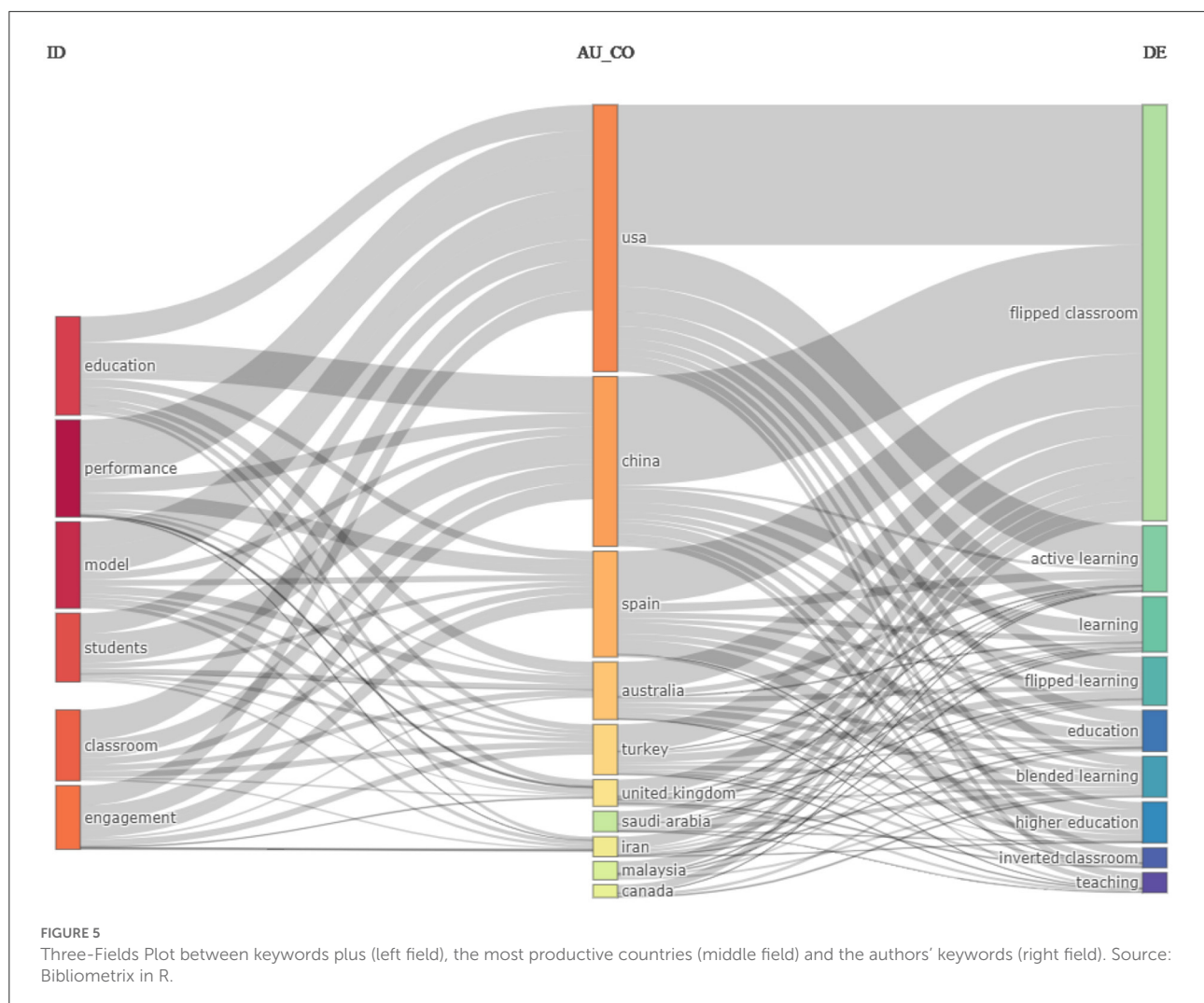
were found showed that the most important were “Education Educational Research,” which encompassed 83% of the publications, followed by the area of “Computer Science,” with 22.38% (Table 3). This study subject is directly associated with education research and working with technologies.

In agreement with the areas of education research in which the flipped classroom studies are framed, it is in education-related journals where most of the publications were found. Thus, the top places were occupied by journals related with Education and Health, followed by journals about Education and Technologies, and lastly, generalist journals on Education Science. Figure 3 shows the journals in order according to the flipped classroom articles published: the journal with the most articles was the Journal of Chemical Education, followed by BMC Medical Education, Interactive Learning Environments, Computers Education and Education Sciences. It should be pointed out that the most important in the area of Education was the journal Interactive Learning Environments.

As for the geographical distribution of the publications as a function of the different countries, the most important were the USA, China, and Spain (Figure 4). In this sense, the software analyses the country of the different affiliations of the authors.

Delving into this section, a figure was created of the keywords in the titles of the studies (keywords plus, ID), between the countries, and between the keywords from the authors (keywords, DE).

Setting aside the keyword Flipped Classroom, which is the primary term and which appears in the literature from all the countries analyzed, it should be noted that for the USA, the concepts (ID) performance and model were the most important, as well as the (DE) active learning and learning. For China, the most important ID were education and students, and the DE learning and education. Lastly, for Spain, the first ID were



performance and engagement, and the DE higher education and education (Figure 5).

Most important authors: Citations and progress

As for the authors with the most publications, referring to the term Flipped classroom, they are shown in Table 4.

In this phase of the study, an analysis was performed of the publications which were cited the most and a summary of their contributions are shown in Table 5.

After analyzing the most-cited texts, and considering the results obtained from the search equation, they are organized as a network, and it can be verified that there was a progression in time in the incorporation of authors other than those found in the English speaking context, where the flipped classroom

originated from, thereby showing the expansion of the model (Figure 6).

The subjects addressed by the authors with the most publications were recurring: the promotion of self-regulated learning of the students through this model, and the effects on the learning acquired.

Flipped classroom clusters during the 2007–2021 period

Next, the information from the 2,159 articles was downloaded and analyzed with the VosViewer software. The type of analysis was co-occurrence, and the unit of analysis were the author's keywords. Also, a Thesaurus file was added to homogenize concepts (Table 6).

In the previous table, it is observed that the main keywords were “flipped classroom,” followed by “active learning,” “blended learning,” and “higher education” (Figure 7).

As for the different maps provided by the VosViewer software, these were programmed so that they showed only the keywords that had a minimum of 16 occurrences in the different articles. Thus, the following maps were obtained:

A cluster analysis was also performed, that is, elements were grouped together in the same cluster, with the same specific characteristics that differentiate them from other clusters. The clusters provide us with information about groups that are homogeneous amongst themselves. To identify them, 6 key concepts were chosen (the primary term Flipped Classroom was not considered), and under these criteria, the following are highlighted:

- Cluster 1: New teacher/student roles in the Flipped Model (in red): where the six key concepts are: academic achievement, engagement, flipped learning, motivation, gamification, and teacher education. The Flipped Classroom concept appears in this group as the most common, but given its use as the main term, it is excluded.
- Cluster 2: Innovation and Quality improvement (in green). It is composed by the following concepts: improving classroom teaching, innovation, learning analytics, learning strategies, secondary education, and self-regulation.
- Cluster 3: Flipped Model during the pandemic (in dark blue): it is composed by the concepts blended learning, COVID-19, e-learning, technology and video lectures.
- Cluster 4: Collaborative work in the Flipped Classroom model (in yellow): it is composed by the concepts: collaborative learning, cooperative learning, curriculum, and student centered learning.
- Cluster 5: Methodological strategies compatible with the Flipped Model (in purple): the following are underlined: education, learning, simulation, and problem-based learning.
- Cluster 6: Flipped Classroom in Higher Education (in light blue): the following are highlighted: higher education, instructional design, inverted classroom and MOOCS.

Independently of the cluster it belongs to, when we analyzed the concepts that were cited more often, we found terms such as: “engagement,” “student-centered learning,” “inverted classroom,” “improving classroom teaching,” “inverted classroom,” and “teaching-learning strategies” (Figure 8).

New strategic lines of research

When analyzing the most repeated words in publications since 2017, we highlight terms such as: “higher education,”

TABLE 4 Main authors who published and cited the most on flipped classroom.

Authors	Citations	Number of articles
McLaughlin Jacqueline	831	10
Hwang, Gwo-Jen	566	11
Lai, Chiu-Lin	490	5
Hew, Khe Foon	422	13
Io, Chung Kwan	404	10
Hung, Hsiu-Ting	362	5
Chen, Nian-Shing	323	6
Kinshuk	323	6
Zainuddin, Zamzami	274	9
González-Gómez, David	231	13

Source: Created by authors from Web of Science.

“flipped learning,” “self-regulation,” “motivation,” “academic performance,” “Innovation,” “learning outcomes,” and “academic achievement” (Figure 9). Thus, we can establish, as the current lines of research on the Flipped Classroom model, every aspect associated with obtaining scientific evidence on the efficiency of the model, with respect to the academic performance and the learning results. Another current line is associated with the student’s commitment and self-regulation.

Discussion

Bibliometric analysis is based on the search for statistically regular behavior over time in the different elements related to the production and consumption of scientific information. It can be said that it helps to visualize the progression of research and the generation of knowledge, allowing future lines of interest to be defined.

With a search methodology based on inclusion and exclusion criteria and in different phases of refinement, a series of publications could be analyzed following a series of established bibliometric indicators: citations, productivity, content, etc. We find studies of this type such as those of [Duque and Cervantes-Cervantes \(2019\)](#), [Fernandez et al. \(2020\)](#), [Neria-Piña and Reyes Guerrero \(2021\)](#), and [Gómez et al. \(2022\)](#).

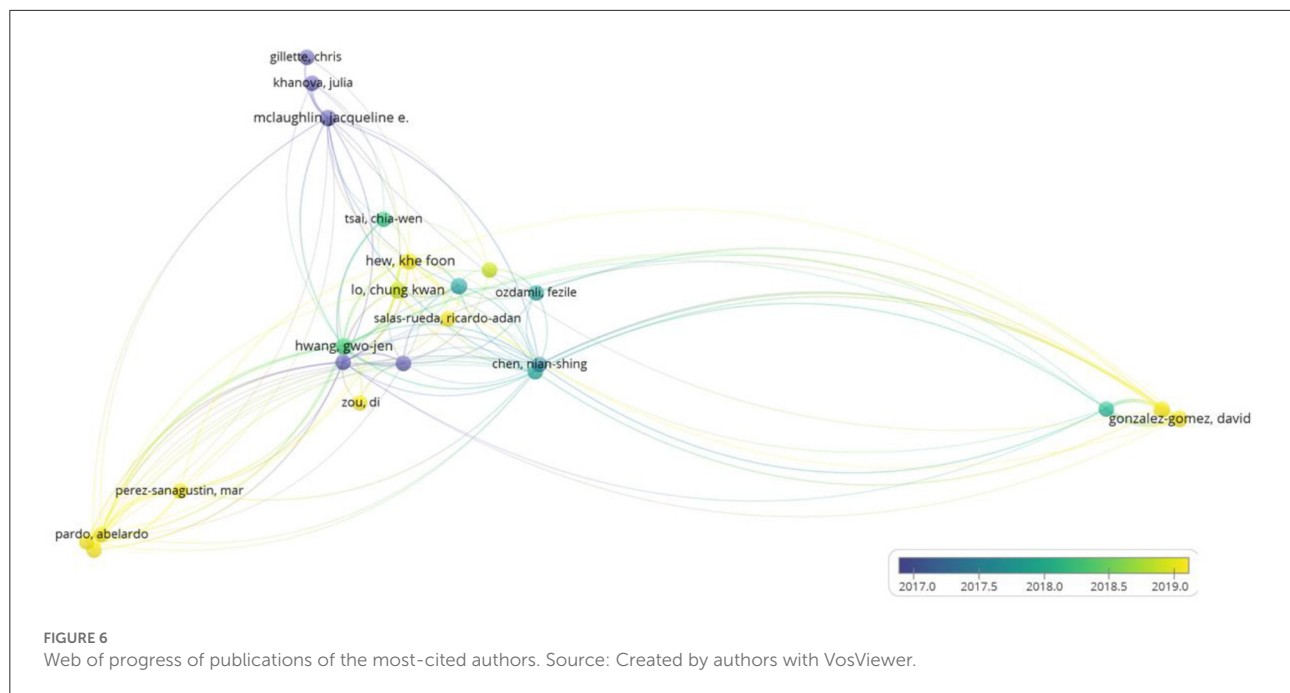
Thus, the descriptive bibliometric study helped us to identify the most important articles, and the matters addressed in the study of the flipped classroom model, and to discover the current and future trends on this subject. The first significant result was the exponential growth in the last 5 years of publications on flipped classroom studies and experiences. Although the first publications were found in the English-speaking context, the interest on the subject quickly spread to Asian countries (China), and the publication from Spain were also notable.

TABLE 5 Analysis of the most-cited FC publications.

Publication	Citations	Summary
J. McLaughlin, M. Roth, D. Glatt, N. Gharkholonarehe, C. Davidson, G. LaToya, <i>et al.</i> The flipped classroom: A course redesign to foster learning and engagement in a health professions school <i>Academic Medicine</i> , 89 (2) (2014), pp. 236–243 https://doi.org/10.1016/j.iheduc.2015.02.002	1,397	The objective of this far-reaching review was to provide a general overview of the research on the relationship between the appearance of the flipped classroom and the associations with pedagogy and the education results, by identifying the missing aspects in the literature which could provide information for future designs and assessments. The most important aspects: -The flipped classroom has the ability to create permanent skills for students in the 21st century. -Misunderstanding of the key elements needed for the success of the flipped classroom. -Under-utilization of the conceptual frameworks and the design of the flipped classroom. -Need for more solid proof to evaluate the results of the students in the flipped classrooms.
Lai, C. L., & Hwang, G. J. (2016). A self-regulated flipped classroom approach to improving students' learning performance in a mathematics course. <i>Computers & Education</i> , 100, 126–140.	570	The objective was to analyze a self-regulated flipped classroom approach to help students program their time outside of the classroom, to efficiently read and understand the content to be learned before class, so that they are able to interact with their classmates and the professor in class for a more in-depth discussion. To assess the efficacy of the approach proposed, a quasi-experimental design was utilized in a mathematics class in primary school. The study concludes that: - The approach helped the students to efficiently plan their time outside of the classroom. -An experiment was conducted in a mathematics class in a primary school. -The approach improved the learning performance, the self-efficacy, and the self-regulation of the students. -The approach helped the students to determine the objectives of learning and the performance.
HEW, K.F., LO, C.K. Flipped classroom improves student learning in health professions education: a meta-analysis. <i>BMC Med Educ</i> 18, 38 (2018). https://doi.org/10.1186/s12909-018-1144-z	541	The objective was to present a meta-analysis that specifically examined the effect of the flipped classroom as compared to the traditional classroom, on the learning of the students. This study examined the results of the comparative articles through a meta-analysis, to summarize the general effects of teaching with a flipped classroom approach.
Hwang, GJ., Lai, CL. & Wang, SY. Seamless flipped learning: a mobile technology-enhanced flipped classroom with effective learning strategies. <i>J. Comput. Educ.</i> 2, 449–473 (2015). https://doi.org/10.1007/s40692-015-0043-0	520	The objective is to present challenges, as well as the definition, the characteristics, and the education objectives of flipped learning; also, a model of flipped learning is proposed without flaws, by integrating the characteristics of the mobile communication and wireless technologies on the flipped classroom model to provide a guide for researchers and teachers for the development of efficient flipped learning activities and plans to help students learn without flaws in the different contexts.
Lo, C.K., Hew, K.F. A critical review of flipped classroom challenges in K-12 education: possible solutions and recommendations for future research. <i>RPTEL</i> 12, 4 (2017). https://doi.org/10.1186/s41039-016-0044-2	445	The objective of the present review is to provide a general view of the flipped classroom studies in K-12 education. It is concluded that the use of a flipped classroom approach in K-12 education had a neutral or positive impact on the performance of the students, as compared to the traditional classroom.
McLaughlin, J. E., Griffin, L. M., Esserman, D. A, Davidson, C. A, Glatt, D. M., Roth, M. T, Mumper, R. J. (2013). Pharmacy student engagement, performance, and perception in a flipped satellite classroom. <i>American Journal of Pharmaceutical Education</i> , 77(9), Article 196.	485	The objective was to determine if the “flipping” of a traditional basic pharmacy course that was synchronously taught in 2 satellite campuses would improve academic performance, the commitment and perceptions of the students. It was concluded that the pharmacy flipped classroom could improve the experiences of the satellite students in a basic pharmacy course through the reflective design of the course, the enriched dialogue, and the promotion of the student's autonomy.

We can state that starting in 2013, there was a greater scientific production, and the mean number of citations per publication was 28,706.

In light of the results obtained, the themes/concepts that were most analyzed in the different publications were: new teacher/student roles in the Flipped Classroom model, Flipped Classroom model and education innovation, Flipped Classroom



model during the pandemic, Flipped Classroom model and collaborative work, Methodological strategies compatible with the Flipped Classroom model, and the Flipped Classroom model in Higher Education. The articles in the present review encompassed a broad range of disciplines, but the most important areas of research were “Education educational research,” followed by the “Computer science”. Also, the journal *Interactive Learning Environments* was highlighted as one of the most pioneering in Flipped Classroom subjects with the area of Education.

The predominance of the Flipped Classroom model in some areas of research could be because this model cannot be applied to all school subjects. This was also stated by authors such as [Strayer \(2012\)](#), who conducted a comparative study between a flipped classroom and a traditional classroom for an introductory course in statistics. The results of this study showed that the students who participated in the flipped classroom were less satisfied than the students in the traditional classroom.

When analyzing the most-cited keywords, and the keywords from authors who had published the most, the following study dimensions can be considered as those that garnered the most interest:

- The effectiveness of the Flipped Classroom Model, with special emphasis on the academic performance and the learning results. This, these are studies which focused on the virtues of the model. Many articles were published on the satisfaction of the main learning protagonists. More specifically, most of the publications were focused on the

TABLE 6 Concepts that were most repeated in the keywords.

Keyword	Occurrences	Keyword	Occurrences
flipped classroom	1,167	motivation	41
active learning	210	online learning	41
blended learning	162	learning	38
higher education	119	problem based	35
		learning	
flipped learning	101	self-regulation	35
education	82	gamification	34
e-learning	69	curriculum	33
medical education	69	student-centered	32
		learning	
teaching/learning	63	COVID-19	31
strategies			
inverted classroom	54	nursing education	31
video lectures	49	student engagement	31
collaborative	48	technology	30
learning			
teaching methods	48	engagement	28
pedagogy	45	MOOCS	27
teaching	43	learning analytics	25
educational	42	student perceptions	25
technology			

Source: Created by authors from Web of Science.

positive perceptions of the flipped classroom students, and in light of these results, some authors warned that we must consider the “Hawthorne” effects, as pointed out by

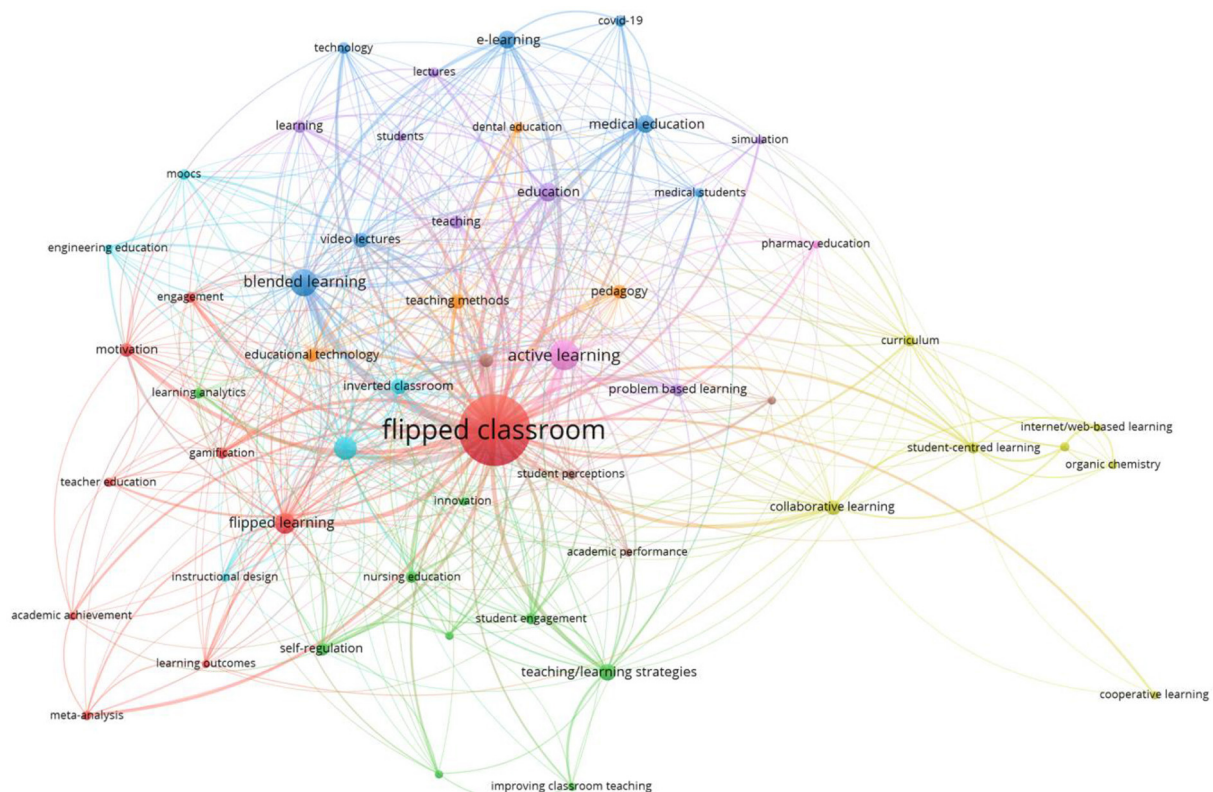


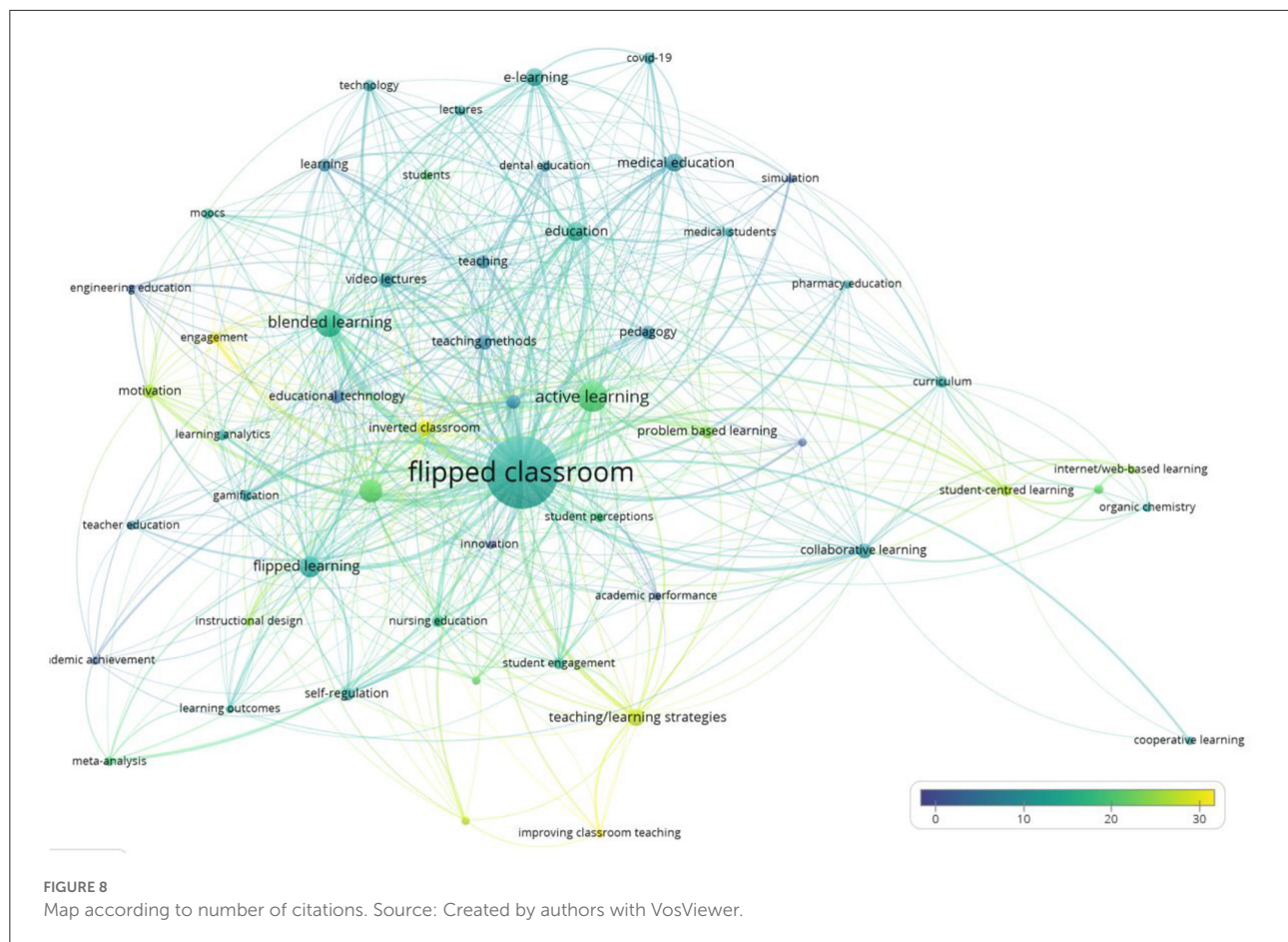
FIGURE 7
Network map. Source: Created by authors with VosViewer.

Forsey et al. (2013). These effects are generated when any change is made to the operational procedures in teaching processes, which can lead to increases in productivity and the satisfaction of the participants, due to the novelty of the changes.

- Despite the great number of publications on the effect of the model, many authors believed that there were not many significant studies that strongly demonstrated, with scientific evidence, that the flipped classroom was more effective than the traditional classroom. Most of the publications mentioned an improvement in the satisfaction and motivation of the students in favor of the flipped classroom, with a relative improvement in academic performance (Hung, 2015), but it has not been demonstrated that it has a direct effect on deep and consolidated learning through time (O'Flaherty and Phillips, 2015).
- If the keywords are grouped into research clusters, we found differences in the following subjects: (1) New teacher/student roles in the Flipped Classroom model; (2) Flipped Classroom model and education innovation; (3) Flipped Classroom model during the pandemic; (4) Flipped Classroom model and collaborative work; (5)

Methodological strategies compatible with the Flipped Classroom model and (6) the Flipped Classroom model in Higher Education.

- The model acquired importance in Higher Education, with special emphasis during the pandemic, when the number of publications on this subject increased. It must be remembered that educational systems worldwide were forced to modify the face-to-face classes for virtual ones. When dealing with emergency teaching, the flipped classroom model offers learning opportunities that are more flexible, and which can provide a response to problems of accessibility to face-to-face traditional teaching (Santillán-Aguirre et al., 2021). This model shifts from a classroom that is focused on the teacher, to a classroom that is focused on the student, increasing the opportunities for active learning, where the students become co-responsible for their own learning (Hamdan et al., 2013).
- During the pandemic, the Flipped model was applied to different fields of knowledge: law (Torralbo Muñoz, 2021) economics (Argandoña-Mendoza et al., 2020), engineering (Riquelme et al., 2021), etc. Nevertheless, despite the appearance of different publications on the use of the flipped model on emergency teaching during the pandemic,



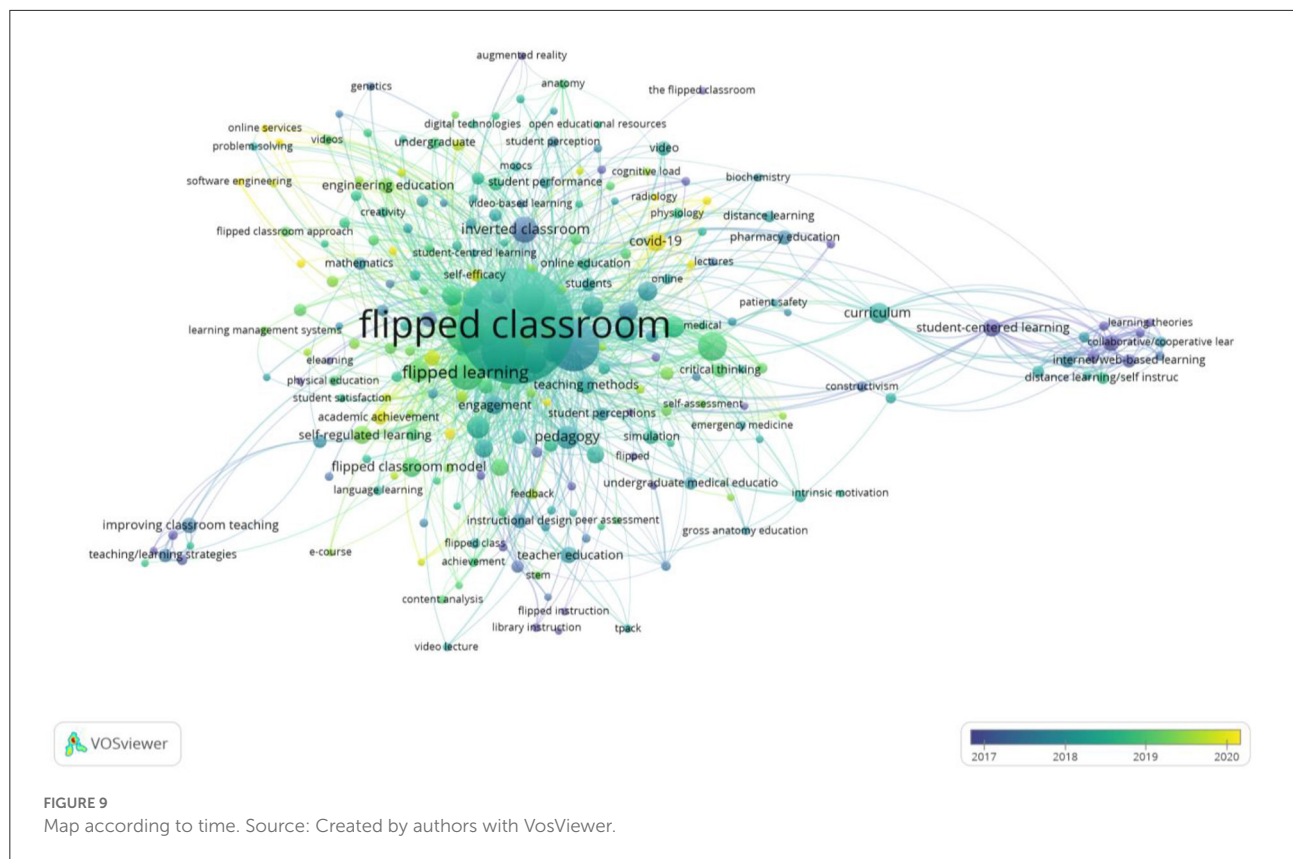
studies are still lacking which validate the efficacy of the model and its resiliency for its application when faced with emergency situations. In most of the cases, an educational experience was described, and qualitative data of satisfaction and greater motivation of the student was provided, along with some data about the improvement in assessment processes.

- Terms such as “higher education,” “flipped learning,” “self-regulation,” “motivation,” “academic performance,” “innovation,” “learning outcomes,” or “academic achievement” were the most investigated in the last few years. This demonstrates the interest in obtaining scientific evidence on the virtues of the model, and especially to demonstrate the effect on the academic performance and the learning results.
- In the last 5 years, we witnessed the appearance of the concept of self-regulation of learning and the addressing of the commitment of the student in the process. Self-regulation implies the capacity of the student to participate independently and proactively to reach the learning objectives. It is evident that in the Flipped Classroom model, more opportunities are offered for the students to

become involved in their own learning, with them being the model’s focus, and active participation in their education, as well as their assessment, can also be achieved (del Arco et al., 2019; Thi Thai et al., 2020).

Conclusions

The FC pedagogic model started to gain popularity due to teachers (Bergmann and Sams, 2009, 2012), but it was not until the year 2013 that an exponential increase was observed in the publications which emphasized showing evidence of the virtues of the model (Awidi and Paynter, 2019). All the studies define the FC model as an example of active learning which places students in the center of the teaching-learning process. It requires a change in the culture of learning, as the student must be actively involved in the construction of knowledge thanks to opportunities afforded by the model for their participation in their own learning and their own assessment (Bergmann and Sams, 2012; Abeysekera and Dawson, 2015; O’Flaherty and Phillips, 2015; Gillette et al., 2018; Strelan et al., 2020).



Meanwhile, the teacher acquires the role of mediator, thus becoming authentic education professionals, who pay close attention to the conceptual and procedural acquisition of the contents presented in the classroom, by developing observation, feedback, and assessment skills (Thi Thai et al., 2020).

The most-cited concepts, engagement, student-centered learning, inverted classroom, improving classroom teaching, inverted classroom and teaching-learning strategies, provide clues on the interest of the researchers to describe the model and provide scientific evidence on how to increase active learning through the decreased role of direct instruction in the classroom and the unidirectional interaction of teachers with students.

Despite the scientific literature being important in the past few years, many aspects still need to be analyzed, which are defined as lines of future work: evidence of the improvement of the academic performance and results of solid and profound learning with its application in different fields of knowledge. Also, every aspect related with the co-responsibility and commitment of the students in their own process of learning, to stimulate independence and self-regulation.

It is also interesting to open new paths on the effective applicability of this model with special education students. It is

necessary to conduct more qualitative and quantitative studies to analyze the potential of the FC model in different educational stages, different contexts, different fields of knowledge, or different types of students (Bergmann and Sams, 2012; Hamdan et al., 2013; Bicen and Beheshti, 2022).

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding authors.

Author contributions

Conceptualization, formal analysis, and data curation: IA and PM-M. Methodology: IA and AR-P. Validation, investigation, writing-original draft preparation, writing—review and editing, and visualization: IA, PM-M, ÒF, and AR-P. Supervision: IA. All authors have read and agreed to the published version of the manuscript.

Funding

This research is doubly funded by The flipped classroom model. Case study of the faculties of Nursing and Education (DOTSS Chair) and In the framework of the reverse classroom model as an alternative to synchronous online teaching: we design materials and resources of the call for grants to carry out innovation and teaching improvement projects at the University of Lleida, 2020-2021 (approved by the Governing Council of the UdL on 24 April 2020).

Acknowledgments

Thanks to the DOTSS Chair of the University of Lleida for their support in carrying out this study.

References

- Abeysekera, L., and Dawson, P. (2015). Motivation and cognitive load in the flipped classroom: definition, rationale and a call for research. *High. Educ. Res. Dev.* 34, 1–14. doi: 10.1080/07294360.2014.934336
- AbuSeileek, A. F. (2012). The effect of computer-assisted cooperative learning methods and group size on the EFL learners' achievement in communication skills. *Comput. Educ.* 58, 231–239. doi: 10.1016/j.compedu.2011.07.011
- Ackerman, R. H., and Maslin-Ostrowski, P. (2004). The wounded leader. *Educ. Leader.* 61, 1–9.
- Akçayır, G., and Akçayır, M. (2018). The flipped classroom: a review of its advantages and challenges. *Comput. Educ.* 126, 334–345. doi: 10.1016/j.compedu.2018.07.021
- Albahuoth, H. (2020). Effectiveness of flipped classroom in developing 11th graders' grammatical competences in Arabic. *Interact. Learn. Environ.* 1–17. doi: 10.1080/10494820.2020.1821714
- Anderson, L. W., and Krathwohl, D. R. (2001). *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*. Boston, MA: Allyn and Bacon.
- Argandoña-Mendoza, M. F., García-Vera, C. E., and Vallejo-Valdivieso, P. A. (2020). Flipped classroom y Educación para el emprendimiento durante la pandemia por COVID-19. *EPISTEME KOINONIA* 3, 320–338. doi: 10.35381/e.k.v3i6.855
- Ash, K. (2012). Educators view flipped model with a more critical eye. *Educ. Week* 32, S6–S7.
- Awidi, I. T., and Paynter, M. (2019). The impact of a flipped classroom approach on student learning experience. *Comput. Educ.* 128, 269–283. doi: 10.1016/j.compedu.2018.09.013
- Bennett, S., Agostinho, S., and Lockyer, L. (2015). Technology tools to support learning design: Implications derived from an investigation of university teachers' design practices. *Comput. Educ.* 81, 211–220. doi: 10.1016/j.compedu.2014.10.016
- Bergmann, J., and Sams, A. (2009). Remixing chemistry class: two Colorado teachers make vodcasts of their lectures to free up class time for hands-on activities. *Learn. Lead. Technol.* 36, 22–27.
- Bergmann, J., and Sams, A. (2012). *Flip Your Classroom: REACH Every Student in Every Class Every Day*. Internal Society for Technology in Education.
- Bethavas, V., Bridgman, H., Kornhaber, R., and Cross, M. (2016). The evidence for 'flipping out': a systematic review of the flipped classroom in nursing education. *Nurse Educ. Today* 38, 15–21. doi: 10.1016/j.nedt.2015.12.010
- Bicen, H., and Beheshti, M. (2022). Assessing perceptions and evaluating achievements of ESL students with the usage of infographics in a flipped classroom learning environment. *Interact. Learn. Environ.* 30, 498–526. doi: 10.1080/10494820.2019.1666285
- Camió, R. S. (2019). Conectando el modelo Flipped Learning y la teoría de las Inteligencias Múltiples a la luz de la taxonomía de Bloom. *Magister: Revista miscelánea de investigación* 31, 45–54. doi: 10.17811/msg.31.2.2019.45-54
- Chang, B. Y., Chang, C. Y., Hwang, G. H., and Kuo, F. R. (2019). A situation-based flipped classroom to improving nursing staff performance in advanced cardiac life support training course. *Interact. Learn. Environ.* 27, 1062–1074. doi: 10.1080/10494820.2018.1485709
- Chen, Y., Wang, Y., Kinshuk, N., and Chen, S. (2014). Is FLIP enough? Or should we use the FLIPPED model instead? *Comput. Educ.* 79, 16–27. doi: 10.1016/j.compedu.2014.07.004
- Cheng, L., Ritzhaupt, A. D., and Antonenko, P. (2019). Effects of the flipped classroom instructional strategy on students' learning outcomes: a meta-analysis. *Educ. Technol. Res. Dev.* 67, 793–824. doi: 10.1007/s11423-018-9633-7
- Cho, B., and Lee, J. (2018). A meta-analysis on effects of flipped learning in Korea. *J. Dig. Conver.* 16, 59–73. doi: 10.14400/JDC.2018.16.3.059
- Contreras, J. A., Arias, J., Melo, M. G., and Martín, R. (2017). Uso del modelo de aprendizaje inverso para mejorar materiales educativos universitarios. *RISTI: Revista Ibérica de Sistemas y Tecnologías de Información* 23, 17–32. doi: 10.17013/risti.23.17-32
- del Arco, I. (2015). "Flippear", siendo alumno digital, desde el Trabajo cooperativo. *Escuela* 5–6.
- del Arco, I., Flores, Ö., and Ramos-Pla, A. (2021). Structural model to determine the factors that affect the quality of emergency teaching, according to the perception of the student of the first university courses. *Sustainability* 13, 2945. doi: 10.3390/su13052945
- del Arco, I., Flores, Ö., and Silva, P. (2019). El desarrollo del modelo flipped classroom en la universidad: impacto de su implementación desde la voz del estudiantado. *Revista de Investigación Educativa* 37, 451–469. doi: 10.6018/rie.37.2.327831
- del Arco, I., Segura, J., Ramos-Pla, A., and Flores, Ö. (2022). *Processos Didàctics i Organitzatius*. Materials per flippear la classe (accessed June 15, 2022).
- Duque, P., and Cervantes-Cervantes, L. S. (2019). Responsabilidad Social Universitaria: una revisión sistemática y análisis bibliométrico. *Estudios Gerenciales* 35, 451–464. doi: 10.18046/j.estger.2019.153.3389
- Enfield, J. (2013). Looking at the impact of the flipped classroom model of instruction on undergraduate multimedia students at CSUN. *Techtrends* 57, 14–27. doi: 10.1007/s11528-013-0698-1
- Fernandez, L. D., Alarcón, L. M. P., and Sánchez, E. B. (2020). Estudio bibliométrico sobre educación digital. *Revista Tecnología Educativa* 5, 1–16.
- Flores, O., Del Arco, I., and Silva, P. (2016). The flipped classroom model at the university: analysis based on professors' and students' assessment

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

in the educational field. *Int. J. Educ. Technol. High. Educ.* 13, 1–12. doi: 10.1186/s41239-016-0022-1

Forsey, M., Low, M., and Gance, D. (2013). Flipping the sociology classroom: towards a practice of online pedagogy. *J. Sociol.* 49, 471–485. doi: 10.1177/1440783313504059

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., et al. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proc. Natl. Acad. Sci. USA* 111, 8410–8415. doi: 10.1073/pnas.1319030111

Gilboy, M. B., Heinerichs, S., and Pazzaglia, G. (2015). Enhancing student engagement using the flipped classroom. *J. Nutr. Educ. Behav.* 47, 109–114. doi: 10.1016/j.jneb.2014.08.008

Gillette, C., Rudolph, M., Kimble, C., Rockich-Winston, N., Smith, L., and Broedel-Zaug, K. (2018). A meta-analysis of outcomes comparing flipped classroom and lecture. *Am. J. Pharm. Educ.* 85, 6898. doi: 10.5688/ajp.e6898

Gómez, R. J. M., Carrillo, C. J. B., and Borré, D. A. F. (2022). Análisis bibliométrico de la producción científica sobre covid-19 en latinoamérica. *Revista Boletín Redipe* 11, 223–233. doi: 10.36260/rbr.v11i1.1638

González-Gómez, D., Jeong, J. S., and Cañada-Cañada, F. (2019). Enhancing science self-efficacy and attitudes of Pre-Service Teachers (PST) through a flipped classroom learning environment. *Interact. Learn. Environ.* 30, 896–907. doi: 10.1080/10494820.2019.1696843

Hamdan, N., McKnight, P., McKnight, K., and Arfstrom, K. (2013). *A White Paper Based on the Literature Review Titled A Review of Flipped Learning*. Pearson.

Han, H., and Rokenes, F. (2020). Flipped classroom in teacher education: a scoping review. *Front. Educ.* 5, 1–20. doi: 10.3389/feduc.2020.601593

Hao, Y. (2016). Exploring undergraduates' perspectives and flipped learning readiness in their flipped classrooms. *Comput. Human Behav.* 59, 82–92. doi: 10.1016/j.chb.2016.01.032

Herrera Mueses, M. L., Perugachi Mediavilla, J. I., and Baldeón Egas, P. F. (2019). Las TIC en el desarrollo de clase inversa: experiencia Unidad Educativa Fiscal San Francisco de Quito. *Revista Conrado* 15, 248–257.

Hew, K. F., and Lo, C. K. (2018). Flipped classroom improves student learning in health professions education: A meta-analysis. *BMC Med. Educ.* 18, 38. doi: 10.1186/s12909-018-1144-z

Hmelo-Silver, C. E. (2004). Problem-based learning: what and how do students learn? *Educ. Psychol. Rev.* 16, 235–266. doi: 10.1023/B:EDPR.0000034022.16470.f3

Hung, H. (2015). Flipping the classroom for English language learners to foster active learning. *Comput. Assis. Lang. Learn.* 28, 81–96. doi: 10.1080/09588221.2014.967701

Jorge-Vázquez, J., Nández-Alonso, S. L., Sanz-Bas, D., and Chivite-Cebolla, M. P. (2020). *Nuevas tecnologías educativas al servicio del enfoque pedagógico Flipped Learning: Contribuciones de la Tecnología Digital en el Desarrollo Educativo y Social*. Adaya Press.

Lage, M. J., Platt, G. J., and Treglia, M. (2000). Inverting the classroom: a gateway to creating an inclusive learning environment. *J. Econ. Educ.* 31, 30–43. doi: 10.1080/00220480009596759

Lai, C. K., and Hwang, G. J. (2016). A self-regulated flipped classroom approach to improving students' learning performance in a mathematics course. *Comput. Educ.* 100, 126–140. doi: 10.1016/j.compedu.2016.05.006

Lo, C. K., and Hew, K. F. (2017). A critical review of flipped classroom challenges in K-12 education: Possible solutions and recommendations for future research. *Res. Pract. Technol. Enhanced Learn.* 12, 1–22. doi: 10.1186/s41039-016-0044-2

Lundin, M., Bergviken, A., Hillman, T., Lantz-Andersson, A., and Peterson, L. (2018). Higher education dominance and siloed knowledge: a systematic review of flipped classroom research. *Int. J. Educ. Technol. High. Educ.* 15, 1–30. doi: 10.1186/s41239-018-0101-6

Namaziandost, E., and Çakmak, F. (2020). An account of EFL learners' self-efficacy and gender in the flipped classroom model. *Educ. Inform. Technol.* 25, 4041–4055. doi: 10.1007/s10639-020-10167-7

Neria-Piña, E., and Reyes Guerrero, S. (2021). Competencias de liderazgo. Una revisión Bibliométrica. *Revista de Ciencias Humanísticas y Sociales (ReHuSo)* 6, 67–92. doi: 10.5281/zenodo.5512893

Nguyen, T. (2015). The effectiveness of online learning: beyond no significant difference and future horizons. *MERLOT J. Online Learn. Teach.* 11, 309–319.

O'Flaherty, J., and Phillips, C. (2015). The use of flipped classrooms in higher education: a scoping review. *Internet. High. Educ.* 25, 85–95. doi: 10.1016/j.iheduc.2015.02.002

Pacheco-Mendoza, J., and Alhuay-Quispe, J. (2019). Unidades de Bibliometría, espacios necesarios para el monitoreo de producción científica en la universidad moderna. *Revista Habanera de Ciencias Médicas* 18, 376–380.

Page, M. J., Moher, D., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., et al. (2021). PRISMA 2020 explanation and elaboration: updated guidance and exemplars for reporting systematic reviews. *BMJ: Clin. Res.* 372, 160. doi: 10.31222/osf.io/gwdhk

Parra Giménez, F. J. (2017). La taxonomía de Bloom en el modelo aula invertida. *Publicaciones didácticas* 86, 176–179.

Ramos-Pla, A., del Arco, I., and Flores, Ö. (2021a). University professor training in times of COVID-19: analysis of training programs and perception of impact on teaching practices. *Educ. Sci.* 11, 684. doi: 10.3390/educsci11110684

Ramos-Pla, A., Tintoré, M., and del Arco, I. (2021b). Leadership in times of crisis. School principals facing COVID-19. *Heliyon* 7, e08443. doi: 10.1016/j.heliyon.2021.e08443

Riquelme, A., Pastor Navarro, J. L., Cano, M., Tomás, R., Robles Azorín, J., Díaz Castañeda, E., et al. (2021). "Adaptación de las prácticas de cartografía geológica en Ingeniería Civil a la modalidad dual en tiempos de pandemia mediante flipped classroom," in *Redes de investigación e innovación en docencia universitaria*, ed R. Satorre (ICE de la Universitat d'Alacant), 223–233.

Roehl, A., Reddy, S. L., and Shannon, G. J. (2013). The flipped classroom: an opportunity to engage millennial students through active learning strategies. *J. Family Consum. Sci.* 105, 44–49. doi: 10.14307/JFCS105.2.12

Sánchez, S. P., Belmonte, J. L., Guerrero, A. J. M., and Hinojo-Lucena, F. J. (2020). Flipped learning y competencia digital: Una conexión docente necesaria para su desarrollo en la educación actual. *Revista Electrónica Interuniversitaria de Formación del Profesorado* 23, 127–141. doi: 10.6018/reifop.422971

Santillán-Aguirre, J. P., Santos-Poveda, R. D., and Jaramillo-Moyano, E. M. (2021). Flipped learning, el enfoque pedagógico en tiempos de pandemia por el covid-19. *Dominio de las Ciencias* 7, 685–701.

Schlairet, M. C., Green, R., and Benton, M. J. (2014). The flipped classroom: strategies for an undergraduate nursing course. *Nurse Educ.* 39, 321–325. doi: 10.1097/NNE.0000000000000096

Serrano Pastor, R. M., and Casanova López, O. (2018). Recursos tecnológicos y educativos destinados al enfoque pedagógico flipped learning. *REDU: Revista de Docencia Universitaria* 16, 155–173 doi: 10.4995/redu.2018.8921

Sohrabi, B., and Iraj, H. (2016). Implementing flipped classroom using digital media: a comparison of two demographically different groups perceptions. *Comput. Human Behav.* 60 514–524. doi: 10.1016/j.chb.2016.02.056

Stöhr, C., Demazière, C., and Adawi, T. (2020). The polarizing effect of the online flipped classroom. *Comput. Educ.* 147, 103789. doi: 10.1016/j.compedu.2019.103789

Strayer, J. F. (2012). How learning in an inverted classroom influences cooperation, innovation and task orientation. *Learn. Environ. Res.* 15, 171–193. doi: 10.1007/s10984-012-9108-4

Strelan, P., Osborn, A., and Palmer, E. (2020). The flipped classroom: a meta-analysis of effects on student performance across disciplines and education levels. *Educ. Res. Rev.* 30, 100314. doi: 10.1016/j.edurev.2020.100314

Sun, J. C., Wu, Y. T., and Lee, W. I. (2017). The effect of the flipped classroom approach to OpenCourseWare instruction on students' self-regulation. *Br. J. Educ. Technol.* 48, 713–729. doi: 10.1111/bjet.12444

Talbert, R. (2017). *Flipped Learning: A Guide for Higher Education Faculty*. Sterling, VA: Stylus.

Tang, B., Coret, A., Qureshi, A., Barron, H., Ayala, A. P., and Law, M. (2018). Online lectures in undergraduate medical education: scoping review. *JMIR Med. Educ.* 4, 1–10. doi: 10.2196/mededu.9091

Thi Thai, N. T., Wever, B., and Valcke, M. (2020). Feedback: an important key in the online environment of a flipped classroom setting. *Interact. Learn. Environ.* 1–14. doi: 10.1080/10494820.2020.1815218

Tomas, L., Evans, N., Doyle, T., and Skamp, K. (2019). Are first year students ready for a flipped classroom? A case for a flipped learning continuum. *Int. J. Educ. Technol. High. Educ.* 16, 1–22. doi: 10.1186/s41239-019-0135-4

Torralbo Muñoz, B. (2021). Flipped classroom y Derecho Penal en tiempos de pandemia. *Docencia y Derecho* 17, 183–194. doi: 10.38180/rpdi.v0i0.187

Tourón, J., and Santiago, R. (2015). El modelo Flipped Learning y el desarrollo del talento en la escuela. *Revista de Educación* 368, 196–231. doi: 10.4438/1988-592X-RE-2015-368-288

Velegol, S. B., Zappe, S. E., and Mahoney, E. (2015). The evolution of a flipped classroom: evidence-based recommendations. *Adv. Eng. Educ.* 4, 37.



OPEN ACCESS

EDITED BY

Ana Luísa Rodrigues,
University of Lisbon, Portugal

REVIEWED BY

Jacinto Jardim,
Universidade Aberta, Portugal
Lütfi Sürücü,
European University of Lefka, Turkey

*CORRESPONDENCE

Lijun Tian
996819063@qq.com

SPECIALTY SECTION

This article was submitted to
Higher Education,
a section of the journal
Frontiers in Education

RECEIVED 19 August 2022

ACCEPTED 10 October 2022

PUBLISHED 21 October 2022

CITATION

Tian L (2022) The influence of work
values of college students on
entrepreneurial intention:
The moderating role of psychological
capital.
Front. Educ. 7:1023537.
doi: 10.3389/feduc.2022.1023537

COPYRIGHT

© 2022 Tian. This is an open-access
article distributed under the terms of
the [Creative Commons Attribution
License \(CC BY\)](#). The use, distribution
or reproduction in other forums is
permitted, provided the original
author(s) and the copyright owner(s)
are credited and that the original
publication in this journal is cited, in
accordance with accepted academic
practice. No use, distribution or
reproduction is permitted which does
not comply with these terms.

The influence of work values of college students on entrepreneurial intention: The moderating role of psychological capital

Lijun Tian^{1,2*}

¹School of Education, Nanchang Normal University, Nanchang, China, ²School of Teacher Education, Zhejiang Normal University, Jinhua, China

Purpose: The aim of this study is to determine the influences of work values on entrepreneurial intention among college students. The moderating role of psychological capital was also examined.

Materials and methods: A total of 723 college students were investigated with work values questionnaire, entrepreneurial intention scale and positive psychological capital Questionnaire.

Results: Work values was significantly and positively correlated with entrepreneurial intention ($r = 0.23$, $P < 0.001$); Psychological capital was significantly and positively correlated with entrepreneurial intention ($r = 0.33$, $P < 0.001$); Psychological capital did not moderate the relationship between work values and entrepreneurial intention ($\beta = 0.02$, $P > 0.05$); Hope moderated the relationship between work values and unconditional entrepreneurial intention ($\beta = 0.09$, $P < 0.05$). The relationship between work values and unconditional entrepreneurial intention was stronger in the high hope group (simple slope = 0.21 , $p < 0.001$) than in the low hope group (simple slope = 0.07 , $p < 0.001$).

Conclusion: Hope moderates the relationship between work values and unconditional entrepreneurial intention. Improving the quality of hope can be used as an intervention to improve college students' unconditional entrepreneurial intention.

KEYWORDS

work values, entrepreneurial intention, psychological capital, college students, hope

Introduction

Entrepreneurship is purposeful behavior (Krueger et al., 2000), and entrepreneurial intention plays a very important role in the process of starting a business, especially in the early stage of the business, where the intention to start a business is considered to be an important part of the enterprise (Baron, 2007). Entrepreneurial intention is a psychological state in which individuals bring attention, energy and behavior toward a specific goal, and an entrepreneurial idea can only be realized through the entrepreneurial intention (Bird, 1988). According to the theory of planned behavior, intention predicts how much effort people are willing to make in order to achieve the goal of behavior, to determine the subjective probability of taking a special behavior, and intention directly determines the behavior, the stronger intention, the more behavior (Ajzen, 1991). So entrepreneurial intention predicts whether individuals tend to start their own business, which is the key to the emergence of entrepreneurial behavior.

For decades, entrepreneurship has been object of many academic studies, it has found that the personal predisposition and family, economic, and cultural contexts that most influence the option for the development of entrepreneurial projects (Jardim et al., 2021). However, it is not sufficiently clear what kind of personal predisposition are related to entrepreneurial intention. Some researchers have found that entrepreneurial intentions are influenced by personality traits, such as age, sex, education, family businessman, risk, neuroticism, kindness, emotional intelligence (Chang and Wang, 2009; Espíritu-Olmos and Sastre-Castillo, 2015; Liu et al., 2016; Mei et al., 2019). Most of the general personality traits are stable and hard to change and the researches how to improve entrepreneurial intentions are limited. Thus, most of the previous studies are more conceptual than empirical, neglecting the cognitive and behavioral results (Jardim et al., 2021).

Values are cognitive, deliberate and evaluative determinants of goals (Veroff and Smith, 1985), can predicting behavioral intention (Eyal et al., 2009), and constitute the basic of individual behavior (Matusik et al., 2008). The research also identifies values can predicting behavioral intentions in the condition of value-expressive (Maio and Olson, 1995). In the process of entrepreneurship, one's personal values determine her entrepreneurial intentions (Hollenbeck and Whitener, 1988; Jaén and Liñán, 2013). Bird (1988) confirmed the entrepreneur's values, beliefs and needs were the foundations of the intentional process to entrepreneurial activity. Work values represent the cognitive recognition of the way to strive for, and the important of work values lies in the capacity to guide goal setting, so they are important in explaining human actions (Hueso et al., 2021). Fayolle and Liñán (2014) found personal values to work played a key role in making the entrepreneurial decisions. Gorgievski et al. (2011) researched that the criteria to define success

in entrepreneurial endeavors was related to personal values. There is already evidence that personal values differ in their effect on the formation of entrepreneurial intentions (Hueso et al., 2021). However, the research of examining the specific values that relate to entrepreneurial intentions and behavior is limited. And the studies of the relationship between work values and entrepreneurial intentions are still few. The formation of entrepreneurial intention is not yet clear.

The present study aims to determine the influences of work values on entrepreneurial intention among college students, which provides theoretical and empirical basis for exploring the cultivation mechanism of entrepreneurial intentions among college students. In addition, college students play a leading and driving role in innovative entrepreneurship, and the goal of boosting employment through entrepreneurship will be reached, so as to increase the rate of employment in entrepreneurship ultimately.

Theoretical basis and research hypothesis

Psychological capital

Psychological capital, like traditional human capital and social capital, belongs to the human resources of the organization and plays an important role in maintaining the competitive advantage. Based on organizational behaviorism and positive psychology, psychological capital shifts the focus from "who are you" to "who are you going to be," which is a state-like rather than a trait that can be acquired and effectively developed through learning (Avolio and Luthans, 2006). The American scholar Luthans et al. (2007) defined psychological capital as: The positive psychological state of individual development is composed of four positive psychological factors—self-efficacy, optimism, hope and resilience. Self-efficacy is an individual's belief that one can mobilize motivation, cognitive resources and action plans to succeed (Stajkovic and Luthans, 1998); Optimism has both positive and motivational attributes, with optimistic individuals characterized by perseverance, achievement and health, which can make positive attribution to success; Hope is related to positive outcomes, such as perceived control and the ability to cope with stress, difficulty, and high hope individuals will elaborate plans, and there are at least two alternative paths to achieve the goal in order to be able to switch paths in time when they encounter obstacles; Resilience is an individual's psychological resilience in the face of difficulties and adversity (Luthans et al., 2005). Therefore, self-efficacy, optimism, hope and resilience play an important role in entrepreneurship, and the synergy of these four structures may be greater than the sum of each component, each having a unique feature,

when integrated, works synergistically to elevate the potential behavior of the individual. Psychological capital is like a jigsaw puzzle, and each structure is a piece of that puzzle (Papanikos, 2011). Optimists are able to find opportunities in any situation, they use them to set high goals, and they believe they can achieve goals and find a path to success. In order to achieve goals, individuals need a high level of self-efficacy, which means they will put in the effort to achieve goals. Then they will look for solutions to many of the problems they face in starting a business to achieve goals, and if they fail in the first attempt, they will have the resilience to fight again until succeed. Studies have suggested that psychological capital has a significant effect on entrepreneurial intentions (Ghani et al., 2013; Ke et al., 2013; Peng et al., 2014), and that the higher the individual's psychological capital, the stronger their entrepreneurial intentions. Therefore, the following hypothesis is proposed:

H1: psychological capital affects college students' entrepreneurial intentions positively.

Work values

Work values are a domain-specific set of values. Work values are people's evaluation of the needs of social occupation, that is a reflection of life values on the issue of work (Huang et al., 1994). Prominent theories of vocational development from Holland, assign work values a central role in vocational preferences and choices (Holland, 1997). Work values represent an individual's perception of the importance people place on different job characteristics and the types of rewards they seek to attain (Lechner et al., 2017). Work value motivates college students to aspire to a career when they graduate. In the study, we distinguish between three work value dimensions: health factors (e.g., good pay; good welfare; good work environment; housing), prestige status (e.g., high social status; high profile company; high economic status), self-development (e.g., opportunities for education; playing to talents; fair competition; more autonomy).

According to Maslow's (1943) Hierarchy of Needs, from the low level to the high level, the human needs are divided into physiological needs, security needs, belonging and love needs, self-esteem needs, and self-realization needs. The lower level needs must be satisfied before the higher level needs are pursued (Maslow, 1943). The personal needs of college students in career choice process are different due to their family background, ideal pursuit and professional skills. Different needs lead to different evaluations of social occupation. It has been concluded that work values have a significant predictive effect on entrepreneurial intentions (Hirschi and Fischer, 2013; Espiritu-Olmos and Sastre-Castillo, 2015), and that work values

may influence the psychological state in which individuals direct their attention, energy, and behavior toward planned occupational behaviors. Therefore, the following hypothesis is proposed:

H2: work values affect college students' entrepreneurial intentions positively.

Moderating effects of psychological capital on work values and entrepreneurial intentions

There is, a few of studies suggesting that work values do exert its influence on entrepreneurial intentions (Hirschi and Fischer, 2013; Espiritu-Olmos and Sastre-Castillo, 2015; Sebor, 2017), but it is still unclear as to whether work values directly influence entrepreneurial intentions. Psychological capital is a construct that was first adopted in the workplace to symbolize positive psychology (Wang et al., 2014). Previous studies have focused on the positive relationship between psychological capital and employee performance (Luthans, 2011), competitive advantage (Youssef and Luthans, 2010), and business excellence (Hsu et al., 2014). Some researches on entrepreneurial intentions have focused on the effect of the subdimension of psychological capital. Such as, Robledo et al. (2015) found optimism had a positive effect on entrepreneurial intentions; Saeid et al. (2011) confirmed the effect of self-efficacy. The study of the relationship between psychological capital and entrepreneurial intentions is just emerging.

Furthermore, from the positive psychology perspective, the study exploring the influences of work values on entrepreneurial intention is very limited. And only several studies have explored the indirect effect of psychological capital. Zhu et al. (2021) found entrepreneurial self-efficacy played a mediating role between entrepreneurial values and entrepreneurial intentions. Sun and Xu (2020) found that entrepreneurial psychological capital moderates the relationship between work values and entrepreneurial intentions; Zhao and Chen (2018) confirmed psychological capital had a moderating effect on the relationship between work values of prestige and status and entrepreneurial execution intention. That showed the reasons for the low entrepreneurial intention of college students were largely related to their internal psychological factors.

According to the theory of planned behavior, perceived behavior control refers to the perceived difficulty of performing behavior (Ajzen, 2011). The stronger the individual's perceived control behavior to achieve the goal, the more likely the individual is to succeed. Psychological capital can be understood as a form of perceived behavior control, whose connotation is the control of the behavioral perception in the process of achieving the goal. Perceived behavior control plays a role in the

relationship between behavioral attitude and entrepreneurial intention (Zaremohzzabieh et al., 2019). Therefore, work values may be modulated by psychological capital in influencing entrepreneurial intentions. The following hypothesis is proposed:

H3: psychological capital plays a moderating role between the relationship work values and college students' entrepreneurial intentions.

Methodology

Participants

The data this study came from 723 college students in Jiangxi Province, China, who were asked to participate voluntarily. The sample was composed of 153 freshmen, 193 sophomores, 253 juniors and 124 seniors, and there were 80 boys and 643 girls.

Measurement

Work values questionnaire

To assess work values, we used a questionnaire designed by Ling et al. (1999). There are 22 items in the questionnaire, which was divided into three dimensions: health factors, prestige status, and self-development. All questions were rated on a five-point Likert scale (strongly disagree = 1, strongly agree = 5). The reliability of this questionnaire was verified to be good (Cronbach's α , 0.93).

Entrepreneurship intention questionnaire

Entrepreneurial Intention Questionnaire of Martin revised by Obschonka et al. (2010), was divided into two dimensions, unconditional entrepreneurship intention and conditional entrepreneurship intention, with three items in each dimension. Questions were rated on a five-point Likert scale (strongly disagree = 1, strongly agree = 5), the higher the overall score, the stronger the intention to start a business. The reliability of the questionnaire was verified (Cronbach's α , 0.91).

Psychological capital questionnaire

The Positive Psychological Capital Questionnaire (PPQ) was developed by Zhang et al. (2010), a total of 26 items, divided into four dimensions: self-efficacy, resilience, hope and optimism. A seven-point scale was used, ranging from 1 (not at all) to 7 (fully), the higher the total score, the higher the psychological capital level. The Cronbach α coefficient of the scale was 0.87, which indicates that the variables meet the requirement of reliability.

Data processing

The collected data were processed by SPSS22.0 software. The statistical methods used were factor analysis, reliability analysis, descriptive analysis, analysis of variance, correlation analysis, and regression analysis.

Empirical results

Common method deviation test

The Harman one-way factor test of the scale showed 9 factors with the eigenvalue greater than 1, and the variation explained by the first common factor is 21.46%, which is less than the critical standard of 40%. Therefore, there is no serious common method deviation in this study (Zhou and Long, 2004).

Descriptive analysis

The results of the descriptive statistical analysis of college students' entrepreneurial intention and its sub-dimensions are shown in Table 1. The results show that the average score of college students' entrepreneurial intention is 3.08, which is at an average level, with the average score of unconditional entrepreneurial intention being 2.84, which is below the average level, while the intensity of conditional entrepreneurial intention is slightly higher than that of unconditional entrepreneurial intention.

Statistical analysis of difference

The results of the statistical analysis of differences in entrepreneurial intention and its sub-dimensions among college students on the demographic variables of gender, family location and whether parents are entrepreneurs or not are shown in Table 2 and it can be concluded that the intensity of entrepreneurial intention is significantly higher for male students than female students, with an effect size of 0.58; The level of entrepreneurial intention is significantly influenced by the entrepreneurial behavior of parents, and the intensity of entrepreneurial intention is significantly higher for students whose parents are entrepreneurs than for whose parents are not entrepreneurs, with an effect size of 0.22; There was no significant difference in the variables of family location, but the degree of entrepreneurial intention of students in urban areas is higher than that of students in rural areas. In the sub-dimension of entrepreneurial intention, the difference effect of unconditional entrepreneurial intention in population variables is more than that of conditional entrepreneurial intention.

TABLE 1 Descriptive statistics of college students' entrepreneurial intentions and its dimensions.

	Entrepreneurial intention	Conditional entrepreneurial intention	Unconditional entrepreneurial intention
M	3.08	3.32	2.84
SD	0.76	0.86	0.81

TABLE 2 Statistical of differences in demographic variables among college students' entrepreneurial intention and its dimensions.

Demographic variable		Entrepreneurial intention M (SD)	<i>t</i>	<i>d</i>	Conditional entrepreneurial intention M (SD)	<i>t</i>	<i>d</i>	Unconditional entrepreneurial intention M (SD)	<i>t</i>	<i>d</i>
Gender	Male	3.47 (0.87)	4.29***	0.58	3.71 (0.88)	4.38***	0.52	3.23 (1.01)	3.67***	0.54
	Female	3.03 (0.73)			3.27 (0.85)			2.80 (0.77)		
Home location	Towns	3.11 (0.77)	0.76	0.06	3.33 (0.89)	0.23	0.02	2.89 (0.80)	1.19	0.09
	Rural	3.07 (0.76)			3.31 (0.85)			2.81 (0.82)		
Whether the parents are entrepreneurs	Yes	3.23 (0.73)	2.05*	0.22	3.43 (0.80)	0.08	0.15	3.04 (0.80)	2.43*	0.27
	No	3.06 (0.76)			3.30 (0.87)			2.82 (0.81)		

N = 723; **p* < 0.05, ****p* < 0.001.

TABLE 3 Correlations among work values, psychological capital, and entrepreneurial intentions.

	Entrepreneurial intention	Conditional entrepreneurial intention	Unconditional entrepreneurial intention	Psychological capital	Self-efficacy	Resilience	Hope	Optimism
Work values	0.23***	0.24***	0.17***	0.18***	0.10**	0.04	0.21***	0.22***
Prestige and status	0.28**	0.24***	0.27***	0.10**	0.07	0.01	0.11**	0.13***
Health factors	0.045	0.10**	−0.02	0.10**	0.03	0.01	0.16***	0.16***
Self-development	0.22***	0.26***	0.14***	0.26***	0.17***	0.10**	0.30***	0.30***
Conditional entrepreneurial intention				0.31***	0.27***	0.18***	0.28***	0.29***
Unconditional entrepreneurial intention				0.30***	0.30***	0.18***	0.22***	0.26***
Entrepreneurial intention				0.33***	0.31***	0.19***	0.28***	0.30***

N = 723; ***p* < 0.01, ****p* < 0.001.

Correlation analysis

Subsequently, the relation of the work values, psychological capital and entrepreneurial intentions were estimated through a point biserial correlation by Pearson correlation approach. In Table 3 the values of correlation's coefficients can be observed. The results demonstrated that the three variables of work values, psychological capital and entrepreneurial intention are significantly correlated in two, but the correlation coefficients are not high, that is, the level of correlation is average. The prestige and status dimension and self-development dimension of work values were significantly and positively correlated with the entrepreneurial intentions, while the correlation between health factors and the entrepreneurial intentions

was not significant and the correlation with unconditional entrepreneurial intention was negative. The sub-dimensions of work values were all significantly and positively correlated with psychological capital, but only the self-development was significantly correlated with all four sub-dimensions of psychological capital. Furthermore, the four sub-dimensions of psychological capital were significantly correlated with entrepreneurial intentions and its sub-dimensions.

Validation of moderation effects

The influences of work values on entrepreneurial intention among college students and the moderating role of psychological capital were examined. Firstly, the

TABLE 4 Validation of moderation effects.

	Model 1 entrepreneurial intention		Model 2 entrepreneurial intention		Model 3 unconditional entrepreneurial intention		Model 4 unconditional entrepreneurial intention	
	<i>B</i>	<i>t</i>	<i>B</i>	<i>t</i>	<i>B</i>	<i>t</i>	<i>B</i>	<i>t</i>
Work values	0.19	5.27***	0.19	5.31***	0.14	3.77***	0.15	3.99***
Psychological capital	0.27	7.34***	0.27	7.33***				
Work values × Psychological capital			0.02	0.68				
Hope					0.16	4.15***	0.16	4.23***
Work values × Hope							0.10	2.76**
<i>R</i> ²	0.17		0.17		0.10		0.11	
<i>F</i>	16.32***		14.73***		8.93***		8.87***	

N = 723; ***p* < 0.01, ****p* < 0.001.

independent, dependent, and moderating variables were standardized. Secondly, demographic variables such as gender, family location, and whether parents are entrepreneurs were as control variables, work values as independent variables, and psychological capital as moderating variables. Finally, the interaction term (occupational value × psychological capital) was added to the regression equation. The results were shown in Table 4. From the model 1, the main effect of work values on entrepreneurial intention was significant, and the main effect of psychological capital on entrepreneurial intention was also significant, that is to say, work values can predict entrepreneurial intention and hypothesis 1 was true. Psychological capital can predict entrepreneurial intentions, hypothesis 2 is confirmed. From the model 2, the interaction effect was not significant. Therefore, psychological capital did not play a moderating role in the relationship between work values and entrepreneurial intentions of college students, and hypothesis 3 did not hold. Further, the relationship between the sub-dimensions of variables was explored. It showed that the

main effect of work values on unconditional entrepreneurial intention was significant, and the main effect of hope on unconditional entrepreneurial intention was significant from model 3. In Model 4, the interaction effect between work values and hope was significant, so it was hope to have a moderating effect on the relationship between work values and unconditional entrepreneurial intention.

To more clearly reveal the moderating effect of hope in the relationship between the work values and unconditional entrepreneurial intention, a simple slope test was conducted. We divided into high-hope group and low-hope group according to the criteria of one standard above and below the mean of hope and the results were shown in Figure 1. The positive correlation between career values and entrepreneurial intention was stronger in the case of high-hope level (simple slope 0.21, *p* < 0.001), and weaker in the case of low-hope level (simple slope 0.07, *p* < 0.001).

Conclusion and discussion

This paper draws the following main conclusions:

- (1) Work values have a significant effect on college students' entrepreneurial intentions.
- (2) Psychological capital has a significant effect on college students' entrepreneurial intentions.
- (3) Psychological capital does not moderate the relationship between work values and entrepreneurial intentions among college students;
- (4) The hope dimension of psychological capital moderates the relationship between college students' work values and unconditional entrepreneurial intentions.

From the study, firstly, college students have no strong desire to start a business, especially have an even lower unconditional entrepreneurial intention. That is, students are more inclined to start a business if they have sufficient financial support, good



partners, and good market prospects, whereas in the absence of these conditions, individuals are less likely to engage in entrepreneurial activities. There are a lot of uncertainty factors, especially in the early stage of entrepreneurship, which is even unrewarding. Then the physiological needs are not guaranteed, so students have no strong entrepreneurial intention at this stage, especially unconditional entrepreneurial intention.

Regarding the relation between the values, the results of the study confirm that prestige and status and self-development are significantly correlated with the entrepreneurial intention, while health factor are not significantly correlated with entrepreneurial intentions and have a negative correlation with unconditional entrepreneurial intention. Health factors include high income, stable employment, elegant working environment, reliable health insurance and pension. Entrepreneurship is unstable, has a poor working environment, no medical insurance and pension, and needs to invest more money without return in the early period. Therefore, college students with strong perception of hygienic factors have a weaker entrepreneurial intention and are less likely to start a business, even the deeper the students' perception of health factors, the weaker the degree of unconditional entrepreneurial. The correlation between prestige and status and entrepreneurial intention was stronger than that of self-development. That is to say, students with a strong perception of prestige and status are more inclined to choose entrepreneurship.

Psychological capital and its four dimensions are all significantly and positively correlated with entrepreneurial intention. That indicate that the higher the level of psychological capital, the stronger the entrepreneurial intention the students are. Individuals with a high level of psychological capital could regard their future more positively, and believed that they are in control the process of entrepreneurship. Students with positive psychological qualities such as self-efficacy, hope, optimism, and resilience are more inclined to start their own business. They have confidence that they can complete the challenging work of starting a business, they are able to solve the problems encountered in the process of starting a business, they can positively attribute to their success, and they can demonstrate strong willpower in the face of entrepreneurial adversity.

Both work values and psychological capital have significant predictive effect on entrepreneurial intention. Further, the study reveals that psychological capital don't play a moderating role between work values and entrepreneurial intention of college students by hierarchical regression analysis, while hope has significant moderating effect on the relationship between work values and unconditional entrepreneurial intentions. Specifically, the work values of students with high levels of hope are more predictive of unconditional entrepreneurial intentions than those with low levels of hope. Conditional entrepreneurial intentions indicate the degree to which individuals are inclined to start a business if there is sufficient funding, good markets and good partners. College students with unconditional

entrepreneurial intentions will consciously understand the process and methods of business start-up, regardless of the external conditions, and they start the business due to intrinsic motivational factors such as the personal interests and values. Therefore, the level of unconditional entrepreneurial intentions can better reflect the trend of college students after graduation.

Implications

Cultivate work values in college education is a key factor affecting students' entrepreneurial intention. Actually, only the work values are not enough. Therefore, this paper established a moderation effect in which psychological capital moderated the relationship between work values and entrepreneurial intention. We conclude the work values of students with high levels of hope are more predictive of unconditional entrepreneurial intentions than those with low levels of hope.

According to the hope theory model proposed by [Snyder et al. \(1991\)](#), hope is an acquired tendency of individuals to think and act and is a cognitive trait, as well as a kind of motivational state, a fusion of goal-focused, motivational thinking and path thinking. Motivational thinking is an individual's necessary motivation and beliefs to stimulate himself to move along a set goal, while path thinking is the individual's perceptions and beliefs about his ability to find effective ways to achieve a goal. High-hope individuals are more likely to choose goals with uncertainty, to challenge difficulty problems, and to make impossibility possible. When high-level students pursue the goal of entrepreneurship, their path thinking will inevitably produce a path to achieve the goal of entrepreneurship, and have the confidence to achieve. Studies have shown that high hopefuls are able to make more assertive judgments about how to achieve work goals ([Woodbury, 1999](#)), and are able to find the positive and clear pathway, while the low hopefuls have much weaker path thinking, and the pathways are vague and unclear ([Snyder et al., 1998](#)).

As to the goal of starting a business, the college students with high-level of hope can decisively find the successful path, and can quickly adjust to find an alternative path if they encounter difficulties in the process of starting a business, and have strong willpower to achieve the entrepreneurial goals. Therefore, we can train college students acquiring the quality of hope in the process of entrepreneurship education.

Limitation and future research

Firstly, the sample of this study is limited, which can only explain the general situation in Jiangxi Province, China, but cannot explain the overall situation of the whole country. Secondly, the number of female college students selected is much large than of male college, which may lead to the fact

that entrepreneurial intention characteristics of male students are not obvious and those of female students are too prominent in the study results. In addition, the measurement tools need to be further developed and revised to make it more applicable to the local students in China.

Currently, few scholars research about the mechanism of work values affecting entrepreneurial intentions, especially from the positive psychology perspective which can be researched in the future.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

LT: conceptualization, methodology and formal analysis, software, writing – original draft, and preparation.

References

- Ajzen, I. (1991). The theory of planned behavior. *Organ. Behav. Hum. Process.* 50, 179–211. doi: 10.1016/0749-5978(91)90020-T
- Ajzen, I. (2011). The theory of planned behavior: Reactions and reflections. *Psychol. Health* 26, 1113–1115. doi: 10.1080/08870446.2011.613995
- Avolio, B. J., and Luthans, F. (2006). *The High Impact Leader: Moments Matter In Accelerating Authentic Leadership Development*. New York, NY: McGraw-Hill.
- Baron, R. A. (2007). “Entrepreneurship: a process perspective,” in *The Psychology of Entrepreneurship, the Organizational Frontiers*, eds J. R. Baum, M. Frese, and R. A. Baron (Mahwah: Lawrence Erlbaum Associates Publishers).
- Bird, B. (1988). Implementing entrepreneurial ideas: The case of intention. *Acad. Manag. Rev.* 3, 442–453. doi: 10.5465/amr.1988.4306970
- Chang, H., and Wang, C. (2009). Achievement needs influence on entrepreneurial intentions—Dual mediating role of risk propensity and entrepreneurial alertness. *Soft Sci.* 33, 34–39.
- Espíritu-Olmos, R., and Sastre-Castillo, M. A. (2015). Personality traits versus work values: Comparing psychological theories on entrepreneurial intention. *J. Bus. Res.* 68, 1595–1598. doi: 10.1016/j.jbusres.2015.02.001
- Eyal, T., Sagristano, M. D., Trope, Y., Liberman, N., and Chaiken, S. (2009). When values matter: Expressing values in behavioral intentions for the near vs. Distant future. *J. Exp. Soc. Psychol.* 45, 35–43. doi: 10.1016/j.jesp.2008.07.023
- Fayolle, A., and Liñán, F. (2014). The future of research on entrepreneurial intentions. *J. Bus. Res.* 67, 663–666. doi: 10.1016/j.jbusres.2013.11.024
- Ghani, M., Hooshangi, M., and Hassan, M. (2013). The effect of psychological capital on university of Tehran students’ entrepreneurial intention. *Asian J. Res. Bus. Econ. Manag.* 3, 313–321.
- Gorgievski, M. J., Ascalon, M. E., and Stephan, U. (2011). Small business owners’ success criteria, a values approach to personal differences. *J. Small Bus. Manag.* 49, 207–232. doi: 10.1111/j.1540-627X.2011.00322.x
- Hirschi, A., and Fischer, S. (2013). Work values as predictors of entrepreneurial career intentions. *Career Dev. Int.* 18, 216–231. doi: 10.1108/CDI-04-2012-0047
- Holland, J. L. (1997). *Making Vocational Choices: A Theory of Vocational Personalities and Work Environments*, 3rd Edn. Odessa, FL: Psychological Assessment Resources.
- Hollenbeck, J. R., and Whitener, E. M. (1988). Reclaiming personality traits for personnel selection: Self-esteem as an illustrative case. *J. Manag.* 14, 81–91. doi: 10.1177/014920638801400108
- Hsu, S., Wang, Y., Chen, Y., and Dahlgaard, S. M. (2014). Building business excellence through psychological capital. *Total Qual. Manag. Bus. Excell.* 25, 1210–1233. doi: 10.1080/14783363.2014.913349
- Huang, X. T., Zhang, J. F., and Li, H. (1994). *Contemporary Chinese Youth Values And Education*. Chengdu: Sichuan Education Press.
- Hueso, J. A., Jaén, I., and Lián, F. (2021). From personal values to entrepreneurial intentions: A systematic literature review. *Int. J. Entrep. Behav. Res.* 27, 205–230. doi: 10.1108/IJEBR-06-2020-0383
- Jaén, I., and Lián, F. (2013). Work values in a changing economic environment: The role of entrepreneurial capital. *Int. J. Manpow.* 34, 939–960. doi: 10.1108/IJM-07-2013-0166
- Jardim, J., Bártolo, A., and Pinho, A. (2021). Towards a global entrepreneurial culture: A systematic review of the effectiveness of entrepreneurship education programs. *Educ. Sci.* 11:398. doi: 10.3390/educsci11080398
- Ke, J. L., Feng, J. Y., and Deng, J. G. (2013). An empirical study on the effect of college students’ psychological capital on entrepreneurial intention. *Youth Stud.* 3, 40–49.
- Krueger, N. F., Reilly, M. D., and Carsrud, A. L. (2000). Competing models of entrepreneurial intentions. *J. Bus. Ventur.* 15, 411–432. doi: 10.1016/S0883-9026(98)00033-0
- Lechner, C. M., Sortheix, F. M., Goellner, R., and Salmela-Aro, K. (2017). The development of work values in the transition to adulthood: A two-country longitudinal study. *J. Vocat. Behav.* 99, 52–65. doi: 10.1016/j.jvb.2016.12.004
- Ling, W. Q., Fang, L. L., and Bai, L. G. (1999). A study on career values of Chinese college students. *Psychol. Sin.* 31, 342–348.
- Liu, D., Ye, B. J., and Guo, S. Y. (2016). The Influence of active personality on college students’ entrepreneurial intention: The mediation of perceived entrepreneurial value. *Chin. J. Clin. Psychol.* 24, 946–949.
- Luthans, F. (2011). *Organizational Behavior. An Evidence-based Approach*. New York, NY: McGraw-Hill.

Funding

This research was funded by the Social Science Foundation of Jiangxi Province, China, grant number 20JY50.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher’s note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

- Luthans, F., Avolio, B. J., Walumbwa, F. O., and Li, W. (2005). The Psychological capital of Chinese workers: Exploring the relationship with performance. *Manag. Organ. Rev.* 1, 249–271. doi: 10.1111/j.1740-8784.2005.00011.x
- Luthans, F., Youssef, C. M., and Avolio, B. J. (2007). *Psychological Capital*. London: Oxford University Press. doi: 10.1037/t06483-000
- Maio, G. R., and Olson, J. M. (1995). Relations between values, attitudes, and behavioral intentions: The moderating role of attitude function. *J. Exp. Soc. Psychol.* 31, 266–285. doi: 10.1006/jesp.1995.1013
- Maslow, A. H. (1943). A theory of human motivation. *Psychol. Rev.* 50, 370–396. doi: 10.1037/h0054346
- Matusik, S. F., George, J. M., and Heeley, M. B. (2008). Values and judgment under uncertainty: Evidence from venture capitalist assessments of founders. *Strateg. Entrep. J.* 2, 95–115. doi: 10.1002/sej.45
- Mei, Y., Cheng, K., and Liu, J. P. (2019). Effects of emotional intelligence on college students' entrepreneurial intentions: Chain mediating effects of achievement motivation and entrepreneurial self-perception. *Chin. J. Clin. Psychol.* 39, 173–178.
- Obschonka, M., Silbereisen, R. K., and Schmitt-Rodermund, E. (2010). Entrepreneurial intention as development outcome. *J. Vocat. Behav.* 77, 63–72. doi: 10.1016/j.jvb.2010.02.008
- Papanikos, G. T. (2011). *International Developments In Management Research*. Athina: Athens institute for education and research.
- Peng, W., Zhang, H. R., and Wang, Y. (2014). The influence of psychological capital on college students' entrepreneurial intention. *Heilongjiang High. Educ. Res.* 12, 116–120.
- Robledo, J., Arán María, V., Sanchez, V., and Rodriguez-Molina, M. (2015). The moderating role of gender on entrepreneurial intentions: A TPB perspective. *Intang. Cap. J.* 11, 92–117. doi: 10.3926/ic.557
- Saeid, K., Harm, B., and Thomas, L. (2011). "Application of structural equation modelling to assess the effect of entrepreneurial characteristics on students' entrepreneurial intention," in *Paper Presented At The 6th European Conference On Entrepreneurship And Innovation*, (Aberdeen: Robert Gordon University), 954–967.
- Sebora, T. C. (2017). *Psychological Capital And The Entrepreneurial Intention Of College Students*. Berlin: Research Gate.
- Snyder, C. R., Harris, C., Anderson, J. R., Holleran, S. A., Irving, L. M., Sigmon, S. T., et al. (1991). The will and the ways: Development and validation of an individual differences measure of hope. *J. Pers. Soc. Psychol.* 60, 570–585. doi: 10.1037/0022-3514.60.4.570
- Snyder, C. R., Lapointe, A. B., Crowson, J. J., and Early, S. (1998). Preferences of high and low-hope people for self-referential input. *Cogn. Emot.* 12, 807–823. doi: 10.1080/026999398379448
- Stajkovic, A. D., and Luthans, F. (1998). Social cognitive theory and self-efficacy: Going beyond traditional motivational and behavioral approaches. *Organ. Dyn.* 26, 62–74. doi: 10.1016/S0090-2616(98)90006-7
- Sun, Y. H., and Xu, Q. Y. (2020). The relationship between work values and entrepreneurial intention of College students: The moderating effect of entrepreneurial psychological capital. *J. Youth Stud.* 27–31.
- Veroff, J., and Smith, D. A. (1985). Motives and values over the adult years. *Adv. Motiv. Achiev.* 4, 1–53.
- Wang, X., Zheng, Q., and Cao, X. (2014). Psychological capital: A new perspective for psychological health education management of public schools. *J. Public Pers. Manag.* 43, 371–383. doi: 10.1177/0091026014535182
- Woodbury, C. A. (1999). The relationship of anxiety, locus of control and hope to career indecision of African American students. *Diss. Abstr. Int.* 59:4072.
- Youssef, C. M., and Luthans, F. (2010). *An Integrated Model Of Psychological Capital In The Workplace*. New York, NY: Oxford University Press, Inc. doi: 10.1093/oxfordhb/9780195335446.013.0022
- Zaremohzzabieh, Z., Ahrari, S., Krauss, S. E., Samah, A. A., Meng, L. K., Ariffin, Z., et al. (2019). Predicting social entrepreneurial intention: A meta-analytic path analysis based on the theory of planned behavior. *J. Bus. Res.* 96, 264–276. doi: 10.1016/j.jbusres.2018.11.030
- Zhang, K., Zhang, Y. L., and Dong, Y. H. (2010). Positive psychological capital: Measurement and the relationship with mental health. *Psychol. Behav. Res.* 8, 58–64.
- Zhao, Q., and Chen, G. P. (2018). Work values, psychological capital and entrepreneurial intentions. *Contin. Educ. Res.* 48–53.
- Zhou, H., and Long, L. L. (2004). Statistical test and control of common method bias. *Adv. Psychol. Sci.* 12, 942–950.
- Zhu, W. J., Fang, Y. S., and Liu, Y. (2021). Link ages among entrepreneurial intention, entrepreneurial values and entrepreneurial self-efficacy in college students: The moderating effect of gender. *Psychol. Res.* 14, 341–349.



OPEN ACCESS

EDITED BY

Ana Luísa Rodrigues,
University of Lisbon, Portugal

REVIEWED BY

Pam Denicolo,
University of Reading, United Kingdom
Lindsey Eberman,
Indiana State University, United States

*CORRESPONDENCE

Janine S. Senekal
jssenekal@uwc.ac.za

SPECIALTY SECTION

This article was submitted to
Higher Education,
a section of the journal
Frontiers in Education

RECEIVED 01 August 2022

ACCEPTED 05 October 2022

PUBLISHED 25 October 2022

CITATION

Senekal JS, Munnik E and Frantz JM
(2022) A systematic review of doctoral
graduate attributes: Domains and
definitions. *Front. Educ.* 7:1009106.
doi: 10.3389/feduc.2022.1009106

COPYRIGHT

© 2022 Senekal, Munnik and Frantz.
This is an open-access article
distributed under the terms of the
[Creative Commons Attribution License
\(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use, distribution or
reproduction in other forums is
permitted, provided the original
author(s) and the copyright owner(s)
are credited and that the original
publication in this journal is cited, in
accordance with accepted academic
practice. No use, distribution or
reproduction is permitted which does
not comply with these terms.

A systematic review of doctoral graduate attributes: Domains and definitions

Janine S. Senekal^{1*}, Erica Munnik¹ and Jose M. Frantz²

¹Department of Psychology, University of the Western Cape, Bellville, South Africa, ²Research and Innovation, University of the Western Cape, Bellville, South Africa

Doctoral graduate attributes are the qualities, skills, and competencies that graduates possess, having completed their doctorate degree. Graduate attributes, in general, lack conceptual clarity, making the investigation into and quality assurance processes attached to doctoral outcomes challenging. As many graduate attributes are “unseen” or implicit, the full range of attributes that doctoral graduate actually possess needs to be synthesized, so that they may be recognized and utilized by educational stakeholders. The aim of this study was to establish and describe what attributes graduates from doctoral degrees possess. A systematic review of peer-reviewed, primary literature published between January 2016 and June 2021 was conducted, identifying 1668 articles. PRISMA reporting was followed, and after screening and full text critical appraisal, 35 articles remained for summation through thematic synthesis. The doctoral graduate attribute domains identified included knowledge, research skills, communication skills, organizational skills, interpersonal skills, reputation, scholarship, higher order thinking skills, personal resourcefulness, and active citizenship. Many of the domains were conceptualized as transferable or interdisciplinary, highlighting the relevance of the attributes doctoral graduates possess. The review findings align with existing frameworks yet extend those that tend to focus on generic “seen” attributes, and include a range of “unseen”, intrinsic qualities as outcomes of the doctoral degree. The review contributes to the conceptual development of doctoral graduate attributes, by synthesizing actual outcomes, as opposed to prospective attributes or attributes-in-process. Doctoral graduate attributes should be conceptualized to integrate both generic attributes alongside intrinsic qualities that are important for employability. Increased awareness as to the scope of doctoral graduate attributes among stakeholders, such as doctoral supervisors, students, graduates and employers, may facilitate improved educational outcomes and employability. Future research into the contextual relevance of the domains identified and how they are developed may be beneficial. Future research could involve the development of context-relevant scales to empirically measure doctoral graduate attributes among alumni populations, as a quality assurance outcome indicator. Such findings could inform program reform, improving the relevance of doctoral education and the employability of doctoral graduates.

KEYWORDS

doctoral education, doctoral graduate attributes, interdisciplinarity, systematic review, transferable skills, educational outcomes, postgraduate education and training, research skills

Introduction

Doctoral graduate attributes are defined as the qualities or characteristics of a doctoral graduate, integrating skills, knowledge and competencies with doctoral identity (Yazdani and Shokooh, 2018). Graduate attributes are of interest within the context of higher education quality assurance and the international focus on producing skilled and employable graduates (Bitzer and Withering, 2020). Graduate attributes are typically defined institutionally and embedded in curriculum learning outcomes (Bridgstock, 2009; Mashiyi, 2015). However, doctoral degrees often lack a standardized curriculum, with the primary focus being original research under supervision (Elliot et al., 2016; Molla and Cuthbert, 2016), leaving no formal frame into which doctoral graduate attributes may be embedded. The transferability of graduate attributes is an important consideration for higher education institutions, so that the attributes instilled are relevant to multiple work contexts, enhancing graduate employability (Kensington-Miller et al., 2018). This is particularly relevant in the context of doctoral education, with the shift away from the thesis as the primary outcome, and the increased demand for transferable skills to the increasingly competitive world of work (Denicolo and Reeves, 2014). Doctoral graduate attributes, as outcomes of doctoral education, are important to consider for quality assurance, the employability of graduates, and the relevance of doctoral education.

Graduate attributes are generally critiqued as lacking conceptual clarity (Mowbray and Halse, 2010; Bitzer and Withering, 2020). This conceptual ambiguity is reflected in the “range of adjectives such as “transferable”, “generic”, “soft”, “key”, “graduate” and “employability” [that] have been diversely paired with nouns such as “skills”, “attributes”, “outcomes” and “capabilities”” (Kensington-Miller et al., 2018, p. 1440). In short, the following differentiations between terms may be made: “competence” is a performance-based term, referring to successful or efficient performance whereas “competencies” refers to the knowledge and behaviors that, if utilized effectively, result in competent performance (Potolea, 2013; Durette et al., 2016). “Skills” are typically learned abilities or expertise, but can be more broadly defined to include “the acquisition or development of specific capacities, abilities, aptitudes or competencies” (Gilbert et al., 2004, as cited by Mowbray and Halse, 2010, p. 655). “Attributes” refers to the inherent characteristics or features of someone or something. By extension, doctoral graduate attributes would be the features or characteristics of doctoral graduates, and may thus be an umbrella term that integrates skills, knowledge and competencies, as expressed by Yazdani and Shokooh (2018). This definition allows for the multidimensional and interrelated nature of the qualities and skills doctoral graduates possess (Mowbray and Halse, 2010).

Measuring graduate attributes is complicated, partly due to the conceptual ambiguity noted. Graduate attributes are typically developed longitudinally, making them challenging to operationalize, and context dependent, limiting the generalizability of scales (Hughes and Barrie, 2010; Cavanagh et al., 2015; Nell and Bosman, 2017). Graduate attributes often include a combination of skills, dispositions, values, and competencies that may be more abstract and difficult to quantify (Hinchliffe and Jolly, 2011). Many graduate attributes are “unseen” or “invisible” as they may reflect the qualities of the person, and are not as explicit as those clearly embedded in the curriculum or formal degree processes (Kensington-Miller et al., 2018). These “invisible” attributes are often implied, yet are important to consider for a graduates’ overall profile, such as resilience (Kensington-Miller et al., 2018). It is important to synthesize evidence on what attributes doctoral graduates actually do possess, in order to reconsider the scope of what is included in traditional lists of doctoral graduate attributes. In so doing, due consideration may be given to the “unseen” attributes that are outcomes of the doctoral degree. The notion of implicit attributes in parallel to those explicit to the “product” of the degree, aligns with the shift of focus in doctoral education from focusing exclusively on the production of the doctoral thesis, to include the holistic development and tacit learning involved in the doctoral journey (Mowbray and Halse, 2010; Yazdani and Shokooh, 2018). Despite the challenges associated with conceptualizing graduate attributes, they remain pertinent to assess (Bitzer and Withering, 2020).

There has been significant investment in improving postgraduate education, including the implementation of transferable skills development, particularly in the Global North (Denicolo and Reeves, 2014). This has given rise to various models and frameworks related to researcher attributes and doctoral competencies. One of the most widely used frameworks, particularly in the United Kingdom, is the Researcher Development Framework (Vitae, 2010). According to Reeves et al. (2012, p. 4), “the purpose of the framework is to support the development of individual researchers while enhancing our capacity to build a workforce of world-class researchers within the UK higher education research base.” As such, it can be used to facilitate qualitative reflection on one’s development, and encompasses a wider view of researcher career progression, beyond the doctorate degree. Similarly, the Researcher Skill Development Framework (Willison and O’Regan, 2008/2015), developed in the Australian context, provides a developmental framework of research-related skills and agency, from first year undergraduate studies to established academics. The framework includes a qualitative matrix that may be well suited for developmental use in the context of doctoral supervision, or for curriculum development, rather than as an outcome indicator. The competence model for science, engineering and technology (SET) Ph.D. students and

graduates (Nikol and Lietzmann, 2019), in the broader European context, pertains to the doctorate, yet is focused on SET disciplines only and is curriculum focused, rather than outcomes focused. Notably, all of the above frameworks were developed in the Global North. In general, these models have been used with focus on the development of doctoral education and training, including formal curriculum and transferable skills development programs. They are well suited to use for personal, qualitative reflection on one's skill development. In the South African context, the Council for Higher Education (CHE, 2018) has compiled the qualification standards for doctoral degrees, including a prospective list of graduate attributes, with five knowledge and four skill domains. However, these domains are not theoretically defined or clearly operationalized.

The Researcher Development Framework was validated prior to its launch in 2011 (Reeves et al., 2012). Since then, there has been extensive ongoing work in the field of doctoral education and efforts to develop context and field specific models, such as CHE (2018) and Nikol and Lietzmann (2019). Further, many institutional or governmental frameworks are aspirational ideals of the attributes institutions hope graduates will possess (Kensington-Miller et al., 2018) that do not necessarily reflect the attributes that graduates actually do possess when they graduate. As such, there is a need to identify what recent evidence there is of the attributes doctoral graduates possess after completing their doctorate degrees. The focus of the models above aligns with the typical focus of doctoral education evaluation: the doctoral process and student experiences during the doctorate (Luo et al., 2018). However, doctoral graduate attributes also need to be conceptualized as outcomes, rather than prospective qualities, in order to facilitate good, empirical quality assurance (Harley, 2020). Therefore, the target population for evaluating graduate attributes as outcomes should be graduates who have completed their degree. As noted by Durette et al. (2016, p. 1356):

Ph.D. students might not be the adequate population to study competencies developed during doctoral training since (1) they have not finished it entirely and (2) Ph.D. students might not be well aware of the competencies they have developed... in particular because they have not had the opportunity to exercise these competencies in other professional contexts.

There is a need to consolidate evidence of doctoral graduate attributes from the perspective of graduates only, excluding student populations. In so doing, a synthesis of the doctoral graduate attributes as outcomes, once the doctorate has been completed, may be possible. This may give preliminary indications of the extent to which developmental models used in curriculum and personal development, such as those identified above, have translated into real outcomes for doctoral graduates.

Limited empirical research exists attempting to synthesize graduate attributes (Bridgstock, 2009). The Researcher Development Framework is an example of extensive work toward synthesizing doctoral graduate attributes (Reeves et al., 2012). A recent example is the conceptual analysis of "doctorateness" by Yazdani and Shokooh (2018) that included literature published between 1995 and 2016. While the study appears to follow some review processes, it does not reflect the rigor required of a systematic review (Page et al., 2021). The article provides a synthesis of "doctorateness" as a concept, however, the findings were limited to broad categories of attributes, without definitions or detail as to what these domains entail. Further, much literature has been published since 2016 that warrants consideration. Therefore, there is a gap in the consolidation of more recent literature that bears global evidence of the attributes that doctoral graduates possess.

The aim of this review was to establish and describe what attributes graduates from doctoral degrees possess, through a systematic review of recent, high-quality research literature. The objectives of the review were: (1) to identify doctoral graduate attribute domains and sub-domains, and (2) to clarify their theoretical and/or operational definitions.

Methods

Study design

A systematic review is a rigorous, systematic process used to filter and synthesize available evidence on a topic (Laher and Hassem, 2020). There is a need to filter evidence to focus on a specific perspective, i.e., that of doctoral graduates, to the exclusion of doctoral students, in order to consolidate recent evidence of what attributes doctoral graduates actually possess, specifically focusing on the conceptualization of doctoral graduate attributes as outcomes of the doctoral degree. A systematic review is a suitable method to filter the available evidence and synthesize the various definitions and iterations of doctoral graduate attributes. Systematic reviews are recommended for use in scale development, as part of identifying and clarifying the scale construct (Munnik and Smith, 2019), and thus are a suitable method for facilitating conceptual clarity of a constructs, such as graduate attributes.

Review question

The systematic review question was: what attributes do graduates from doctoral degrees possess? The formulation of PEO (population, exposure and outcome) was used (Moola et al., 2020), with doctoral graduates as the population, the doctoral degree as the exposure, and doctoral graduate attributes being the outcome.

Eligibility

Inclusion and exclusion criteria were set *a priori*, to systematically determine which articles to include (Gough et al., 2017). Articles had to meet the following criteria to be eligible for inclusion:

1. The participants were graduates from doctoral degree programs (any discipline, no geographic limitation, no specified timeframe since graduation);
2. A clear focus on the attributes of doctoral graduates must be present (e.g., skills, competencies, abilities);
3. Qualitative, quantitative and mixed-methods research were considered; and
4. Published between January 2016 and June 2021, to ensure that recent literature on the topic was included.

Articles were excluded if they were not published and peer reviewed. Gray literature, such as theses and conference proceedings, were excluded. Articles that were not accessible in full text and in English were excluded. The University of the Western Cape (UWC) library assisted in locating full text and English translations, where necessary.

Information sources

Databases were accessed through uKwazi, a composite search function available through the UWC library. Databases included: Academic Search Complete, Directory of Open Access Journals, EBSCOhost, Emerald Journals, JSTOR, Sabinet, SAGE, Springer, Taylor and Francis, and Wiley. The use of uKwazi allowed for a comprehensive, composite search of all databases simultaneously, using the same search terms and limiters, thus enhancing the systematic nature of the review. The use of this platform automatically excluded duplicate articles, streamlining the screening process.

Search strategy

The PEO model was used to develop search strings, as shown in Table 1. The population of interest was doctoral graduates who completed their degree, thus excluding students, as the focus was specifically on attributes as outcomes. The term “graduate” was used to ensure specificity, as the inclusion of “student” would have resulted in too wide a search. The search terms related to exposure referred to the pursuit of the doctoral degree and was intentionally general to include various formats of doctoral degree study. The search terms included “doctorate OR doctoral OR Ph.D.”, which would include any combination of fields of study, for example, professional doctorate, Doctor of Education, or Doctor of Philosophy. This was intentionally

TABLE 1 Search strategy.

PEO	Search string	Search filters
Population	Graduate	Any field
Exposure	Doctorate Or doctoral Or Ph.D.	Subject contains
Outcome	Abilities OR attributes OR capabilities OR capacities OR characteristics OR competencies OR identity OR outcomes OR qualities OR skills	Any field

kept broad, as many studies did not specify what kind of doctorate was reported on or included mixed groupings from various types of doctorates. The outcome of doctorate graduate attributes, for which the search string was kept general, to include various iterations of nouns used in relation to doctoral graduate attributes.

The search strings were compiled into a Boolean phrase, as indicated in Table 1 that was entered into uKwazi for a composite search of all databases simultaneously. The first and third strings were searched in all fields, to include titles, abstract and subject. The second string was searched only in the subject field, to exclude irrelevant articles that were included in the search due to the authors’ credentials (e.g., Ph.D.). The composite search was limited to include only articles, available in English, peer reviewed, with full text available online, and published between 2016 and 2021—in alignment with the inclusion and exclusion criteria. These limiters were applied on the search platform as part of the search process, prior to recording the search results.

A second search, using the single search term “doctorateness” (any field) was conducted through uKwazi. The same limiters were applied. The supplementary search was conducted to ensure that potentially relevant articles were not unintentionally excluded.

Study selection

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) was followed to ensure methodological rigor and transparency in reporting (Page et al., 2021). The citation information of each article identified in the search was imported into Rayyan, an online systematic review platform (Ouzzani et al., 2016). Rayyan was utilized to streamline the review process and enhance reporting, as it facilitated dual review and tracking of exclusion reasons. Two reviewers independently screened the titles and abstracts for relevance against the inclusion and exclusion criteria. Articles that did not meet all the inclusion criteria or met at least one of the exclusion criteria were excluded. The full texts of all

remaining articles were retrieved and screened for eligibility, against the inclusion criteria. Reviewers independently screened each article, noting reasons for inclusion or exclusion. Disagreements were resolved through discussion.

Quality appraisal tool

The methodological quality of the remaining articles was assessed through the Smith, Franciscus and Swartbooi (SFS) full text critical appraisal tool, version E (Smith et al., 2015). The tool includes three sections: (A) purpose, including problem statement, literature and theoretical framework (22 points); (B) methodological rigor, including design, sampling, data collection, data analysis, results, discussion and conclusion (52 points); and (C), general considerations of publication and peer review status (5 points). A minimum threshold score of 60% (strong to excellent quality) was set that must be met for inclusion in the review (Smith et al., 2015), to ensure that only high quality research was included. The critical appraisals were independently conducted by two reviewers. Articles with scores that differed by five or more points were reviewed through discussion ($n = 4$), until consensus was reached.

Data extraction and synthesis

A self-developed data extraction table was used to extract descriptive data (location, design, sample etc.) and analytic information relating to the doctoral graduate attribute domains and definitions. The review findings were analyzed using thematic synthesis (Gough et al., 2017). Thematic synthesis is the equivalent of thematic analysis in primary research, and follows a similar process of coding and theme development (Gough et al., 2017). The coding process employed was selective, focusing primarily on the findings reported (Gough et al., 2017), for example, the attributes doctoral graduates indicated they possessed after having completed their studies. A hybrid inductive-deductive approach was used, with a primarily inductive approach was used for the initial coding, with codes emerging from the text (Xu and Zammit, 2020). A deductive approach was utilized for subsequent readings of the articles, to identify potential codes that may have been overlooked in the initial coding, and for theme development to group the codes into subdomains and domains. The deductive approach drew on existing literature related to doctoral graduate attributes, such as Vitae (2010), Yazdani and Shokooh (2018), and Nikol and Lietzmann (2019). In order to compare the findings of the review to existing models, selected frameworks were coded, using a deductive approach, to facilitate mapping against the domains and subdomains identified in the review. In some instances, the detail of descriptions differed, and so it was not always possible to map to the models exactly.

Ethics considerations

This review is part of a broader study, which obtained ethics clearance from the Humanities and Social Sciences Research Ethics Committee at UWC (HS21/7/19). Secondary data collection in the form of a systematic review does not require consent. However, consideration of the ethical practice and quality of each article under review, through critical appraisal, ensured the quality of the review findings. The authors of the original work were appropriately cited, so that there was no infringement on intellectual property or copyright. Only sources available in the public domain were utilized, and those that the researchers had legal access to through their institution. Furthermore, permission for the use of the SFS critical appraisal tool was obtained from the author.

Results

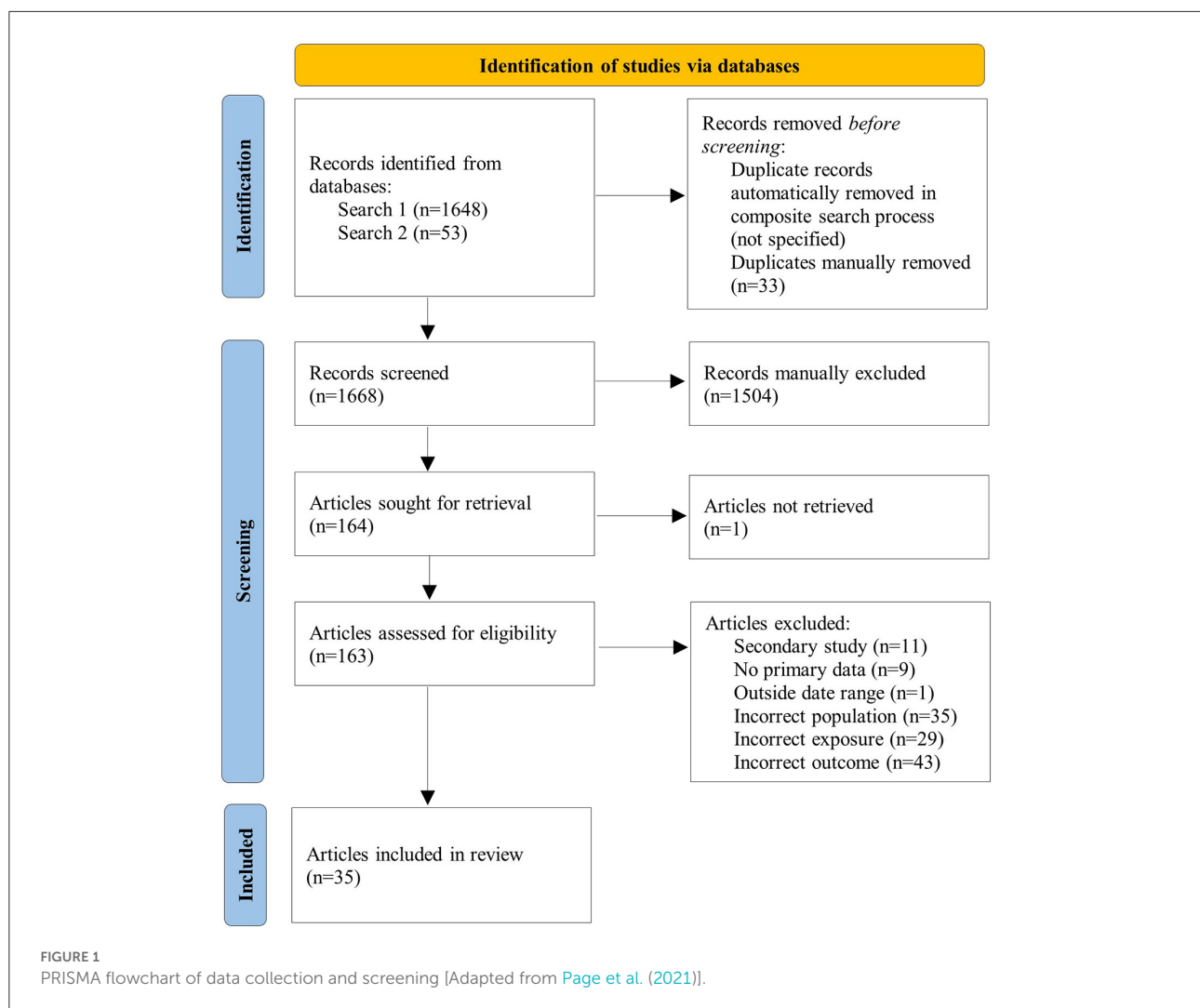
The findings of the review include the outcome of the study selection process, the quality appraisal of articles, the descriptive characteristics of the studies in the review, and the doctoral graduate attributes domains, subdomains and descriptions that were identified.

Process results

A total of 1,701 articles were identified in the review (Figure 1). Duplicates were automatically excluded in the comprehensive, integrated search through uKwazi. Duplicates between searches one and two were manually removed ($n = 33$). Studies were manually excluded if they were secondary studies (e.g., reviews; secondary analysis), did not include reporting on primary data (e.g., letter to editor; theoretical papers), were outside of the publication range (first published prior to January 2016 or after June 2021); included the incorrect population (graduates from other degree levels; Ph.D. student populations without any Ph.D. graduates represented; or did not allow for differentiation between graduates and students); the incorrect exposure (e.g., did not explicitly relate to the Ph.D.); or the incorrect outcome (e.g., focus on doctoral experience or attributes needed for completion, without explicit mention of attributes possessed on completion). A total of 35 articles met all criteria and were included in the review.

Quality appraisal results

All studies included in the review ($n = 35$) exceeded the threshold score of 60% in the quality appraisal stage (Table 2), and thus had strong to excellent methodological quality (Smith et al., 2015). A common methodological gap identified in articles



through the appraisal was not reporting on the analysis methods used ($n = 18$). The focus of the review was on the domains relating to doctoral graduate attributes covered, so the actual results of the studies under review were not the primary focus. Further, the review was descriptive, thus the goal was not generalizability. There was sufficient evidence of methodological quality in the articles included for synthesis.

Study characteristics

The studies included in the review ($n = 35$) represented various universities internationally (Table 3). Graduates from universities in the United States of America (USA) ($n = 9$), Australia ($n = 8$), and the United Kingdom (UK) ($n = 7$) were most strongly represented. Graduates from universities across Europe (Belgium, France, Germany, Ireland, Poland, Portugal, Spain, Sweden, Switzerland, and the UK), North America (USA and Canada); Asia (Bhutan, China, Japan, and Malaysia), and

Africa (South Africa) were represented. Most studies focused on a single country ($n = 28$), if not a single university within that country. Cross-country comparisons were evident in seven studies. The studies reflected greater representation of graduates from institutions in the USA, Australia and the UK. This aligns with the USA and UK being among the top producers of doctoral graduates among Organization for Economic Co-operation and Development (OECD) countries (OECD, 2019). There was low representation of graduates from universities in Asia, yet there has been noted growth in doctoral enrolments in China specifically since the early 2000s (Luo et al., 2018). While there was lower representation of graduates from African institutions, it is unsurprising that the two studies included represented graduates from South African institutions, as there has been significant local investment in doctoral education in recent years, and South African higher education institutions attract doctoral students from various African countries (Molla and Cuthbert, 2016). There was no representation of graduates from institutions in the Middle East or South America. Due to

TABLE 2 Quality appraisal scores of included articles.

No.	Author (Year)	Score %	Quality
1	Adham et al. (2018)	80	Excellent
2	Ai (2017)	69	Strong
3	Allgood et al. (2018)	70	Strong
4	Bitzer and Matimbo (2017)	71	Strong
5	Boud et al. (2021)	81	Excellent
6	Boulos (2016)	63	Strong
7	Bröchner and Sezer (2020)	69	Strong
8	Bryan and Guccione (2018)	77	Strong
9	Caretta et al. (2018)	74	Strong
10	Creaton and Anderson (2021)	78	Strong
11	Devos et al. (2016)	77	Strong
12	Draper and Harrison (2018)	60	Strong
13	Durette et al. (2016)	82	Excellent
14	Feldon et al. (2017)	82	Excellent
15	González-Ocampo and Castelló (2019)	75	Strong
16	Goodall et al. (2017)	70	Strong
17	Grab-Kroll et al. (2019)	82	Excellent
18	Granata and Dochy (2016)	78	Strong
19	Greene et al. (2021)	77	Strong
20	Guerin (2020)	75	Strong
21	Hager et al. (2019)	75	Strong
22	Holley (2018)	78	Strong
23	Kennedy et al. (2020)	82	Excellent
24	Kilbourne et al. (2018)	83	Excellent
25	Kowalczyk-Waledziak et al. (2017)	72	Strong
26	Lemon et al. (2020)	83	Excellent
27	Luo et al. (2018)	77	Strong
28	Maxwell (2019)	77	Strong
29	Maxwell and Chophel (2020)	75	Strong
30	McAlpine et al. (2020)	78	Strong
31	Merga and Mason (2021)	78	Strong
32	Merga et al. (2020)	72	Strong
33	Rabe et al. (2021)	69	Strong
34	Shih et al. (2019)	77	Strong
35	Walker and Yoon (2017)	80	Strong

increased trends of mobility and internationalization in higher education (OECD, 2019), it is likely that doctoral graduates from various nationalities were represented in the study, however, the nationalities of graduates were not consistently reported on.

The articles under review reported various methodologies, primarily interviews ($n = 13$), surveys ($n = 11$) or autoethnographies ($n = 7$). Sample sizes ranged from 1 (Boulos, 2016; Ai, 2017) to 2794 (Durette et al., 2016). According to the inclusion criteria, all studies included doctoral graduates. In Table 3, the graduate samples were classified as early career researchers (ECR) who graduated within the 5

years, mid-career researchers (MCR) who graduated between 6 and 15 years prior (Nguyen et al., 2020), and those who graduated more than 15 years prior. Studies focused primarily on ECR and MCR. Samples of only doctoral graduates were most common ($n = 23$). Mixed populations were included, where differentiation of the perspectives of graduates from other participants was possible. Some studies included faculty, supervisors, key persons in higher education, doctoral students and non-completers as participants. Most studies focused on a specific degree ($n = 26$), with education-related fields having the highest frequency ($n = 10$). The remaining studies ($n = 9$) included cross-disciplinary samples of doctoral degrees in science, technology, engineering and mathematics (STEM) and humanities, arts, and social sciences (HASS). There was a range of disciplines and fields represented, with good representation of both HASS and STEM fields. In half of the studies ($n = 17$), the doctoral degrees reported on were Doctor of Philosophy (Ph.D.). Professional doctorates were specified in a fifth of the articles ($n = 7$), indicated by “Doctor of [field name]”, for example “Doctor of Education” or “Ed.D”. The remaining articles did not specify if it was a Ph.D. or professional doctorate ($n = 11$). Given the greater prevalence of Ph.D. programs in comparison to professional doctorate programs, this may demonstrate good representation of both degree types. Neither type of doctorate nor field of study were gaps in the review. There were no notable trends in the type of doctorate, field of study, geographic location and emerging domains.

Scalar information on subscale(s) measuring dimensions related to doctoral graduate attributes were reported in six studies. Subscales addressing teaching (Allgood et al., 2018; Shih et al., 2019) and research skills (Luo et al., 2018; Shih et al., 2019) were used in two studies each. Subscales of general scientific competencies (Grab-Kroll et al., 2019), and universal skills (Luo et al., 2018) were identified. Two other studies (Walker and Yoon, 2017; Bröchner and Sezer, 2020) provided nominal information on the scales utilized, with insufficient detail to identify what domains were covered. The scales were either adapted from other studies (Allgood et al., 2018; Shih et al., 2019; Bröchner and Sezer, 2020), or self-developed for the study (Walker and Yoon, 2017; Luo et al., 2018; Grab-Kroll et al., 2019). Shih et al. (2019) was the only study to report on psychometric properties. Where information was available, subscales had between 2 and 13 items per domain. Items were most often in Likert scale format (Allgood et al., 2018; Luo et al., 2018; Grab-Kroll et al., 2019; Shih et al., 2019). Other formats used included continuous scales (Bröchner and Sezer, 2020) and multiple-choice formats (Walker and Yoon, 2017).

Doctoral graduate attributes

The studies under review rarely defined or mentioned doctoral graduate attributes explicitly, referring more

TABLE 3 Study characteristics.

Author (Year)	University location	Study design/method	Sample size	Participants ^a	Degree
Boulos (2016)	Ireland	Autoethnography	1	Doctoral graduate (ECR)	Ph.D. in Higher Education Research
Devos et al. (2016)	Belgium	Semi-structured interviews	21	Ph.D. graduates (timeframe not specified); non-completers	Ph.D.s in Science and Technology; Social Sciences; Health Sciences
Durette et al. (2016)	France	Open-ended survey	2794	Doctoral graduates (most ECR-MCR, some later)	Doctorates in Exact Sciences or Humanities
Granata and Dochy (2016)	Belgium	Narrative literature review and case study (semi-structured interviews)	14	Doctoral students (final year); doctoral graduates (ECR)	Academic and semi-industrial Ph.D. in faculty of electrical engineering
Ai (2017)	Australia	Narrative autoethnography	1	Doctoral graduate (ECR)	Ph.D.: school of Education
Bitzer and Matimbo (2017)	South Africa	Narrative approach (not specified)	2	Doctoral graduate (ECR); supervisor	Ph.D.: faculty of education
Feldon et al. (2017)	USA	Interpretivist interviews and focus groups	44	Doctoral students; postdoctoral researchers (ECR); faculty	Ph.D. in cellular and molecular biology
Goodall et al. (2017)	UK	Collaborative autoethnography	4	Doctoral graduates (ECR)	Professional doctorate in education (Ed.D)
Kowalczuk-Waledziak et al. (2017)	Poland; Portugal	Semi-structured interviews	16	Doctoral graduates (ECR-MCR)	Ph.D. in educational sciences
Walker and Yoon (2017)	Canada	Interpretivist in-depth survey (48) and interviews (15)	48; 15	Doctoral graduates (MCR-later)	Ph.D. in education
Adham et al. (2018)	UK; Malaysia; Australia	Semi-structured interviews	10	Doctoral graduates, now faculty (ECR-MCR)	Ph.D. in management fields
Allgood et al. (2018)	USA	Survey	569	Directors of graduate studies; departmental chairs; new Ph.D. graduate economists (ECR)	Ph.D. in economics
Bryan and Guccione (2018)	UK	Semi-structured interviews, with pre-screening questionnaire	22	Doctoral graduates (ECR-MCR)	Doctoral degrees in STEM or HASS fields
Caretta et al. (2018)	Sweden; UK; Australia	Collaborative autoethnography	4	ECR and MCR	Ph.D. in Geography
Draper and Harrison (2018)	Australia	Discussion paper with integrated questionnaire	8	Doctoral graduates (timeframe not specified); doctoral candidates	Doctor of Musical Arts (DMA)
Holley (2018)	USA	Longitudinal interviews	9	Doctoral students -> scholars (ECR-MCR)	Interdisciplinary Ph.D. in neuroscience
Kilbourne et al. (2018)	USA	Phenomenology: semi-structured interviews	16	Junior faculty (doctorate holders, timeframe not specified)	Doctorate degrees; not specified (likely athletics training)

(Continued)

TABLE 3 (Continued)

Author (Year)	University location	Study design/method	Sample size	Participants*	Degree
Luo et al. (2018)	China	Survey and in-depth interviews	2009	Doctoral students (about to graduate); doctoral graduates (ECR)	Doctoral degrees; not specified (likely agricultural fields)
González-Ocampo and Castelló (2019)	Spain	Structured narratives	61	Supervisors (doctoral graduates, timeframe not specified)	Supervising doctoral theses in HASS fields
Grab-Kroll et al. (2019)	Germany	Survey	188	Doctoral graduates (ECR-MCR) and students	Doctorates in (experimental) medicine
Hager et al. (2019)	Europe (countries not specified); USA	Case study: participant-observer conversations, open-ended survey	2	Doctoral graduates (ECR)	Doctor of Business Administration
Maxwell (2019)	Not specified (participants from Bhutan)	Open-ended questionnaire	25	Doctoral graduates (most ECR-MCR, 2 later); key persons in Bhutan HE	Doctorates in education fields
Shih et al. (2019)	USA	Survey	503	Doctoral graduates (ECR-later)	Doctoral programs in mathematics education
Bröchner and Sezer (2020)	Sweden	Survey	125	Doctoral graduates (ECR-later)	Ph.D. in construction engineering
Guerin (2020)	Australia	Narrative enquiry; semi-structured interviews	12	Doctoral graduates (ECR-MCR)	Ph.D.s in HASS fields
Kennedy et al. (2020)	USA	Semi-structured interviews	11	Doctoral graduates (likely ECR)	Ed.D online program
Lemon et al. (2020)	USA	Hermeneutic phenomenology; semi-structured interviews	9	Doctoral graduates (timeframe not specified)	Doctorate in Marriage and Family Therapy
Maxwell and Chophel (2020)	Not specified (participants from Bhutan)	Open-ended questionnaire	44	Doctoral graduates (most ECR-MCR, 1 later); key persons in Bhutan HE/civil service	Non-education doctorate (sciences, arts, social sciences)
Merga et al. (2020)	Australia	Qualitative, open-ended survey	246	Doctoral graduates (ECR)	Ph.D., thesis by publication in various fields
Boud et al. (2021)	UK; Australia	Collaborative enquiry	11	Doctoral graduates (ECR-MCR); academic faculty	Doctor of Professional Studies
Creaton and Anderson (2021)	UK	Semi-structured interviews	25	Doctoral graduates (ECR-MCR)	Professional doctorates in business and management education
Greene et al. (2021)	USA	Collaborative autoethnography	4	Doctoral graduates (ECR)	DMA music education

(Continued)

TABLE 3 (Continued)

Author (Year)	University location	Study design/method	Sample size	Participants	Degree
Luo et al. (2018)	China	Survey and in-depth interviews	2009	Doctoral students (about to graduate); doctoral graduates (ECR)	Doctoral degrees; not specified (likely agricultural fields)
McAlpine et al. (2021)	UK; Switzerland	Narrative, cross-case approach (survey, interviews, secondary data)	24	Ph.D. graduates (ECR-MCR)	Ph.D.s in HASS; STEM
Merga and Mason (2021)	Australia; Japan	Semi-structured interviews	30	Doctoral graduates (ECR)	Ph.D. in HASS; STEM
Rabe et al. (2021)	South Africa	Collaborative autoethnography	5	Doctoral graduates (ECR); supervisor	Doctorate in Sociology

In ascending order, by publication year, then alphabetically by first author.

^a Doctoral graduates classified by time since graduation: early career researcher: 0–5 years since completion of doctorate; mid-career researcher: 6–15 years of doctorate completion (Nguyen et al., 2020), and later: 16+ years since graduation.

often to the impact of the doctorate or the experiences of doctoral graduates. Related terms, such as competence, competency and competencies were noted. Greene et al. (2021) defined competence as “knowing negotiated within a single community of practice” (p. 95), suggesting that competence is context specific. Durette et al. (2016) defined competency by differentiating between the output, competent performance, and input—the “underlying attributes required for a person to achieve competent performance” (Hoffmann, 1999, as cited by Durette et al., 2016, p. 1356). Durette et al. (2016) further defined competencies as “the resources available to doctorate holders to act competently” (p.1357). While these definitions differ, they all point to the definition of doctoral graduate attributes adopted for this study, which includes the qualities, skills, and competencies that doctoral graduates possess. Interestingly, of the frameworks and models identified previously, only two articles mentioned the Researcher Development Framework (Bryan and Guccione, 2018; Creaton and Anderson, 2021), and this was in the introduction of the articles. These articles were two of the seven articles reflecting research conducted in the UK context, where the Researcher Development Framework was developed. As such, it appears that none of the articles under review explicitly drew on the conceptual and theoretical development that is evidenced in the existing models.

The studies addressed a wide range of doctoral graduate attributes identified as outcomes of the doctoral degrees mentioned in the studies. The domains include: knowledge, research, communication, organizational skills, interpersonal skills, scholarship, reputation, higher order thinking skills, personal resourcefulness, and active citizenship (Table 4). Theoretical definitions of the actual domains identified in the studies were sparse, lacking theoretical or conceptual frameworks. These definitions were more general and process-oriented, not linked to a specific domain. Theoretical

definitions for the identified domains and/or subdomains are provided, where available. Thereafter, descriptions of what these attributes entail are provided, i.e., how they may be operationalized.

Knowledge

The first domain of “knowledge” included codes that related to the knowledge doctoral graduates possessed ($n = 18$). This excluded knowledge that explicitly related to “research”, as these were included under a subsequent domain. There was no explicit definition of “knowledge” in the articles under review. However, Adham et al. (2018) made reference to explicit and tacit knowledge, differentiating between knowledge that can be communicated or shared with others, and knowledge that is not as easily communicated. Knowledge development was defined as the processing of information within the individuals’ “foundations, understanding, experience and beliefs” (Adham et al., 2018, p. 813). The various types of knowledge that doctoral graduates possessed were grouped into the following subdomains: discipline specific knowledge, interdisciplinary knowledge, and professional knowledge. In some instances, doctoral graduates were vaguely noted to possess “knowledge”, with no further explanation of what type of knowledge was indicated ($n = 2$). In some studies, doctoral graduates were found to possess discipline specific knowledge, referring to the breadth and depth of their disciplinary knowledge base. Studies found that doctoral graduates’ disciplinary expertise included the theoretical knowledge ($n = 14$) and practical or technical skills of their discipline ($n = 3$). Both their research and coursework were noted as sources of these forms of knowledge. In some instances, doctoral graduates had interdisciplinary knowledge from related or complementary

TABLE 4 Doctoral graduate attributes domains and subdomains.

Domain	Subdomains	Source*
Knowledge	Discipline specific knowledge	1, 5, 8, 10, 13, 16, 18, 19, 20, 21, 22, 25, 29, 33
	Professional knowledge	5, 8, 20, 24, 29
	Inter- and transdisciplinary knowledge and skills	5, 18, 22, 27
	Discipline specific techniques and skills	8, 13, 18
	Knowledge (unspecified)	26, 28
Research	Data collection and analysis	1, 5, 10, 15, 17, 20, 21, 23, 27
	Literature skills	1, 10, 14, 17, 21, 23
	Research skills (unspecified)	16, 25, 28, 32, 33, 35
	Research attitude	11, 13, 29, 33
	Research methods	1, 5, 23, 34
	Discipline specific research skills	12, 14, 15
	Research conceptualization	10, 17
	Research expertise	29
	Interdisciplinary research skills	27
Communication	General communication skills (not specified)	8, 10, 12, 13, 18, 27, 31, 32
	Written communication skills	1, 8, 10, 20, 27, 31, 32, 35
	Oral communication skills	7, 10, 12, 17
	Language skills	7, 13, 27
	Interdisciplinary communication skills	10, 18, 31
	Publication skills	29, 31, 32
	Disciplinary communication skills	15, 30
Interpersonal	Teaching	3, 9, 12, 20, 24, 27, 34
	Collaboration and teamwork	7, 13, 18, 22, 30
	Networking	5, 29
	Leadership	12, 29
	Supervision	5, 9
Organizational	Project management	6, 8, 10, 13, 18, 27, 30
	Time management	13, 18, 24
Scholarship	Practitioner scholarship	5, 21, 23, 25, 29
	Identity as scholar	2, 19, 35
Reputation	Credibility	5, 8, 10, 20, 26, 28, 29, 32
	Legitimacy	16, 21, 25, 30
Higher Order Thinking	Critical thinking	5, 8, 10, 25, 29, 30
	Problem solving	7, 8, 13, 17, 23, 27
	Cognitive abilities	8, 10, 13, 33
	Innovation	5, 22, 27
	Creativity and curiosity	13, 26

(Continued)

TABLE 4 (Continued)

Domain	Subdomains	Source*
Personal Resourcefulness	Confidence	4, 5, 7, 10, 12, 16, 23, 26, 27, 28, 29, 32
	Self-efficacy	17, 26, 29, 31, 33, 35
	Autonomy and independence	4, 13, 15, 27, 35
	Resilience	8, 13, 33
	Agency	2, 9, 15
	Adaptability	13, 25, 26
	Self-regulation	5, 11, 15
	General life skills and study skills	8, 27
Active	Advocacy	20, 29
Citizenship	Awareness of injustice and inequality	6, 23
	Social justice-oriented disposition	23

*See Table 2 for corresponding authors of articles.

disciplines ($n = 4$), and had a unique and/or holistic perspective. Interdisciplinarity was defined as “integrating knowledge from two or more disciplines” (Holley, 2018, p. 107). Some studies found that doctoral graduates possessed professional knowledge relating to navigating the administrative and operational functioning of higher education institutions and/or work environment ($n = 5$). The domain of knowledge, as a doctoral graduate attribute, thus includes subdomains of disciplinary and interdisciplinary knowledge, and professional knowledge.

Research skills

The domain of “research” included all codes that reflected skills utilized in the various stages of research, and included competencies related to research methods and processes, and attitudes related to research ($n = 21$). This was labeled as the domain of research skills. There were no theoretical definitions related to research skills provided in the articles under review. In some instances, research skills were generally mentioned, without specific description ($n = 6$). Studies identified that doctoral graduates were noted to possess skills related to the various stages of research: literature review ($n = 6$), conceptualization ($n = 2$), methods ($n = 4$), and/or data collection and analysis ($n = 9$). Literature skills reflected their ability to search, critically evaluate, synthesize, and write a literature review. Skills related to conceptualization included the ability to formulate research hypotheses, understand research ethics, and select suitable methods. Research methods included the knowledge of methods, and the ability to conduct quantitative and/or qualitative research. Data collection and data analysis skills included the context-relevant use of quantitative and/or qualitative data collection and data analysis

methods. Consideration of discipline-specific methods skills ($n = 3$), such as designing appropriate experimental controls, and the reflexive process of artistic research, and interdisciplinary research skills were noted ($n = 1$). Doctoral graduates were noted to possess research expertise ($n = 1$), and a research attitude ($n = 4$) denoted by a respect for knowledge, a broadened outlook, research ownership and rigor. The domain of research skills that doctoral graduates possess included subdomains of range of methodological competencies, from conceptualization to data analysis, as well as research attitude and research expertise.

Communication skills

The domain of “communication” included codes that referenced various formats and forms of communication ($n = 16$). There was no evidence of theoretical definitions of communication skills. In some studies, doctoral graduates were noted to possess language skills ($n = 3$), and were articulate and confident in their communication skills ($n = 8$). The written communication skills doctoral graduates possessed ($n = 8$) included academic, scientific and technical writing skills, and being able to construct persuasive arguments. These writing skills ($n = 8$) were utilized for various purposes and formats of written documents. Further, it was found that doctoral graduates possessed confidence in their written skills. Doctoral graduates’ publication skills ($n = 3$) were differentiated from their general writing skills, as this included knowledge of the journal landscape and publication process, and the skills to prepare an article, work with co-authors, negotiate and manage the publication process, and deal with rejection and reviewer feedback. Doctoral graduates possessed oral communication skills ($n = 4$), including general presentation skills, and the dissemination of research findings through the presentation of scientific content. As with the domain of knowledge, some studies indicated that doctoral graduates possessed discipline specific communication skills ($n = 2$), such as interviewing skills, and interdisciplinary communication skills ($n = 3$), in their ability to communicate with non-academic audiences and produce non-academic outputs. The interdisciplinary nature of these communication skills is linked to the concept of research translation, that is defined as the “multidirectional nature of knowledge exchange between researchers and end-users” (Merga and Mason, 2021, p. 673). Communication skills as a domain thus included various modes and formats of communication, reflected in the subdomains.

Organizational skills

The domain of “organizational skills” reflects the skills that were learnt through managing the thesis project ($n = 8$). In some studies, doctoral graduates possessed organizational skills, including project management and time management. Project

management was defined as a transferable skill, that is developed “through a range of experiences... [as students] learned to determine priorities and achieve deadlines, became skillful in producing outcomes despite a limited budget, equipment failures or administrative impediment” (Mowbray and Halse, 2010, p. 661). Studies indicated that doctoral graduates were able to manage and run projects, and demonstrated coordinating skills, people skills, and goal-directed vision ($n = 7$). Doctoral graduates possessed time management skills ($n = 3$), being able to plan, work to deadlines and balance responsibilities. The organizational skills domain included subdomains of organizational and management skills at both a project and personal level.

Interpersonal skills

Interpersonal skills as a domain reflects a group of attributes that relate to interpersonal interaction in some form or another ($n = 14$). Doctoral graduates possessed a range of interpersonal skills including collaboration and teamwork, networking, leadership, teaching and supervision. Collaboration was defined as “any type of joint effort of two or more people pursuing a common goal” (Granata and Dochy, 2016, p. 998). Collaboration and teamwork ($n = 5$) were identified as being transferable skills. Doctoral graduates in the studies were able to demonstrate internal and external collaboration and teamwork, with clients, experts and industry. This involved the ability to work with people from different sectors and across research boundaries, including “working daily with close colleagues, data exchange with external partners and joint publications of findings with researchers in other faculties and universities” (Granata and Dochy, 2016, p. 998). Some doctoral graduates were able to network and connect with the scientific community ($n = 2$), resulting in access to resources and information. Other studies highlighted that doctoral graduates demonstrated leadership capacity ($n = 2$), which was cross-cutting of some other domains, including articulate communication skills (both written and verbal), the ability to work within structure, discipline of thought, investment in research, and university visibility through publication and collaboration. Doctoral graduates in some studies were noted to possess teaching skills ($n = 7$), including being prepared to teach, the ability to deal with students, teaching at undergraduate level and facilitating groups effectively, and supervision skills ($n = 2$) at under- and/or post-graduate level. The domain of interpersonal skills that doctoral graduates possessed, included subdomains that reflect various skills for collaborative engagement with others, for work, research and teaching.

Scholarship

The domain of “scholarship” included codes related to scholarly practice and identity that doctoral graduates possess

($n = 8$). Studies mentioned scholarship in relation to doctoral graduates' practitioner scholarship and identity as scholar. Practitioner scholarship was defined as "professionals who bring theoretical, pedagogical, and research expertise to bear on identifying, framing and studying problems of practice and leading informed change in their [professional] contexts" (Adams et al., 2014, p.366, as cited by Kennedy et al., 2020, p. 654). Practitioner scholarship was not exclusive to those who completed professional doctorates, but was also mentioned by a study focusing on an academic doctoral program (Kowalczyk-Waledziak et al., 2017), and a study that did not specify the type of doctorate, but included a variety of fields (Maxwell and Chophel, 2020). Theoretical definitions of processes related to scholarship and identity were noted. Professional identity development was defined as taking place through developmental networks. Similarly, socialization was defined as the process through which students "gain the knowledge, skills, and values necessary for successful entry into a professional career requiring an advanced level of specialized knowledge and skills" (Weidman et al., 2001, piii, as cited by Feldon et al., 2017, p. 2574). Some studies identified that doctoral graduates demonstrated practitioner scholarship in their critical and reflexive approach to practice which is informed by theory and research, and using scholarship and research to respond to local needs ($n = 5$). In some instances, doctoral graduates' scholarly identity included their independent academic identity as scholar, and, in some instances, balancing and navigating multiple roles as scholar and practitioner ($n = 3$). The domain of scholarship thus speaks to the subdomains of the identity of doctoral graduates as scholars and professionals.

Reputation

The domain of "reputation" included codes relating to the perceived shift of their reputation that doctoral graduates experienced, which may have shifted due to the title of "Doctor" ($n = 12$). Conceptually, professional credibility was noted to have a positive impact on professional relationships with colleagues and clients. As a result, doctoral graduates were respected, with colleagues and students "looking up" to them. There was a level of status, prestige and respect associated with having achieved the doctoral degree. Doctoral graduates in some of the studies possessed academic, experiential and professional credibility, respect, and professional standing ($n = 8$). This was linked to their experience of legitimacy, in terms of the recognition they received, and the internally perceived legitimization of graduates' role, work, and participation in the academic community ($n = 4$). The domain of reputation relates to the impact of the doctorate on how graduates are received and/or perceived due to their doctoral title, reflected in the subdomains of credibility and legitimacy.

Higher order thinking skills

The domain of "higher order thinking skills" was defined by codes that reflected cognitive abilities and reasoning skills ($n = 14$). Higher order thinking skills was an intrinsic doctoral graduate attribute that emerged in the review. While no theoretical definition for this domain was present in the review, articles in the review identified problem solving, cognitive abilities and innovation as transferable skills. In some instances, doctoral graduates possessed critical thinking skills ($n = 6$), including critical reflection and analysis, questioning, justifying, and reflective and reflexive abilities. They possessed problem solving skills ($n = 6$), being able to discover, analyze and solve problems, split problems into sub-problems, and having a problem-solving mindset. Doctoral graduates' cognitive abilities ($n = 4$) included academic reasoning ability and the ability to construct an argument. Studies noted that doctoral graduates possessed the capacity to advance innovation, think outside the box and develop innovative research questions ($n = 3$). Similarly, some doctoral graduates possessed creativity and curiosity ($n = 2$), in their openness to new ideas, questioning stance and unique perspective. The domain of higher order thinking skills included various subdomains of cognitive skills, problem solving, critical thinking, innovation, creativity and curiosity.

Personal resourcefulness

The domain of "personal resourcefulness" collates various intrapersonal attributes and individual qualities that doctoral graduates possessed ($n = 22$). Personal resourcefulness was defined by Mowbray and Halse (2010, p. 657) as:

The acquisition of skills that enable students to become more assertive, confident, resilient, persistent and resolute in determining how to progress their Ph.D. while balancing their other commitments. Consequently, personal resourcefulness is the reflexive, perceptual, emotional and contextual capacity that students develop during their Ph.D. that they used to discern and guide their actions.

Personal resourcefulness, resilience and independence were defined as transferable skills. Doctoral graduates had self-efficacy ($n = 6$), which is theoretically central to perseverance, because, according to Bandura (1989, p. 1,176, as cited by Merga and Mason, 2021, p. 681), "the acquisition of knowledge and competencies usually requires sustained effort in the face of difficulties and setbacks, it is resiliency of self-belief that counts." Self-efficacy was demonstrated through persistence, self-discipline, self-organization, and dedication. Similarly, doctoral graduates in some studies had strategies for resilience, determination and tenacity that allowed them to persevere despite challenges ($n = 3$). It was these personal

qualities that facilitated the development of all other skills and knowledge.

Confidence was the subdomain with the second highest frequency count overall ($n = 12$). Confidence was referred to in two ways: sources of confidence and the resultant confidence for action. Firstly, in some instances, doctoral graduates had confidence due to having experienced success in completing the doctorate, confidence in their research skills and knowledge, and confidence due to having successfully published. Secondly, and as a result of the first, doctoral graduates' achievements resulted in a sense of confidence in their professionalism, confidence to pursue innovative research, to defend their ideas, and confidence, in some instances, to bridge academic and professional worlds.

A group of intrapersonal qualities that are linked to doctoral graduates' organizational skills include agency, autonomy, adaptability and self-regulation. In some instances, doctoral graduates were noted to possess agency ($n = 3$) in their decision-making capacity to manage priorities and work responsibilities, that may be reflected in their organizational skills. Some were autonomous ($n = 5$), able to work independently as a scholar and researcher. Others were adaptable and flexible ($n = 3$), with the versatility to manage and transition between multiple roles. Self-regulation was mentioned ($n = 3$), and was theoretically defined based on the feedback loop model of self-regulated learning (Devos et al., 2016), that included goal setting, goal operating and goal monitoring, thus referring to the ability to move toward a goal, adjusting behavior over time in order to achieve that goal. Doctoral graduates had the capacity to self-regulate, through goal setting, being able to see the big picture, and to manage stress. Their ability to self-regulate would thus be closely linked with the enactment of their organizational skills, such as project and time management. General life skills and study skills were nominally noted as attributes that some doctoral graduates possess ($n = 2$). While not explicitly linked to self-regulation, these may be skills that facilitate or are used in self-regulation. The intrinsic qualities of doctoral graduates possess are thus closely linked to the skills they demonstrate. The domain of personal resourcefulness thus includes the subdomains of resilience, independence, agency, self-efficacy, confidence, self-regulation and general life and study skills.

Active citizenship

A cluster of attributes identified in the review were grouped under the domain "active citizenship," although this term was not explicitly used in the articles ($n = 4$). In other literature, active citizenship is defined as "knowing and practicing your rights as well as uplifting others in the realization and practice of theirs" (Isaacs et al., 2016, p. 103), and often refers to issues of transformation and empowerment (Gal and Gan, 2020). Some doctoral graduates demonstrated active citizenship in their advocacy through

strategic planning and policy development ($n = 2$), and increased awareness of injustice and inequality ($n = 2$). Some doctoral graduates were noted to have a social justice-oriented disposition ($n = 1$), that is defined as a proactive stance, or a "disposition of action that [drives] change efforts result[ing] from graduates' increased awareness and knowledge... regarding educational inequity, marginalization and White privilege as motivating their persistent efforts to address problems of practice" (Kennedy et al., 2020, p. 658). There is preliminary evidence of social justice-related subdomains, indicating a broader domain of active citizenship. The domain of active citizenship, while underdeveloped, include potential subdomains of advocacy, awareness and a social-justice oriented dispositions.

Mapping of findings against existing models

The coverage of the review findings and its alignment to existing models was investigated by mapping existing models onto the review findings, as shown in Table 5. The models were coded, using a deductive approach, to identify instances of the domains and subdomains of the review. In some instances, models had indications of broad categories that may imply inclusion of some of the subdomains in the review. The mapping of attributes illustrates that there is variation in the existing models, including the level of detail provided, likely indicative of the common issue of conceptual ambiguity around graduate attributes. There is evidence of each of the domains identified in the review, reflected in each of the models, showing good alignment. However, the present review highlights subdomains that were either not included in previous models, or not delineated in detail.

There were some domains identified in the selected frameworks that were not mentioned in the articles under review. However, these aspects are aligned to the domains and/or subdomains, as indicated in Table 6. While these attributes may indicate potential "gaps" in the coverage of the present review, these attributes are easily integrated under the domains identified, and thus may rather provide additional detail as to the scope of the domains and subdomains identified.

Discussion

The review synthesized high-quality literature on the attributes that doctoral graduates possess, identifying various doctoral graduate attribute domains, subdomains, and definitions. The findings of the review are discussed, in relation to the "seen" and "unseen" nature of

TABLE 5 Alignment of findings to existing frameworks.

Doctoral graduate attribute	Subdomains	The researcher development framework (Vitae, 2010)	The researcher skill development framework (Willison and O'Regan, 2008/2015)	Competence model for SET Ph.D. students and graduates (Nikol and Lietzmann, 2019)
Knowledge	Knowledge (unspecified)	/	✓	/
	Discipline specific knowledge	✓	X	X
	Discipline specific techniques and skills	X	X	X
	Inter- and transdisciplinary knowledge and skills	X	X	✓
	Professional knowledge	X	X	X
Research Skills	Research skills (unspecified)	/	X	/
	Literature skills	X	X	X
	Research conceptualization	X	X	✓
	Research methods	X	X	X
	Data collection and analysis	✓	✓	X
	Discipline specific research skills	X	✓	X
	Interdisciplinary research skills	✓	✓	✓
	Research expertise	✓	✓	X
	Research attitude	✓	X	X
Communication	General communication skills	✓	X	✓
	Language skills	✓	X	✓
	Disciplinary communication skills	X	X	X
	Interdisciplinary communication	✓	✓	✓
	Oral communication skills	✓	✓	✓
	Written communication skills	✓	✓	✓
	Publication skills	✓	X	✓
Organizational skills	Project management	✓	✓	✓
	Time management	✓	X	✓
Interpersonal skills	Collaboration and teamwork	✓	X	✓
	Networking	✓	✓	✓
	Leadership	✓	X	✓
	Teaching	✓	X	✓
	Supervision	✓	X	X
Scholarship	Practitioner scholarship	X	X	X
	Identity as scholar	X	X	X
Reputation	Credibility	✓	X	X
	Legitimacy	X	X	X
Higher Order Thinking Skills	Critical thinking	✓	✓	✓
	Problem solving	✓	X	X
	Cognitive abilities	✓	X	X
	Innovation	✓	✓	✓
	Creativity and curiosity	✓	X	✓
Personal	Confidence	✓	X	X
Resourcefulness	Self-efficacy	X	X	X
	Resilience	✓	X	X
	Autonomy	✓	X	✓
	Agency	X	X	X
	Adaptability	✓	X	X

(Continued)

TABLE 5 (Continued)

Doctoral graduate attribute	Subdomains	The researcher development framework (Vitae, 2010)	The researcher skill development framework (Willison and O'Regan, 2008/2015)	Competence model for SET Ph.D. students and graduates (Nikol and Lietzmann, 2019)
	Self-regulation	X	X	X
	General life skills	X	X	X
	Study skills	X	X	X
Active Citizenship	Advocacy	✓ Other subdomains	X	X
	Awareness of injustice and inequality	mentioned, related to	X	X
	Social justice-oriented disposition	domain	X	X

✓ clearly mentioned; X not mentioned.

TABLE 6 Attributes not mentioned in the review.

Doctoral graduate attribute	The researcher development framework (Vitae, 2010)	The researcher skill development framework (Willison and O'Regan, 2008/2015)	Competence model for set Ph.D. students and graduates (Lietzmann and Nikol, 2019)
Professional knowledge	Professional conduct related sub-domains Career management, continuing professional development	/	Finance, legal and economic skills
Technical skills	Numeracy	/	Digital competence
Project management	Research strategy, risk management	/	Third party funding
Research skills	Enthusiasm and integrity	/	/
Communication	Public engagement	/	Science marketing
Interpersonal skills	Equality and diversity	Ethical, cultural, social and team considerations	Counseling and consultation skills
	People management	Team management	Intercultural competence
Higher order thinking	Intellectual insight and risk	/	/

attributes, conceptual development and evidence for the relevance of doctoral graduate attributes. Thereafter, the strengths, limitations, implication and recommendations are presented.

“Seen” and “unseen” doctoral graduate attributes

The review findings are well-aligned with other models of research-related and doctoral graduate attributes. In general, existing models had a stronger focus on the knowledge, research, communication, organizational skills, interpersonal skills, and higher order thinking domains. These attributes are more easily “seen” (Kensington-Miller et al., 2018), as they are explicit competencies observable in doctoral graduates. Doctorate degrees involve an advanced level of original research, with a novel contribution to knowledge in their field (Denicolo and Park, 2013; CHE, 2018). It follows that doctoral graduates

would possess depth of knowledge and expertise in their field of study (discipline specific knowledge), and a range of research skills, that may facilitate and/or result from their doctoral research. Existing models, with the exception of the Researcher Development Framework (Vitae, 2010) had a greater focus on “seen” as opposed to “unseen” attributes.

The present review includes the intrapersonal domains of personal resourcefulness, scholarship and reputation. The review extends previous models, with a more comprehensive view of the attributes that doctoral graduates possess. The “unseen” or “invisible” attributes of the doctorate are those which reflect the qualities of the person and are often implied in the educational process (Kensington-Miller et al., 2018). Existing models generally focused more on the seen attributes, with less focus on the intrinsic qualities, such as personal resourcefulness. This was particularly evident in models that are more curriculum focused, such as Nikol and Lietzmann (2019). The evidence of intrinsic qualities aligns with research on doctoral education that has highlighted the shift in viewing

the doctorate as a product or commodity, to viewing it as a developmental process (Mowbray and Halse, 2010; Durette et al., 2016; Creaton and Anderson, 2021). Individual identity development and personal qualities are considered equally as important as the research product (Denicolo and Park, 2013; Ai, 2017). The importance of intrinsic development was reflected in the emergence of various intrapersonal domains and subdomains in the review. The qualities graduates possess were sometimes framed as being developed because of the challenges endured in the doctorate (Devos et al., 2016; Lemon et al., 2020; Merga et al., 2020; Rabe et al., 2021). This aligns with the findings of Mowbray and Halse (2010) and their definition of personal resourcefulness as being developed through balancing competing responsibilities and challenges. The internal capacity of the student/graduate to endure the challenges of the doctorate is particularly pertinent in a context of high attrition and extended degree duration (McKenna, 2017; Lemon et al., 2020). However, these intrinsic factors need to be supported externally, for example, through good quality supervision, and peer and institutional support (Granata and Dochy, 2016; Lemon et al., 2020). The intrapersonal domains identified thus reflect the personal growth and qualities the individual develops and/or utilizes during the doctorate process. The domain of reputation speaks to the perceived credibility that graduates have as doctorate holders. There is preliminary evidence that the sense of credibility and legitimacy stems from graduates' perceived competence and status as doctorate holder. Graduates' perceived credibility then informs their interpersonal interactions, such as pursuing opportunities, networking and/or collaboration (Bryan and Guccione, 2018). Reputation may be a mediating attribute that connects or informs the realization of other attributes. The domain of reputation reflects the confidence with which graduates implement their learnings, and by extension, the broader impact of the doctorate. This domain is somewhat different than the other domains, as it has both an externalized and internalized component. Reputation is typically considered to relate to how others view the individual, but the focus of this domain, as expressed in the articles under review, related more to how the individual perceived this as a result of having completed their doctorate degree, which resulted in an improved internal sense of credibility and legitimacy. The emerging domains identified reflect more of the "unseen" dimensions of doctoral education, and thus areas that students and supervisors need to be made aware of, in order to ensure their active investment in their educational process and identity development (Kensington-Miller et al., 2018).

There was preliminary evidence of subdomains that fall under the domain of active citizenship, yet it did not emerge strongly in this review. There is some alignment with existing models, as the Researcher Development Framework (Vitae, 2010) has subdomains of engagement and impact that align with the definition of active citizenship. In

the doctoral context, active citizenship is aligned with the expectation or requirement that research impact should extend beyond academia, especially in applied fields (Creaton and Anderson, 2021). There is evidence of active citizenship as a graduate attribute (UWC, 2009), however, active citizenship as a doctoral graduate attribute requires further investigation and exploration.

Conceptual development of doctoral graduate attributes

Graduate attributes, in general, are noted to lack conceptual clarity (Mowbray and Halse, 2010; Bitzer and Withering, 2020). In the review, this was evidenced by the general lack of theoretical definitions for the graduate attributes discussed and/or measured. While extensive work has gone into developing models and frameworks, the review highlights that published journal articles do not necessarily make reference to or explicitly draw on these models, when referencing the outcomes of doctoral degrees or defining the attributes of doctoral graduates. This may be because frameworks are more often utilized by researchers in their own or their students' development, or by policy makers, trainers and curriculum designers in the development of doctoral education training, as indicated, for example, by the target groups specified for the Researcher Development Framework (Reeves et al., 2012). As such, there is a need to connect these developmental frameworks to outcomes-focused research, such as the studies included under review. This would provide theoretical and conceptual grounding to such research, and a good base on which graduate outcomes could be compared and/or measured. The nominal reporting of psychometric properties relating to scales used in the quantitative studies, gives further evidence of the lack of conceptual grounding of the studies under review. As scale development and validation requires conceptual clarity (Munnik and Smith, 2019), this provides further indication of the noted conceptual ambiguity relating to the measurement of graduate attributes. The review contributed a synthesis of recent evidence of the doctoral graduate attributes and the domains in which they are operationalized. These domains were well-aligned to existing models, despite the articles not making explicit mention of these models. The review itself contributed to the conceptual development of what these attributes are, extending the common themes in existing models, to include additional "unseen" attributes alongside the "seen" or more traditionally conceptualized attributes. The review findings may provide tangential evidence of the developmental impact that existing models may have had on doctoral education, as many of the studies took place in the UK and Australia, where the Researcher Development Framework and the Research Skill Development Framework, respectively, are used. However, a

further exploration of the use and impact of these frameworks is warranted.

Relevance of doctoral graduate attributes

The employability of graduates is a concern for higher education institutions, and thus the transferability of graduate attributes is an important consideration (Kensington-Miller et al., 2018). This review highlighted a range of transferable and interdisciplinary attributes that doctoral graduates possess, in alignment with other models. Studies explicitly identified subdomains of communication, organizational skills, interpersonal skills, higher order thinking skills and personal resourcefulness as transferable skills. This review extends previous research that narrowly conceptualized the knowledge base of doctoral graduates as being discipline specific expertise, to include transferable interdisciplinary knowledge and professional knowledge. The inclusion of research translation and communication with various audiences aligns with the increased focus on interdisciplinarity in doctoral education for improving employability (Holley, 2018). There is good evidence that doctoral graduates are “T-shaped” individuals, with depth of knowledge and skills in their discipline, and cross-cutting transferable skills (Granata and Dochy, 2016). This finding reflects the shifts that took place in doctoral education to include the “development of broader workplace skills and experiences” (Bryan and Guccione, 2018, p. 1,125), and is in alignment with previous work, highlighting the importance of transferable skills for doctoral education and training (Denicolo and Reeves, 2014). However, stakeholders may not yet be aware of the shift and the improved transferability of doctoral skills. Further, there are contextual differences, at a national and institutional level, which may account for gaps in training relevance and doctoral employability. The range of skills and qualities evidenced in the review provides evidence against the critiques of the doctorate being overly specialized and lacking relevance to the workplace (Boulos, 2016; Maxwell and Chophel, 2020). This concern reflects a lack of awareness from employers and graduates themselves, as to the wide range of skills and qualities doctoral graduates possess (Durette et al., 2016). It is important for graduates to first be aware of the range of skills they have developed, in order to market their skills, not just their specialized field of study (Denicolo and Reeves, 2014; Holley, 2018).

Strengths and limitations

The focus of the review on a specific perspective of doctoral graduate attributes, i.e., the attributes that doctoral graduates actually possess, is a strength. The findings synthesize actual outcomes, as opposed to prospective attributes or

attributes-in-process. Therefore, the findings may translate into quality assurance outcome indicators, for example, through the development of scales to measure doctoral graduate attributes. The review findings are well aligned with previous literature and models, and thus provides good evidence that the attributes identified in the review are common across contexts and disciplines. The wide range of literature sources accessed indicates good scope. All reviews are by nature limited to the search criteria used. In order to include only highest quality evidence, potentially relevant gray literature and non-peer reviewed literature was excluded, based on the search criteria and exclusion criteria. For example, much of the work around doctoral education and training, particularly utilizing models and frameworks for improving curriculum and skills development, may have taken place more informally or been published in technical reports, and thus would have been excluded from the present review.

Implications and recommendations

The synthesis of recent evidence of the domains, subdomains and definitions in the review provides preliminary evidence of the impact of the frameworks that are used to improve doctoral education and training, as there is good alignment between the review findings and some of these frameworks. The review therefore contributes to the conceptual development of doctoral graduate attributes. As such, the review findings may support efforts to measure and assess doctoral graduate attributes, for example, for quality assurance. Institutions can use these domains and definitions to develop context-relevant charters of doctoral graduate attributes and use these to guide curriculum development and support programs for doctoral students. These doctoral graduate attributes can be used at an institutional level as part of quality assurance and institutional marketing.

The lack of awareness among doctoral education stakeholders as to the wide range of doctoral graduate attributes possessed needs addressing. The “unseen” nature of many doctoral graduate attributes requires greater support to increase awareness in order to facilitate development (Kensington-Miller et al., 2018). Increased awareness as to the scope of doctoral graduate attributes among stakeholders, such as doctoral supervisors, students, graduates and employers, may facilitate improved educational outcomes and employability (Denicolo and Reeves, 2014). Supervisors should consider appropriate support for the multifaceted and holistic development of doctoral graduates in supervision. Students’ awareness and active engagement in their attribute development may facilitate growth and their capacity to market themselves in their curriculum vitae and/or in job interviews. The various tools

available related to the Researcher Development Framework (Vitae, 2010; Denicolo and Reeves, 2014) and the Researcher Skills Development Framework (Willison and O'Regan, 2008/2015) could be used to support such activities. Prospective doctoral students will be able to enter the doctoral program with more realistic expectations of what growth they can anticipate during the process and can use the attributes to benchmark their progress throughout the degree. Employers' awareness of the multifaceted attributes associated with completion of a doctorate may counteract the misconception that the doctorate has limited relevance or transferability beyond discipline-specific knowledge (Boulos, 2016; Maxwell and Chophel, 2020). Doctoral graduates are key knowledge and innovation creators (Molla and Cuthbert, 2016). Therefore, it is important to ensure that doctoral graduates are equipped and positioned to actively engage in good quality and contextually relevant research that benefits society at multiple levels. Increased awareness among stakeholders may improve the mobility of doctoral graduates across fields, disciplines and workplaces, thereby improving employability.

Future research around doctoral education should utilize existing models or frameworks as conceptual frameworks, adding much needed grounding and cohesion to the literature on doctoral graduate attributes. The review draws on many contexts yet is descriptive in nature and so the findings are not generalizable. Further research into doctoral graduate attributes is recommended for underrepresented contexts in the review, including Africa, Asia, South America, and the Middle East. Given the contextual differences in doctoral education and higher education systems, research in these varied contexts needs to be conducted and shared. The focus on doctoral education in the African context reflects the policy imperative to improve the capacity of the higher education sectors, the national systems of innovation, and facilitate engagement in the knowledge economy (Molla and Cuthbert, 2016). In this context, there is an ongoing need to increase doctoral outputs. However, in the Global North, such as Australia, the academic job market is nearing saturation. Therefore, the questions around doctoral graduate production shift to employability, particularly beyond academia (Guerin, 2020). In line with the recommendations of other authors (Durette et al., 2016; Yazdani and Shokooh, 2018), it is recommended that context-relevant, conceptually sound scales be developed, to reliably and validly measure doctoral graduate attributes among alumni populations. Such scales could be used as quality assurance outcome indicators, or in graduate tracer study research (Senekal and Munro, 2019), to explore issues of employment, employability and the relevance of the doctorate within specific contexts. Further contextual investigation into how the identified domains in this review are developed, including the supportive factors and potential barriers may further inform supervisory practice and institutional support

provision. Research into the reflection of these doctoral graduate attributes in thesis examination processes may be useful, to develop more holistic examination guidelines.

Conclusion

Doctoral graduates (across disciplines and countries) possess a wide range of attributes, including knowledge, research, communication and organizational skills, and a variety of inter- and intrapersonal skills. Many of the attributes identified are transferable and inter- or transdisciplinary. Doctoral graduates—from a wide variety of disciplines and countries—possess a broad range of transferable knowledge and skills that align with those required for the workforce, in both academia and beyond. The review adds to the body of research by consolidating recent findings on the topic, including descriptions and definitions not just domains, and conceptualizing doctoral graduate attributes as outcomes—from the perspective of graduates. The domains identified represent the attributes that doctoral graduates actually do possess, as opposed to an aspirational list of what stakeholders hope students will develop. Doctoral graduate attributes include both the “seen” generic attributes that are more commonly identified in graduate attribute frameworks, such as disciplinary expertise, research skills and communication skills, together with “unseen” intrinsic qualities, such as personal resourcefulness. Doctoral graduate attributes should be conceptualized to integrate both the generic attributes, together with the intrinsic qualities that are invaluable both during the doctoral degree and beyond.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

Author contributions

JS contributed to the conceptualization of the review, fieldwork, data extraction, data analysis, draft write up, revisions, editing, writing and technical aspects of the article, and approved the submitted version. EM and JF contributed to the conceptualization of the review as well as the coordination of the review processes, provided leadership and input to the review team at each stage of the project and the conceptualization of the manuscript, contributed to the write up and technical aspects of the article, and approved the submitted version. All authors contributed to the article and approved the submitted version.

Funding

The financial assistance of the South African Department of Higher Education, Science and Technology (DHEST) via the University Capacity Development Grant, toward this research is hereby acknowledged. Opinions expressed, and conclusions arrived at, are those of the authors and are not necessarily to be attributed to DHEST.

Acknowledgments

The contributions of the following individuals is appreciated and acknowledged: Prof. Ruth Albertyn for her critical reading in reviewing the article for publication and Ms. Kendall Byne-Ross for her assistance in the screening and evaluation stages of the fieldwork for this research.

References

- Adams, A., Bondy, E., Ross, D., Dana, N., and Kennedy-Lewis, B. L. (2014). Implementing an online professional practice doctoral program in a PhD environment: Managing the dilemmas. *J. School Public Relat.* 35, 363–382. doi: 10.3138/jspr.35.3.363
- Adham, K. A., Ha, H., Mohd Nor, S., and Yazid, Z. (2018). Learning to complete the Ph.D. thesis. *Issues Educ. Res.* 28, 811–829. Available online at: <http://www.iier.org.au/iier28/adham.pdf>
- Ai, B. (2017). Constructing an academic identity in Australia: an autoethnographic narrative. *High. Educ. Res. Dev.* 36, 1095–1107. doi: 10.1080/07294360.2017.1303459
- Allgood, S., Hoyt, G., and McGoldrick, K. (2018). Teacher training for Ph.D. students and new faculty in economics. *J. Econ. Educ.* 49, 209–219. doi: 10.1080/00220485.2018.1438947
- Bandura, A. (1989). Human agency in social cognitive theory. *Am. Psychol.* 44, 1175–1184. doi: 10.1037/0003-066X.44.9.1175
- Bitzer, E., and Matimbo, F. (2017). Cultivating African academic capital—Intersectional narratives of an African graduate and his Ph.D. study supervisor. *Innov. Educ. Teach. Int.* 54, 539–549. doi: 10.1080/14703297.2017.1304825
- Bitzer, E., and Withering, M. (2020). Graduate attributes: How some university students experience and learn them. *S. Afr. J. High. Educ.* 34, 13–31. doi: 10.20853/34-3-3504
- Boud, D., Costley, C., Marshall, S., and Sutton, B. (2021). Impacts of a professional practice doctorate: a collaborative enquiry. *High. Educ. Res. Dev.* 40, 431–445. doi: 10.1080/07294360.2020.1765744
- Boulos, A. (2016). The labour market relevance of Ph.D.s: An issue for academic research and policy-makers. *Stud. High. Educ.* 41, 901–913. doi: 10.1080/03075079.2016.1147719
- Bridgstock, R. (2009). The graduate attributes we've overlooked: Enhancing graduate employability through career management skills. *High. Educ. Res. Dev.* 28, 31–44. doi: 10.1080/07294360802444347
- Bröchner, J., and Sezer, A. A. (2020). Effects of construction industry support for Ph.D. projects: The case of a Swedish scheme. *Indus. High. Educ.* 34, 391–400. doi: 10.1177/0950422220904932
- Bryan, B., and Guccione, K. (2018). Was it worth it? A qualitative exploration into graduate perceptions of doctoral value. *High. Educ. Res. Dev.* 37, 1124–1140. doi: 10.1080/07294360.2018.1479378
- Caretta, M. A., Drozdowski, D., Jokinen, J. C., and Falconer, E. (2018). "Who can play this game?" The lived experiences of doctoral candidates and early career women in the neoliberal university. *J. Geogr. in High. Educ.* 42, 261–275. doi: 10.1080/03098265.2018.1434762
- Cavanagh, J., Burston, M., Southcombe, A., and Bartram, T. (2015). Contributing to a graduate-centred understanding of work readiness: An exploratory study of Australian undergraduate students' perceptions of their employability. *Int. J. Manage. Educ.* 13, 278–288. doi: 10.1016/j.ijme.2015.07.002
- CHE (2018). *Qualification Standard for Doctoral Degrees*. Pretoria: Council on Higher Education.
- Creaton, J., and Anderson, V. (2021). The impact of the professional doctorate on managers' professional practice. *Int. J. Manage. Educ.* 19, 100461. doi: 10.1016/j.ijme.2021.100461
- Denicolo, P. M., and Park, C. (2013). "Doctorateness—an elusive concept?," in *Critical Issues in Higher Education*, eds. M. Kompf and P. M. Denicolo. (Rotterdam: Sense Publishers).
- Denicolo, P. M., and Reeves, J. (2014). *Developing Transferable Skills: Enhancing Your Research Employment Potential*. London, UK: SAGE.
- Devos, C., Boudrenghien, G., Van der Linden, N., Azzi, A., Frenay, M., Galand, B., et al. (2016). Doctoral students' experiences leading to completion or attrition: a matter of sense, progress and distress. *Eur. J. Psychol. Educ.* 32, 61–77. doi: 10.1007/s10212-016-0290-0
- Draper, P., and Harrison, S. (2018). Beyond a doctorate of musical arts: experiences of its impacts on professional life. *Br. J. Music Educ.* 35, 271–284. doi: 10.1017/S0265051718000128
- Durette, B., Fournier, M., and Lafon, M. (2016). The core competencies of Ph.D.s. *Stud. High. Educ.* 41, 1355–1370. doi: 10.1080/03075079.2014.968540
- Elliot, D. L., Baumfield, V., Reid, K., and Makara, K. A. (2016). Hidden treasure: successful international doctoral students who found and harnessed the hidden curriculum. *Oxf. Rev. Educ.* 42, 733–748. doi: 10.1080/03054985.2016.1229664
- Feldon, D. F., Rates, C., and Sun, C. (2017). Doctoral conceptual thresholds in cellular and molecular biology. *Int. J. Sci. Educ.* 39, 2574–2593. doi: 10.1080/09500693.2017.1395493
- Gal, A., and Gan, D. (2020). Transformative sustainability education in higher education: activating environmental understanding and active citizenship among professional studies learners. *J. Transform. Educ.* 18, 271–292. doi: 10.1177/1541344620932310
- Gilbert, R., Balatti, J., Turner, P., and Whitehouse, H. (2004). The generic skills debate in research higher degrees. *High. Educ. Res. Develop.* 23, 375–388. doi: 10.1080/0729436042000235454
- González-Ocampo, G., and Castelló, M. (2019). Supervisors were first students: Analysing supervisors' perceptions as doctoral students versus doctoral supervisors. *Innov. Educ. Teach. Int.* 56, 711–725. doi: 10.1080/14703297.2018.1531775

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

- Goodall, H. J., Huggins, V. A., Webber, L. A., and Wickett, K. L. (2017). From student to graduate. *Manage. Educ.* 31, 180–186. doi: 10.1177/0892020617738178
- Gough, D., Oliver, S., and Thomas, J. (2017). *An Introduction to Systematic Reviews*. London, UK: SAGE.
- Grab-Kroll, C., Schneider, A., Keis, O., Mayer, B., Wirth, T., Barthd, T., et al. (2019). Welche Beiträge können strukturierte Promotionsprogramme zur Qualitätssicherung medizinischer Promotionen und wissenschaftlichen Karriereförderung/ Nachwuchsförderung leisten? Eine Evaluation am Beispiel der Programminitiative “Experimentelle Medizin” der Universität Ulm. [What can structured doctoral programs contribute to ensure quality of medical dissertations and scientific careers/junior promotion? An evaluation using the “Experimental Medicine” program initiative of Ulm University as an example]. *Zeitschrift für Evidenz, Fortbildung und Qualität im Gesundheitswesen* 147–148, 110–119. doi: 10.1016/j.zefq.2019.10.001
- Granata, S. N., and Dochy, F. (2016). Applied Ph.D. research in a work-based environment: an activity theory-based analysis. *Stud. High. Educ.* 41, 990–1007. doi: 10.1080/03075079.2014.966666
- Greene, J. L. R., Cote, H. K., Koperniak, M., and Stanley, L. M. (2021). A Foot in Both Worlds: Navigating the Landscapes of P–12 Education Postdoctorate. *J. Music Teach. Educ.* 30, 93–107. doi: 10.1177/1057083720983944
- Guerin, C. (2020). Stories of moving on HASS Ph.D. graduates’ motivations and career trajectories inside and beyond academia. *Arts Human. High. Educ.* 19, 304–324. doi: 10.1177/1474022219834448
- Hager, M. J., Turner, F., and Dellande, S. (2019). Academic and social integration: psychosocial support and the role of developmental networks in the DBA. *Stud. Contin. Educ.* 41, 241–258. doi: 10.1080/0158037X.2018.1551202
- Harley, K. (2020). *National Ph.D. Review—Matters of Quality and Accountability*. University World News: Africa Edition. Available online at: <https://www.universityworldnews.com/post.php?story=2020062909405560#:~:text=At%20the%20heart%20of%20the,integrity%20of%20the%20Qualification%20Standard> (accessed December 3, 2021).
- Hinchliffe, G. W., and Jolly, A. (2011). Graduate identity and employability. *Br. Educ. Res. J.* 37, 563–584. doi: 10.1080/01411926.2010.482200
- Hoffmann, T. (1999). The meanings of competency. *J. Eur. Ind. Train.* 23, 275–86. doi: 10.1108/03090599910284650
- Holley, K. A. (2018). The Longitudinal Career Experiences of Interdisciplinary Neuroscience Ph.D. Recipients. *J. High. Educ.* 89, 106–127. doi: 10.1080/00221546.2017.1341755
- Hughes, C., and Barrie, S. C. (2010). Influences on the assessment of graduate attributes in higher education. *Assess. Eval. High. Educ.* 35, 325–334. doi: 10.1080/02602930903221485
- Isaacs, S., Rose, J., and Davids, C. (2016). Transformative learning: postgraduate students’ reflections on a community engagement program in South Africa. *Soc. Behav. Pers.* 44, 103–116. doi: 10.2224/sbp.2016.44.1.103
- Kennedy, B. L., Bondy, E., Dana, N. F., Vescio, V., and Ma, V. W. (2020). The development and enactment of practitioner scholarship among graduates from one online Ed.D. programme. *J. Further High. Educ.* 44, 653–669. doi: 10.1080/0309877X.2019.1576858
- Kensington-Miller, B., Knewstubb, B., Longley, A., and Gilbert, A. (2018). From invisible to SEEN: a conceptual framework for identifying, developing and evidencing unassessed graduate attributes. *High. Educ. Res. Dev.* 37, 1439–1453. doi: 10.1080/07294360.2018.1483903
- Kilbourne, B. F., Mazerolle, S. M., and Bowman, T. G. (2018). Doctoral preparation influence on new faculty’s perception of role transition. *Athletic Train. Educ. J.* 13, 340–347. doi: 10.4085/1304340
- Kowalcuk-Waledziak, M., Lopes, A., Menezes, I., and Tormenta, N. (2017). Teachers pursuing a doctoral degree: motivations and perceived impact. *Educ. Res.* 59, 335–352. doi: 10.1080/00131881.2017.1345287
- Laher, S., and Hassem, T. (2020). Doing systematic reviews in psychology. *S. Afr. J. Psychol.* 50, 450–468. doi: 10.1177/0081246320956417
- Lemon, J., Pladsen, J., Tawill, S., Clayton-Wood, L., and Morgan-Sowada, H. (2020). The lived experience of marriage and family therapy doctoral graduates: a phenomenological study. *Am. J. Family Ther.* 48, 446–461. doi: 10.1080/01926187.2020.1741474
- Lietzmann, A., and Nikol, P. (2019). *European Core Curriculum in Transferable Skills for SET Disciplines*. TU Berlin, WUT, NTUT and PoliMi.
- Luo, Y., Liu, Z., Zhang, J., and Gu, J. (2018). A study on the quality of doctoral education based on the ipod framework: a case of agriculture-related disciplines. *Chin. Educ. Soc.* 51, 199–221. doi: 10.1080/10611932.2018.1454153
- Mashiyyi, F. N. (2015). Embedding graduate attributes into the foundation programme: Reflections on process and product. *S. Afr. J. High. Educ.* 29, 181–197. doi: 10.20853/29-1-456
- Maxwell, T. W. (2019). Impact of education doctorates: the case of developing country, Bhutan. *Stud. Contin. Educ.* 41, 226–240. doi: 10.1080/0158037X.2018.1546688
- Maxwell, T. W., and Chopel, D. (2020). The impact and outcomes of (non-education) doctorates: the case of an emerging Bhutan. *High. Educ.* 80, 1081–1102. doi: 10.1007/s10734-020-00531-4
- McAlpine, L., Castello, M., and Pyhältö, K. (2020). What influences Ph.D. graduate trajectories during the degree: a research-based policy agenda. *High. Educ.* 80, 1011–1043. doi: 10.1007/s10734-019-00448-7
- McAlpine, L., Skakni, I., and Inouye, K. (2021). Ph.D. careers beyond the traditional: integrating individual and structural factors for a richer account. *Eur. J. High. Educ.* 11, 365–385. doi: 10.1080/21568235.2020.1870242
- McKenna, S. (2017). Crossing conceptual thresholds in doctoral communities. *Innov. Educ. Teach. Int.* 54, 458–466. doi: 10.1080/14703297.2016.1155471
- Merga, M. K., and Mason, S. (2021). Doctoral education and early career research preparedness for diverse research output production. *J. Further High. Educ.* 45, 672–687. doi: 10.1080/0309877X.2020.1807477
- Merga, M. K., Mason, S., and Morris, J. E. (2020). ‘What do I even call this?’ Challenges and possibilities of undertaking a thesis by publication. *J. Further High. Educ.* 44, 1245–1261. doi: 10.1080/0309877X.2019.1671964
- Molla, T., and Cuthbert, D. (2016). In pursuit of the African Ph.D.: A critical survey of emergent policy issues in select sub-Saharan African nations, Ethiopia, Ghana and South Africa. *Policy Futures Educ.* 14, 635–654. doi: 10.1177/1478210316641567
- Moola, S., Munn, Z., Tufanaru, C., Aromataris, E., Sears, K., Sfetcu, R., et al. (2020). “Chapter 7: Systematic reviews of etiology and risk,” in *JBIR Manual for Evidence Synthesis*, eds. E. Aromataris and Z. Munn. Adelaide, Australia: The Joanna Briggs Institute.
- Mowbray, S., and Halse, C. (2010). The purpose of the Ph.D.: theorising the skills acquired by students. *High. Educ. Res. Dev.* 29, 653–664. doi: 10.1080/07294360.2010.487199
- Munnik, E., and Smith, M. R. (2019). Methodological rigour and coherence in the construction of instruments: The emotional social screening tool for school readiness. *Afr. J. Psychol. Assess.* 1, 2a. doi: 10.4102/ajopa.v1i0.2
- Nell, I. A., and Bosman, J. P. (2017). Integrating graduate attributes into a Master of Divinity programme at a South African university. *S. Afr. J. High. Educ.* 31:175–90. doi: 10.20853/31-1-868
- Nguyen, H. V., Phan, T. T. H., Nguyen, H., Nguyen, N., and Nguyen, M. H. (2020). What is a Good Journal? Perceptions of Vietnamese Early-Career and Mid-Career Researchers. *Publish. Res. Q.* 36, 296–303. doi: 10.1007/s12109-020-09718-0
- Nikol, P., and Lietzmann, A. (2019). *mindSET European Transferable Skills Training Demands Survey—Analysis Report*. Washington, D.C.: European Commission.
- OECD (2019). *Education at a Glance 2019: OECD Indicators*. Paris, France: OECD Publishing.
- Ouzzani, M., Hammady, H., Fedorowicz, Z., and Elmagarmid, A. (2016). Rayyan — a web and mobile app for systematic reviews. *Syst. Rev.* 5, 210. doi: 10.1186/s13643-016-0384-4
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., et al. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 372, n71. doi: 10.1136/bmj.n71
- Potolea, D. (2013). Doctoral Studies and Research Competences. *Procedia - Social and Behavioral Sciences* 76, 935–946. doi: 10.1016/j.sbspro.2013.04.238
- Rabe, M., Agboola, C., Kumsa, S., Linong-Fontebo, H., and Mathe, L. (2021). Like a bridge over troubled landscapes: African pathways to doctorateness. *Teach. High. Educ.* 26, 306–320. doi: 10.1080/13562517.2021.1896490
- Reeves, J., Denicolo, P. M., Metcalfe, J., and Roberts, J. (2012). *The Vitae Researcher Development Framework and Researcher Development Statement: Methodology and Validation Report*. UK: The Careers Research and Advisory Centre Limited.
- Senekal, J., and Munro, N. (2019). Lessons learnt from two decades of graduate tracer research: Recommendations for the South African context. *S. Afr. J. High. Educ.* 33, 230–248. doi: 10.20853/33-2-2628
- Shih, J. C., Reys, R. E., Reys, B. J., and Engledowl, C. (2019). A profile of mathematics education doctoral graduates’ background and preparation in the United States. *Invest. Math. Learn.* 11, 16–28. doi: 10.1080/19477503.2017.1375357

- Smith, M. R., Franciscus, G., Swartbooi, C., Munnik, E., and Jacobs, W. (2015). "The SFS scoring system," in *Symposium on Methodological Rigour and Coherence: Deconstructing the Quality Appraisal Tool in Systematic Review Methodology. 21st National Conference of the Psychological Association of South Africa*. South Africa: PsySSA.
- UWC (2009). *Charter of Graduate Attributes*. Cape Town, South Africa: University of the Western Cape.
- Vitae (2010). *Researcher Development Framework*. UK: The Careers Research and Advisory Centre Limited.
- Walker, J., and Yoon, E. (2017). Becoming an academic: the role of doctoral capital in the field of education. *High. Educ. Res. Dev.* 36, 401–415. doi: 10.1080/07294360.2016.1207616
- Weidman, J. C., Twale, D. J., Stein, E. L., and Leahy, E. (2001). *Socialization of Graduate and Professional Students in Higher Education: A Perilous Passage?*. Washington, DC: Office of Educational Research and Improvement. p. 1–139.
- Willison, J., and O'Regan, K. (2008/2015). *Research Skill Development Framework*. Adelaide University. Available online at: <https://www.adelaide.edu.au/melt/ua/media/51/rsd-framework.pdf>
- Xu, W., and Zammit, K. (2020). Applying thematic analysis to education: a hybrid approach to interpreting data in practitioner research. *Int. J. Qual. Methods* 19, 160940692091881. doi: 10.1177/1609406920918810
- Yazdani, S., and Shokooh, F. (2018). Defining Doctorateness: A Concept Analysis. *Int. J. Doctoral Stud.* 13, 031–148. doi: 10.28945/3939



OPEN ACCESS

EDITED BY

Ana Luísa Rodrigues,
University of Lisbon, Portugal

REVIEWED BY

Joshua A. Jackman,
Sungkyunkwan University, South Korea
Sri Adi Widodo,
Universitas Sarjanawiyata Tamansiswa,
Indonesia

*CORRESPONDENCE

Shiau Foong Wong
janicew@sunway.edu.my

SPECIALTY SECTION

This article was submitted to
Higher Education,
a section of the journal
Frontiers in Education

RECEIVED 23 May 2022

ACCEPTED 05 October 2022

PUBLISHED 01 November 2022

CITATION

Mahmud MM and Wong SF (2022)
Digital age: The importance of 21st
century skills among
the undergraduates.
Front. Educ. 7:950553.
doi: 10.3389/feduc.2022.950553

COPYRIGHT

© 2022 Mahmud and Wong. This is an
open-access article distributed under
the terms of the [Creative Commons
Attribution License \(CC BY\)](#). The use,
distribution or reproduction in other
forums is permitted, provided the
original author(s) and the copyright
owner(s) are credited and that the
original publication in this journal is
cited, in accordance with accepted
academic practice. No use, distribution
or reproduction is permitted which
does not comply with these terms.

Digital age: The importance of 21st century skills among the undergraduates

Malissa Maria Mahmud¹ and Shiau Foong Wong^{2*}

¹Academic Enhancement Division, Sunway University, Petaling Jaya, Malaysia, ²Centre for American Education, Sunway University, Petaling Jaya, Malaysia

The recent emphasis on refining the quality of higher education has incited insightful debates about numerous education reforms. Due to the demands of our ever-changing world, many institutions have begun to embed the 21st century skills into the curriculum design to better prepare the students for workplace success and lifelong career development. Despite its importance, there are disparities in regards to establishing an in-depth understanding of its significance. Thus, this study is aimed to investigate the perspective of undergraduate students in Malaysia on the importance of the 21st century skills for career readiness. This study employed the quantitative research design wherein purposive sampling was utilized. The findings assert that data literacy is an essential skill to excel in the workplace, and similarly, problem-solving skill helps develop critical thinking skill, which contribute to the development of creative thinking skill. Recommendations are further deliberated.

KEYWORDS

21st century skills, digital age, undergraduates, workplace, curriculum

Introduction

Higher Education Institutions (HEIs) are deemed as among the prominent catalysts in nurturing the skills demanded by various industries. Whether they are taught directly or indirectly, these skills are often predominantly embedded into the curriculum to cultivate important characteristics for students to be successful, both in the context of their education and eventually work (Ball et al., 2016). 21st century skills characterize and denote a representation of the past professional skills which are now deemed obsolete due to the rapid technological change (Kereluik et al., 2013; Mahmud and Wong, 2022). These skills are defined by broad categories comprising of thinking (e.g., creativity and innovation, critical thinking, problem solving, decision making, learning to learn), working with others (e.g., communication, collaboration/teamwork), facility with tools (e.g., information literacy, communications technology literacy), and general life skills (e.g., citizenship, life and career management, personal and social responsibility, cultural awareness). Typically, these skills are embedded into the

design of higher education curriculum in preparation to join the workforce. Numerous educational and economic organizations have acknowledged the collective demand for the 21st century skills (World Economic Forum, 2016; Van Laar et al., 2017). Nevertheless, it is argued that developing the skills can be challenging (Jang, 2016; Winberg et al., 2019). In this regard, students must be equipped with the 21st century skills like data literacy, problem-solving, programming, and creative thinking for them to remain competitive (Lavi et al., 2021). In the workforce, employees with these skills are more likely to be valued by employers (Habets et al., 2020; Rios et al., 2020). The emergence of advanced technologies has contributed to the significant emphasis placed on the 21st century skills. Researchers predict that activities such as translating languages, driving a truck, working in retail, and even working as a surgeon will be replaced by Artificial Intelligence (AI) with better performance in the next 10 years (Grace et al., 2018). The majority of HEIs have recognized the need to make changes to the existing curriculum in preparation for the needs of the 21st century, including the emphasis on new skills. As part of an ongoing effort for educational reform at the institutional level, numerous HEIs are actively engaging stakeholders to enhance and revamp the necessary 21st century skills development. Therefore, it is important for students to prepare themselves to avoid from being eliminated by their future workplace. Graduates who keep up and adhere with their organizations (i.e., employers) by completing assigned tasks with excellent performance are believed to be well-equipped with the 21st century skills, subsequently justifying its importance for graduates to secure and develop their career progression (Ghafar, 2020). Despite the established significance of acquiring the 21st century skills, it is surprising to notice that many people have limited exposure to it. The majority of them believe that such issue resulted from the absence of clear and proper guidance on how to develop these critical skills, thus making them to feel helpless despite their eagerness to learn. Eventually, these people will lose advantage over others who are well-equipped with the 21st century skills when dealing with problems in the modern society (Joyntes et al., 2019). Previous studies revealed that 21st-century skills are essential to be acquired due to its importance in the workforce and society. However, there are limited assessments that can evaluate 21st century capabilities. Meanwhile, standardized examinations can only examine a small portion of the critical skills and information acquired by students. According to Silva (2009), the 21st century skills are not new yet it is essential as younger employees must be able to identify and analyze information from other sources and use it to make decisions and create new ideas. Therefore, it is important to raise the awareness of undergraduate students in grasping 21st century skills. Thus, this study aims to examine the importance of the 21st century skills required by undergraduate students in the digital age.

Literature review

Previous studies defined the 21st century skills as a broad set of knowledge, skills, work habits, and character traits that educators, school reformers, college professors, and employers believe to be critically important for students to succeed in today's world, particularly in collegiate programs as well as contemporary careers and workplaces (The Glossary of Education Reform, 2016; Rajaratenam, 2019; Davis, 2021). The basic premise behind the concept of the 21st century skills is that students must be taught with in-demand and universally applicable skills. Therefore, educational institutions like schools, colleges, and universities must prioritize on the effective teaching of such skills to students. In other words, 21st century students need to learn relevant skills that reflect the demands placed upon them in the global modern world rather than skills learned by students in the 20th century (Aabla, 2017). In the subsequent paragraphs, four 21st century skills are deliberated to homogenize the current educational initiatives with the fourth industrial revolution and its associated innovations and technologies (Miranda et al., 2021). In a similar vein, a conceptual framework, TPACK framework by Koehler et al. (2014), and 21st century framework developed by Education Performance and Delivery Unit Malaysia (PADU) were also utilized the guiding principles. One of the critical 21st century skills required by university students is data literacy, which is the ability to read, understand, and interpret data. It plays an important role in social studies education where the prevalence of data visualization encountered by students will only be increased by the improvement and access to technologies. In this regard, educational institutions like schools are regarded as a preferable place to begin accumulating data literacy knowledge as it helps individuals to engage on the inundation of information at an earlier age (Raffaghelli, 2020; Robertson and Tisdall, 2020; Shreiner, 2020). Some universities even offer extra workshops to improve data literacy skill among their students along with recommending and providing them with access to data literacy tools. This subsequently enables them to master the skill before entering the job market. Furthermore, data literacy skill also acts as a data-sharing tool. According to Enakriri (2020) and Palsdottir (2021), researchers equipped with data literacy skill are more likely to understand the existing data presented and link various data together to convert it into useful information for their own use. For instance, studying the number of COVID-19 cases every day facilitates the effort to tabulate a graph that illustrates the amount of daily confirmed cases of COVID-19 that allows researchers to examine the trend and prepare for upcoming situations. Therefore, being proficient in data is an important skill for university students to stay competitive in the 21st century. The popularity of data visualization viewed by students will only grow as a technology that improves and becomes more accessible. Furthermore, researchers equipped with data literacy skill are more likely to

comprehend current data and combine disparate datasets to create usable information.

Often referred as the ability to identify underlying problems and actively seeking for solutions, problem-solving has been propounded as another crucial skill to be acquired by students in the 21st century. Within the education sector, several authors (Furino, 2012; Karakoyun and Lindberg, 2020; Demir, 2021) mentioned that problem-solving has been highlighted as an essential skill in schools after the digital literacy skill and it is now introduced into students' learning process to stimulate their higher-order thinking skills. Based on the recent systematic review studied by Mahmud et al. (2021), it reveals that the students possess different skills, including strategic thinking and problem-solving skills in the aftermath of the COVID-19 crisis. This can be further exemplified when schools started to modify their syllabus by inserting higher-order thinking questions to encourage students to think deeply and more critical. Moreover, problem-solving is the most investigated 21st century skill after digital literacy and critical thinking particularly when it comes to determining the 21st century skills within individuals. Generally, there are many ways to assess the problem-solving ability of a person. A commonly used method is performance test (Arslangilay, 2019; Van Laar et al., 2020) by recording the number of attempts that a person used to solve a problem. In summary, past studies advocate on the need for students to equip themselves with problem-solving skill in this modern era. Following such awareness, the education sector has also begun to include higher-order thinking questions to boost problem-solving skill among their students. Additionally, problem-solving skill is highly involved in 21st century studies to examine its significance to the era of big data.

Another important 21st century skill that has been emphasized in the curriculum is programming, which refers to the ability of writing a computer program to ease in data processing. Programming skill can foster the skills and attitudes that are strongly associated with 21st century and digital competency. Therefore, basic computing courses should be introduced since primary school because it builds cognitive dimensions and benefits students with programming and computer skills along with other learning competencies across various subjects at an early age, which are essential for their future career. It also provides students with impactful learning experience, which can be proven by the high level of students' overall satisfaction (Kunpitak, 2019; Theobald and Hancock, 2019; Nouri et al., 2020; Wong and Cheung, 2020). Moreover, programming skill is broadly needed in various sectors nowadays. Instead of the need for coding skill among programmers, there are numerous careers that require coding skill. Important infrastructures such as healthcare, communication, transportation, and defense also expect improvement in software technologies to support their digital platforms (Mittal, 2020). For instance, the medical department uses mathematical modeling to predict how social

distancing can affect the number of COVID-19 cases. Hence, the result can be analyzed and efficient regulations of hygiene measures can be introduced to the public to reduce the number of cases. In conclusion, programming skill is one of the important 21st century skills that should be acquired by students as it builds their cognitive dimension, provides them with fruitful learning experience, and prepares them for their professional careers.

The ability to think creatively is crucial because it allows individuals to see problems and situations in innovative ways. However, the development of students' creative thinking skill has received limited attention. As a result, many graduates struggle to secure job opportunities due to a lack of creativity (Wyse and Ferrari, 2014). As creativity is dependent on information and does not occur in a second, many employees wish that they are more creative and were exposed to creative thinking during their schooling years. However, people rarely use their creative thinking skill to its full potential. Some academics even claim that the educational system inhibits their creativity as most educational institutions do not focus on teaching, practicing, and applying current information to generate creative ideas and problem-solving solutions. Furthermore, creative thinking skill allows people to stand out at the workplace when providing constructive ideas to deal with problems. As mentioned by Anjarwati et al. (2018), Atmojo and Sajidan (2020), and Azid and Md-Ali (2020), thinking fluently, which correlates to creative thinking, enables people to solve problems with a wide range of solutions. This is because they can easily produce ideas and solutions when faced with challenges. In such instance, more solutions can be generated with their ability to think outside the box instead of merely generating one or two general ideas. Occasionally, producing unique solutions is the way to achieve differentiation which allows one to be prominent from others. Generally, people who are well-equipped with creative thinking skill can integrate different situations quickly as compared to others as well as having the ability to generate various kinds of ideas when they are faced with problems. Therefore, it is important to invest prominent attention on equipping students with creative thinking skill to avoid them from having a lack of imagination towards an object as well as the tendency to avoid any challenges in the future.

Research methodology

This study had employed the quantitative research design by distributing a self-developed survey to the undergraduate students to examine their perceptions towards the importance of data literacy skill, problem-solving skill, programming skill, and creative thinking skill in the digital era. The survey used in this study comprised four sections pertaining to data literacy skill, problem-solving skill, programming skill, and

creative thinking skill. Cronbach's Alpha and Explanatory Factor Analysis (EFA) was conducted to determine both the reliability and validity of the instrument used. The data collected from the survey was analyzed using descriptive statistics. In this regard, frequency and percentage was used to calculate the number of respondents who considered data literacy, problem-solving, programming, and creative thinking as important 21st century skills. The Graduate Tracer Study Executive Report 2010 by the Ministry of Higher Education discovered that 24.6% of the 174, 464 graduates were jobless 6 months after graduation (Ministry of Higher Education [MoHE], 2021). The circumstance raises questions on the HEIs "product," and this is consistent with the study target population—students pursuing their undergraduate courses in Malaysia. The group was purposively sampled, and deemed suitable as the study probed at scrutinizing the importance of the 21st century skills among the undergraduates, considering the immense number of graduates entering the labor market. The study began by reviewing past articles and studies on the 21st century skills to identify the existing arguments and empirical evidence. This was done by extracting information from more than 300 academic journals and transferring it into a review matrix, which helped in the process of constructing the research objective and research questions. The survey questionnaire was then designed, finalized, and validated. It was then distributed to the targeted respondents *via* social media such as Telegram, WhatsApp and Instagram. A total of 101 completed survey questionnaires were gathered from undergraduate students between 18 and 25 years old who enrolled in a bachelor's degree course in Malaysia. The respondents provided their responses to 25 items using a 5-point Likert scale, from strongly disagree (1) to strongly agree (5). All data were then processed and analyzed in order to find the answers to the research questions.

Findings and discussion

Table 1 shows the analysis results on the importance of data literacy skills among the undergraduate students in the digital age. It can be seen that the majority of respondents agreed with Item 1 where data literacy skill can be applied to solve numerous problems in the social studies sector, such as to predict future outcomes. Following that, 44 respondents strongly agreed with Item 2 while 18 respondents had stated their neutral stand. This suggests that people are now living in a big data era; therefore, it is better to equip this skill at the first opportunity to fit into the current situation. A study by Robertson and Tisdall (2020) mentioned that introducing data literacy into the school curriculum is highly recommended because the younger generation is curious about data, possesses a high concern about data sharing issues, and wishes to have a deeper understanding about the matter. Furthermore, 47.5% of the respondents strongly agreed with Item 3. As data becomes

more accessible, students are willing to investigate data and use their data understanding in different contexts. This not only allows them to express themselves but also makes them become more knowledgeable and skillful (Deahl, 2014). As a result, these students are more intelligent when dealing with challenges. In addition, Item 5 had the highest percentage of respondents (55.4%) who strongly agreed with the notion. This might due to the fact that students are dissatisfied with their current data literacy knowledge and would like to have a closer approach to this skill. This is supported by Bhargava and D'Ignazio (2015) who stated that data literacy tools can better assist learners' competency in data literacy by providing a stronger support system. On the contrary, Item 4 had the most disagreeing respondents (3.0%). One potential reason for this result is that respondents consider data literacy as an indispensable skill in school, especially when dealing with data for their coursework. As noted by Sickler et al. (2021), students require data literacy skill to transfer the underlying meaning of professional and large-scale data into their coursework based on their understanding. According to Chinien and Boutin (2011), data literacy is recognized as one of the most beneficial skills for the 21st century as it brings positive impact to a valuable knowledge-based economy.

Table 2 presents results on the significance of problem-solving skill among the undergraduate students in the big data era. It was found that 90.1% of the respondents agreed with Item 1 where problem-solving skill should be embedded in the curriculum of undergraduate courses. This is because the majority of university students wish to excel in this skill. According to Rodzalan and Saat (2015), lecturers are encouraged to provide students with challenging tasks that can prompt them to perform critical thinking when solving the assigned problems. Whereas, Item 2 received the highest number of strong agreement from a total of 65 respondents. One possible reason is that students believe that the problem-solving process can stimulate other 21st century skills within them, such as innovation and perseverance. As noted by Furino (2012), problem-based learning provides students with the opportunity to experience potential problems that they may encounter in real life. Next, 13 respondents held a neutral stance on Item 3 while 46 and 42 respondents agreed and strongly agreed with the notion. Such result can be due to the students' mindset where improvement in ICT literacy skill can lead to better thinking skill, which indirectly links to the improvement in problem-solving skill. This is supported by Karyotaki and Drigas (2016) who believe that ICT tools can provide support to students during the entire problem-solving process to enhance their elaboration and the making of evidence-based reasoning. Meanwhile, Item 4 yielded the highest number of agreement (94.1%) where 43 respondents agreed and 52 respondents strongly agreed with the statement. One possible explanation is that when solving a problem in a group, students need to actively engage with their groupmates and think critically to

TABLE 1 Data literacy skill.

Item		5	4	3	2	1
1	I think data literacy should play an important role in social studies education.	43 (42.6%)	46 (45.5%)	12 (11.9%)	0	0
2	I think data literacy skill should be embedded within the school curriculum as early as possible.	44 (43.6%)	39 (38.6%)	18 (17.8%)	0	0
3	Data literacy skill broadens the range of possibilities by connecting the development of awareness, skills, and knowledge.	48 (47.5%)	46 (45.5%)	7 (6.9%)	0	0
4	It is expected that students should have data literacy skills to recognize and identify certain problems, interpret the data, determine strategy, implement and evaluate course of accomplishment.	42 (41.6%)	47 (46.5%)	9 (8.9%)	3 (3.0%)	0
5	Universities should offer courses relevant to data literacy skills by recommending and providing access to the data literacy tools.	56 (55.4%)	32 (31.7%)	11 (10.9%)	2 (2.0%)	0
Total		233 (46.1%)	210 (41.6%)	57 (11.3%)	5 (1.0%)	0
Mean		46.60	42.00	11.40	1.00	0.00
Standard deviation		5.73	6.44	4.16	1.41	0.00

TABLE 2 Problem-solving skill.

Item		5	4	3	2	1
1	I think problem-solving skills should be embedded in the undergraduate curriculum.	59 (58.4%)	32 (31.7%)	9 (8.9%)	1 (1.0%)	0
2	I believe that problem-solving skills must be incorporated into the learning process for young students to develop 21st-century skills.	65 (64.4%)	29 (28.7%)	7 (6.9%)	0	0
3	Institutions should improve the assessment of student's digital information and technical skills and other aspects of ICT literacy skills to improve student's problem-solving skills.	42 (41.6%)	46 (45.5%)	13 (12.9%)	0	0
4	The inclusion of problem-solving skills could build higher-order thinking skills and increase collaborative problem-solving skills.	52 (51.5%)	43 (42.6%)	6 (5.9%)	0	0
5	Problem-solving skills are necessary to find solutions to problems in my future professional careers.	62 (61.4%)	32 (31.7%)	7 (6.9%)	0	0
Total		280 (55.45%)	182 (36.04%)	42 (8.32%)	1 (0.2%)	0.00
Mean		56.00	36.40	8.40	0.20	0.00
Standard deviation		9.19	7.57	2.79	0.45	0.00

produce an ideal solution. Therefore, it is suggested to include problem-solving skill into the curriculum as it is crucial for the acquisition of the 21st century skills (Demir, 2021). Following that, Item 5 had the second-highest number of strong agreement with a total of 62 respondents who strongly agreed with the statement. This is because at the workplace, individuals are often required to solve problems in a good manner to avoid conflicts between employees. According to Karakoyun and Lindberg (2020), problem-solving is the second most important skill after digital literacy in the 21st century workforce. Meanwhile, no disagreement was recorded for Items 2 to 4. The respondents who held a strong agreement for all 5 items contributed to an average of 91.5% of agreement.

Table 3 contains results on the importance of programming skill for the undergraduate students in the big data era. It can be seen that Item 1 yielded 80.2% of agreement from the respondents. This is because almost everything is digitalized nowadays and this makes programming as among the highly demanded skill for one to keep pace

with the current trends. Other than developing computational skill, programming education can also aid in fostering a more general character attitude that is related to the 21st century skills and digital competency (Nouri et al., 2020). Furthermore, Item 4 received an agreement of 79.2% from the respondents. One possible reason is that the young generation must be equipped with programming skill to keep up with the digital transformation where programming skill is broadly needed in various sectors nowadays. Moreover, the importance of programming skill in this big data era is no longer limited to programmers but also various other careers. This is supported by Mittal (2020) who stated that important infrastructures such as healthcare, communication, transportation, and defense also expect improvement in software technologies to support their digital platforms. Whereas, 85 respondents agreed with Item 5, which deduced that programming encompasses the ability to write codes as well as the ability to analyze a situation and recognize critical components, model data, and processes in order to design

TABLE 3 Programming skill.

Item		5	4	3	2	1
1	Programming skill is strongly associated with the 21st-century skills and digital competence.	46 (45.5%)	35 (34.7%)	19 (18.8%)	1 (1.0%)	0
2	I think programming skill is broadly needed in various sectors nowadays.	48 (47.5%)	36 (35.6%)	12 (11.9%)	5 (5.0%)	0
3	I think programming skills should be included in primary school education.	32 (31.7%)	28 (27.7%)	31 (30.7%)	8 (7.9%)	2 (2.0%)
4	I think the young generation must equip with programming skills to keep pace with the digital transformation.	31 (30.7%)	49 (48.5%)	19 (18.8%)	1 (1.0%)	1 (1.0%)
5	Programming skills will enhance and complement my thinking skill, problem-solving skills and creativity.	42 (41.6%)	43 (42.6%)	14 (13.9%)	2 (2.0%)	0
Total		199 (39.4%)	191 (37.8%)	95 (18.8%)	17 (3.4%)	
Mean		39.80	38.20	19.00	3.40	0.60
Standard deviation		7.89	8.04	7.38	3.05	0.89

TABLE 4 Creative thinking skill.

Item		5	4	3	2	1
1	The development of creative thinking skill has less focus in educational settings.	29 (28.7%)	31 (30.7%)	36 (35.6%)	5 (5.0%)	0
2	Creative thinking skill is a required skill needed by 21st-century employers.	42 (41.6%)	47 (46.5%)	12 (11.9%)	0	0
3	Creative thinking skill helps us to stand out at school and workplace, specifically when we can provide constructive ideas.	50 (49.5%)	38 (37.6%)	11 (10.9%)	2 (2.0%)	0
4	Creative thinking skill makes us think from various perspectives and generate completely new ideas when dealing with problems as required in 21st-century.	52 (51.5%)	39 (38.6%)	9 (8.9%)	1 (1.0%)	0
5	Institutions should adopt problem-based learning to enhance creative thinking skill within students.	49 (48.5%)	38 (37.6%)	13 (12.9%)	1 (1.0%)	0
Total		222 (44.0%)	193 (38.2%)	81 (16.0%)	9 (1.8%)	0.00
Mean		44.40	38.60	16.20	1.80	0.00
Standard deviation		9.40	5.68	11.17	1.92	0.00

specific programs. As mentioned by [Wong and Cheung \(2020\)](#), programming skill can strengthen students' thinking skill, problem-solving skill, and creativity by requiring them to set up their own games, subsequently enhancing their programming knowledge during the programming curriculum. Ergo, given the importance of attaining these skills, it can be postulated that programming is one of the 21st century skills that has great importance for future generations, being a process of applying various command sets for computer programming, problem solving and performing a specific task by computers ([Business Dictionary, 2017](#)). The majority of respondents agreed with almost all of the items except for Item 3 where 30.7% of the respondents had a neutral stand while 9.9% of them disagreed with the statement. A possible explanation for this result is the respondents believe that primary students are too young to learn programming skill. According to [Antonitsch \(2015\)](#), there is another viewpoint that sees potential disadvantages in children's development when they are exposed to the computer at an early age. Such viewpoint can be found in both the educational thought of anthroposophical philosophy and the well-known scientific publications. All the items received disagreement from a small proportion of respondents.

Table 4 presents results on the importance of creative thinking skill for the undergraduate students in the big data

era. For item 1, 60 respondents agreed, 36 respondents were neutral, and 5 respondents disagreed that the development of creative thinking skill has less focus in the educational system. [Elder and Paul \(2001\)](#) have emphasized the importance of fostering creative thinking skill in students' education because it allows them to handle both academic and non-academic situations with proper solutions. This indicates that educational institutions should put more attention on practicing critical thinking skill as it allows students to think critically and effectively find solutions, thus helping them to succeed in the future career path. Meanwhile, the majority of respondents agreed with Item 2 where creative thinking is not only important to their daily life but also to jobs that require interaction between individuals. [Finkelman \(2001\)](#) highlighted that professionals who work in the human health field, such as psychologists, counselors, and educationists, must think critically in both practice and management. Creative thinking also leads to higher leadership skill, particularly in managerial roles. Next, Item 3 received a high agreement level from the respondents. Despite the ability to generate ideas from their own experience and knowledge, individuals with creative thinking skill can also obtain ideas from their surroundings ([Allen and Gerras, 2009](#)), thus enabling them to identify the perfect solution to any difficulties experienced in the future. Besides, Item 4 had the highest percentage of agreed respondents (90.1%).

One reason for this result is that the respondents believe that individuals with creative thinking skill can immediately generate unique ideas when seeing a problem at first glance. According to [Atmojo and Sajidan \(2020\)](#), individuals with creative thinking skills can produce alternative solutions to problems easily while tend to obey the originality rule of ideas. Furthermore, 86.1% of the respondents agreed with Item 5. One possible explanation is that problem-based learning requires students to think out of the box and from various perspectives to obtain the desired solution. As noted by [Anjarwati et al. \(2018\)](#), problem-based learning encourages high students involvement by motivating them to find self-concept. It also allows students to think and solve problems creatively using their own ideas.

Conclusion

In summary, this research aims to identify the importance of data literacy, problem-solving, programming, and creative thinking skills in the big data era from the perspective of undergraduate students in Malaysia. The findings indicate that the majority of respondents agreed that data literacy is indeed a necessary skill in the digital world because it allows people to effectively deal with data-related issues. It was also found that data literacy skill possesses an important role in educational institutions. Therefore, the respondents proposed that data literacy skill should be integrated into the school curriculum to expose it to the young generation and cultivate their interests to data at an early age. Additionally, data literacy is also known as a medium for data sharing. Such skill is particularly helpful for students to interpret any forms of data. Hence, it is important to equip students with data literacy skill so that they can easily disclose information presented in raw data. For young learners to gain the 21st century skills, problem-solving skill should be incorporated into the learning process. The survey results showed that problem-solving skill should be included in the curriculum for students to increase their academic achievement and become more adventurous and creative. Furthermore, the findings also showed that problem-solving skill can help to develop critical thinking skill and improve collaborative problem-solving skill. Thus, students must be exposed to problem-solving skill as they will be required to solve problems and issues in their future careers. The results also reported an overall agreement on the strong interrelation between programming skill and the 21st century skills. Programming has become an essential skill in the 21st century. Therefore, every individual should be equipped with such skill to keep pace with the digital revolution as every sector now requires a digital platform, which is linked to the use of programming skill in platform design. As most educational institutions have begun to introduce programming skill into their curriculum, most

respondents agreed that programming skill can strengthen their thinking skill, problem-solving skill, and creativity. They further advocate that the younger generation should be introduced to programming at the early stage skills for them to keep up with the digital transition. However, a small proportion of the respondents believe that it is unnecessary to embed programming skill into primary school education. From the findings, this study concludes that students should have creative thinking skill because it is a must-have ability to remain competitive and relevant in the 21st century. However, most educational institutions are lacking in the attention to creative thinking skill, hence causing graduates to face significant difficulty to secure their jobs. Thus, students must be encouraged to develop creative thinking skill as it allows them to generate unique ideas. This is in line with the respondents' agreement that creative thinking enables them to think and produce solutions to 21st century problems from various perspectives.

Recommendations

Due to the importance of data literacy skill in this data-saturated world, students will require such skill to study and process the open data for them to be relevant. It is recommended that problem-solving skill to be incorporated into the learning process in which real-life situations can be utilized to solve problems independently while receiving minimal guidance. This will train them to expect future events and be prepared to handle any potential problems and issues in the future. However, problem-solving skill is limited to specific courses only. Therefore, educational institutions may want to revise their curriculum to integrate problem-solving skill across a wider range of areas. Echoing similar notion, programming skill should be introduced at school level as students will likely start to develop interest at that juncture. For instance, schools can organize free programming courses and host programming competitions to encourage students' participation and interest in programming. This will cultivate an impactful learning experience to students and boost their interest in this field. In addition, this study also found that creative thinking skill can develop students' creativity to solve real-life problems. Thus, it is recommended for the government to improve the current education system by integrating more problem-based learning to improve students' creative thinking skill such as group-based activities to apply real-life solutions. This in turn will prompt them to think creatively in solving the assigned tasks with their group members, which will eventually help them to simulate creative solutions when faced with similar problems in the future workplace. Consequently, this will produce future employees with the competency to provide

constructive and creative solutions to problems. Besides, educators must also be encouraged to review best strategies for engaging students to develop the 21st century skills by connecting the content to real-life experiences to promote the sound application of the 21st century skills in actual field of work. Today, technology holds the power of transforming our present into a radiant future. Evolving skills set such as digital literacy and digital citizenship needed to undergo digital transformation are in high demand. There is a need to have a common understanding of digital literacy and skills that can be adopted by all stakeholders as a global standard, which can be seen as part of digital intelligence (DQ), which is recognized by the IEEE SA (2021). Therefore, it is recommended for future research to elicit further elaboration from a research emulating a tracer's study to track the progress of 21st century in order to gain more insights for more accurate conclusions to be drawn. Future research can also use cluster sampling to ensure that the number of participants from each age group is the same. This will ensure the accuracy of responses as all age groups will be equally represented, thus eliminating bias among the respondents. In conclusion, the education system should consider problem-based learning as a possible technique to enhance creative thinking skill among students.

Data availability statement

The original contributions presented in this study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

References

- Aabla, B. (2017). A review on 21st century learning models. *Int. Interdiscip. J. Educ.* 6, 254–263. doi: 10.12816/0036081
- Allen, C. D., and Gerras, S. J. (2009). Developing creative and critical thinkers. *Mil. Rev.* 6:77.
- Anjarwati, P. G., Sajidan, S., and Prayitno, B. A. (2018). Problem-based learning module of environmental changes to enhance students' creative thinking skill. *Biosaintifika J. Biol. Biol. Educ.* 10, 313–319. doi: 10.15294/biosaintifika.v10i2.12598
- Antonitsch, P. K. (2015). "A cautious look at coding in primary education," in *The proceedings of international conference on informatics in schools: Situation, evolution and perspectives—ISSEP 2015*, (Ljubljana: University of Ljubljana), 74–81.
- Arslangilay, A. S. (2019). 21st century skills of CEIT teacher candidates and the prominence of these skills in the CEIT undergraduate curriculum. *Educ. Policy Anal. Strateg. Res.* 14, 330–346. doi: 10.29329/epasr.2019.208.15
- Atmojo, I. R. W., and Sajidan. (2020). Effectiveness of CEL-badis learning model on students' creative-thinking skills: Case on the topic of simple food biotechnology. *Int. J. Instr.* 13, 329–342. doi: 10.29333/iji.2020.13323a
- Azid, N., and Md-Ali, R. (2020). The effect of the successful intelligence interactive module on Universiti Utara Malaysia students' analytical, creative and practical thinking skills. *S. Afr. J. Educ.* 40, 7–8. doi: 10.15700/saje.v40n3.a1743
- Ball, A., Joyce, H. D., and Anderson-Butcher, D. (2016). Exploring 21st century skills and learning environments for middle school youth. *Int. J. Sch. Soc. Work* 1. doi: 10.4148/2161-4148.1012
- Bhargava, R., and D'Ignazio, C. (2015). "Designing tools and activities for data literacy learners," in *Proceedings of the web science: Data literacy workshop*, Oxford. doi: 10.15353/joci.v12i3.3280
- Business Dictionary (2017). *Business Dictionary*. Available online at: <http://google.com/IVH6Nq> (accessed August 1, 2021).
- Chinien, C., and Boutin, F. (2011). *Defining essential digital skills in the canadian workplace*. Human resources and skills development Canada. 87. Available online at: http://en.copian.ca/library/research/digi_es_can_workplace/digi_es_can_workplace.pdf (accessed December 15, 2021).
- Davis, B. (2021). *Research paper: What are the benefits of 21st century? Mvorganizing*. Available online at: <https://www.mvorganizing.org/what-are-the-benefits-of-21st-century/> (accessed June 10, 2022).
- Deahl, E. S. (2014). Better the data you know: Developing youth data literacy in schools and informal learning environments. *SSRN Electron. J.* doi: 10.2139/ssrn.2445621
- Demir, Ü (2021). The effect of unplugged coding education for special education students on problem-solving skills. *Int. J. Comput. Sci. Educ. Sch.* 4, 3–30. doi: 10.21585/ijcses.v4i3.95
- Elder, L., and Paul, R. (2001). Critical thinking: Thinking to some purpose. *J. Dev. Educ.* 25:40.

Author contributions

MM: conceptualization, data curation, and writing – original draft. SW: formal analysis and writing – review and editing. MM and SW: investigation and methodology. Both authors contributed to the article and approved the submitted version.

Funding

This work was supported by the Sunway University.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

- Enakrire, R. T. (2020). Data literacy for teaching and learning in higher education institutions. *Lib. Hi Tech News* 38, 1–7. doi: 10.1108/LHTN-01-2020-0005
- Finkelman, A. W. (2001). Problem-solving, decision-making, and critical thinking: How do they mix and why bother? *Home Care Provid.* 6, 194–198. doi: 10.1067/mhc.2001.120987
- Furino, B. (2012). Perspectives on student problem solving and 21st century skills developed at the precollege level. *J. Washington Acad. Sci.* 98, 23–34.
- Ghafar, A. (2020). Convergence between 21st century skills and entrepreneurship education in higher education institutes. *Int. J. High. Educ.* 9, 218–229. doi: 10.5430/ijhe.v9n1p218
- Grace, K., Salvatier, J., Dafoe, A., Zhang, B., and Evans, O. (2018). When will AI exceed human performance? Evidence from AI experts. *J. Artif. Intell. Res.* 62, 729–754. doi: 10.1613/jair.1.11222
- Habets, O., Stoffers, J., Heijden, B. V. D., and Peters, P. (2020). Am i fit for tomorrow's labor market? The effect of graduates' skills development during higher education for the 21st century's labor market. *Sustainability* 12:7746. doi: 10.3390/su12187746
- Jang, H. (2016). Identifying 21st century STEM competencies using workplace data. *J. Sci. Educ. Technol.* 25, 284–301. doi: 10.1007/s10956-015-9593-1
- Joyes, C., Rossignoli, S., and Fenyiwa Amonoo-Kuofi, E. (2019). *21st century skills: Evidence of issues in definition, demand and delivery for development contexts*. Brighton: Institute of Development Studies.
- Karakoyun, F., and Lindberg, O. J. (2020). Preservice teachers' views about the twenty-first century skills: A qualitative survey study in Turkey and Sweden. *Educ. Inf. Technol.* 25, 2353–2369. doi: 10.1007/s10639-020-10148-w
- Karyotaki, M., and Drigas, A. (2016). Online and other ICT-based training tools for problemsolving skills. *Int. J. Emerg. Technol. Learn.* 11, 35–39.
- Kereluik, K., Mishra, P., Fahnoe, C., and Terry, L. (2013). What knowledge is of most worth: Teacher knowledge for 21st century learning. *J. Digit. Learn. Teach. Educ.* 29, 127–140. doi: 10.1080/21532974.2013.10784716
- Koehler, M. J., Mishra, P., Kereluik, K., Shin, T. S., and Graham, C. R. (2014). "The technological pedagogical content knowledge framework," in *Handbook of research on educational communications and technology*, (New York, NY: Springer Science + Business Media), 101–111. doi: 10.1007/978-1-4614-3185-5
- Kunpitak, P. (2019). The flipped classroom in 21st century learning for development of learning skills algorithm analysis of basic programming C language. *IJIE (Indonesian Journal of Informatics Education)* 2, 77–84. doi: 10.20961/ijie.v2i2.24402
- Lavi, R., Tal, M., and Dori, Y. J. (2021). Perceptions of STEM alumni and students on developing 21st century skills through methods of teaching and learning. *Stud. Educ. Eval.* 70:101002. doi: 10.1016/j.stueduc.2021.101002
- Mahmud, M. M., and Wong, S. F. (2022). Stakeholder's perspectives of the twenty-first century skills. *Front. Educ.* 7:931488. doi: 10.3389/feduc.2022.931488
- Mahmud, M. M., Wong, S. F., and Ismail, O. (2021). "Emerging learning environments and technologies post Covid-19 pandemic: What's next?," in *The international conference on information, communication & cybersecurity*, (Cham: Springer), 308–319. doi: 10.1007/978-3-030-91738-8_29
- Ministry of Higher Education [MoHE] (2011). *Graduate tracer study executive report 2010*.
- Miranda, J., Navarrete, C., Noguez, J., Molina-Espinosa, J. M., Ramirez-Montoya, M. S., Navarro-Tuch, S. A., et al. (2021). The core components of education 4.0 in higher education: Three case studies in engineering education. *Comput. Electr. Eng.* 93, 1–27. doi: 10.1016/j.compeleceng.2021.107278
- Mittal, S. (2020). *Coding: 21st century skill for smarter India. Business world*. Available online at: <http://bweducation.businessworld.in/article/Coding-21st-Century-Skill-For-Smarter-India-/15-10-2020-331787/> (accessed June 10, 2022).
- Nouri, J., Zhang, L., Mannila, L., and Norén, E. (2020). Development of computational thinking, digital competence and 21st century skills when learning programming in K-9. *Educ. Inq.* 11:14. doi: 10.1080/20004508.2019.1627844
- Palsdottir, A. (2021). Data literacy and management of research data – a prerequisite for the sharing of research data. *ASLIB J. Inf. Manag.* 2:322. doi: 10.1108/AJIM-04-2020-0110
- Raffaghelli, J. E. (2020). Is data literacy a catalyst of social justice? A response from nine data literacy initiatives in higher education. *Educ. Sci.* 10:233. doi: 10.3390/educsci10090233
- Rajaratenam, R. M. (2019). *Columnist. Tap into 21st century skills*. <https://www.nst.com.my> (accessed June 10, 2022).
- Rios, J. A., Ling, G., Pugh, R., Becker, D., and Bacall, A. (2020). Identifying critical 21st-century skills for workplace success: A content analysis of job advertisements. *Educ. Res.* 49, 80–89. doi: 10.3102/0013189X19890600
- Robertson, J., and Tisdall, E. K. (2020). The importance of consulting children and young people about data literacy. *J. Media Lit. Educ.* 12, 58–74. doi: 10.23860/jmle-2020-12-3-6
- Rodzalan, S. A., and Saat, M. M. (2015). The perception of critical thinking and problem-solving skill among Malaysian undergraduate students. *Proced. Soc. Behav. Sci.* 172, 725–732. doi: 10.1016/j.sbspro.2015.01.425
- Shreiner, T. L. (2020). Building a data literate citizenry: How US state standards address data and data visualizations in social studies. *Inf. Learn. Sci.* 121, 909–931. doi: 10.1108/ILS-03-2020-0054
- Sickler, J., Bardar, E., and Kochevar, R. (2021). Measuring data skills in undergraduate student work: Development of a scoring rubric. *J. Coll. Sci. Teach.* 50, 25–32.
- Silva, E. (2009). Measuring skills for 21st-century learning. *Phi Delta Kappa*. 90, 630–634. doi: 10.1177/003172170909000905
- The Glossary of Education Reform (2016). *21st century skills*. Available online at: <https://www.edglossary.org/21st-century-skills/> (accessed August 1, 2021).
- Theobald, A., and Hancock, S. (2019). How environmental science graduate students acquire statistical computing skills. *Stat. Educ. Res. J.* 18:68. doi: 10.52041/serj.v18i2.141
- Van Laar, E., Van Deursen, A. J. A. M., Van Dijk, J. A. G. M., and De Haan, J. (2020). Determinants of 21st-century skills and 21st-century digital skills for workers: A systematic literature review. *SAGE Open* 10:9. doi: 10.1177/2158244019900176
- Van Laar, E., Van Deursen, A. J., Van Dijk, J. A., and De Haan, J. (2017). The relation between 21st-century skills and digital skills: A systematic literature review. *Comput. Hum. Behav.* 72, 577–588. doi: 10.1016/j.chb.2017.03.010
- Winberg, C., Adendorff, H., Bozalek, V., Conana, H., Pallitt, N., Wolff, K., et al. (2019). Learning to teach STEM disciplines in higher education: A critical review of the literature. *Teach. High. Educ.* 24, 930–947. doi: 10.1080/13562517.2018.1517735
- Wong, G. K.-W., and Cheung, H.-Y. (2020). Exploring children's perceptions of developing twenty-first century skills through computational thinking and programming. *Interact. Learn. Environ.* 28, 438–450. doi: 10.1080/10494820.2018.1534245
- World Economic Forum (2016). *The future of jobs: Employment, skills and workforce strategy for the fourth industrial revolution. Global Challenge Insight Report*. Cologny: World Economic Forum.
- Wyse, D., and Ferrari, A. (2014). Creativity and education: Comparing the national curricula of the states of the European Union and the United Kingdom. *Br. Educ. Res. J.* 41, 30–47. doi: 10.1002/berj.3135



OPEN ACCESS

EDITED BY

David Alonso García,
Complutense University of Madrid,
Spain

REVIEWED BY

Ibrahim Mahmoud,
University of Sharjah, United Arab
Emirates
Sarah Khan,
Zayed University, United Arab Emirates

*CORRESPONDENCE

Nadia Solovieva
nkettell@hct.ac.ae

SPECIALTY SECTION

This article was submitted to
Higher Education,
a section of the journal
Frontiers in Education

RECEIVED 29 May 2022

ACCEPTED 23 September 2022

PUBLISHED 07 November 2022

CITATION

Solovieva N, Dani A, Kane P,
Thomson S, Hamam D and
Solaimani FK (2022) Developing
effective student learning
environment: Case study from
Sharjah, United Arab Emirates.
Front. Educ. 7:955873.
doi: 10.3389/feduc.2022.955873

COPYRIGHT

© 2022 Solovieva, Dani, Kane,
Thomson, Hamam and Solaimani. This
is an open-access article distributed
under the terms of the [Creative
Commons Attribution License \(CC BY\)](#).
The use, distribution or reproduction in
other forums is permitted, provided
the original author(s) and the copyright
owner(s) are credited and that the
original publication in this journal is
cited, in accordance with accepted
academic practice. No use, distribution
or reproduction is permitted which
does not comply with these terms.

Developing effective student learning environment: Case study from Sharjah, United Arab Emirates

Nadia Solovieva*, Anita Dani, Patrick Kane, Sophy Thomson,
Doaa Hamam and Fares Keramatulah Solaimani

Department of General Studies, Higher Colleges of Technology, Sharjah, United Arab Emirates

The impact of COVID-19 on college education has been profound. At the same time, it has also provided an opportunity to test the effectiveness of new teaching approaches in challenging circumstances when the new delivery modes were introduced. In this case study, we have taken the project-based learning approach a little further by directly involving students as co-researchers in the ongoing research project in a higher education institution in Sharjah. This campus-based research project aimed at finding effective solutions to reduce plastic waste at the Sharjah campus. We enabled several groups of students to participate in the primary data collection for our project by aligning their course work projects with the aims of our own research. Hence, the students were directly involved in the ongoing community project, which raised their awareness about important sustainability issues. In addition, the students acquired essential research skills and were able to apply their knowledge to practical issue. This approach was effective: the difference between the final grades of students in the project and non-project groups was statistically significant in 2020 and in 2021. In 2020, the students in the project group scored 5.16% higher than the students in the non-project group. (95% confidence interval is $[-0.9044, 11.2244]$, $p = 0.047$). In 2021, this difference was 6.5% (95% confidence interval is $[2.1176, 10.9026]$, $p = 0.002$).

KEYWORDS

students as co-researchers, student attainment, applied research by undergraduate students, research-based learning, active learning

Introduction

One of the challenges of education is student engagement and developing effective learning environments (e.g., Taylor and Parsons, 2011; Fredricks et al., 2016). This challenge became even more acute during the recent COVID-19 pandemic, with the temporary introduction of 100% online teaching, which often had a detrimental effect on student learning (El-Sakran et al., 2022). However, this has also provided an opportunity to test the effectiveness of new teaching approaches in challenging circumstances, when the new delivery modes were introduced.

It has been widely accepted that active learning approach facilitates effective student learning *via* various collaborative activities, for example, group work, discussions, and projects (Prince, 2004). Research-based learning forms one of the ways for intellectual engagement of undergraduate students' in critical inquiry at university (e.g., Lambert, 2009). In this case study, we have taken the research-based active learning approach a little further by directly involving undergraduate students in the ongoing research project on during two spring semesters, in 2020 and 2021. Undergraduate students became "co-researchers" according to classification by Fielding (2001). This approach was applied in high schools (e.g., Messiou, 2014), colleges, and universities (e.g., Pilkington, 2010; Walkington, 2015) across Europe and North America. However, this is the first time when such pedagogical approach is being reported in the UAE although the effect of project-based learning on university students in the UAE was recently studied by Mohammed (2017).

The internally funded applied research project aimed at finding solutions to the reduction of plastic waste at the college campus. It is well established that petroleum-based plastic waste is one of the most urgent global sustainability issues of the 21st century. Due to its ubiquitous nature, persistence and huge production volumes plastic became a plague of modern time. A plastic bottle takes on average 500 years to biodegrade and every piece of plastic ever produced remains in the environment in one form or another (Orset et al., 2017). Plastic waste is especially harmful to marine life: it is estimated that plastic ingestion kills 1 million marine birds and 100,000 marine animals each year; some 33% of marine mammals and corals are threatened (Brondízio et al., 2019).

Although the college seeks initiatives to reduce plastic waste (TÜV Middle East, 2017), we have discovered that the amount of plastic waste at the Sharjah campus remained high.

Many students, especially the members of Sustainability Club, were concerned about the amount of plastic waste on campus, and this student interest and concern have given us the idea to directly involve the students into our applied research. In this approach, we pursued two goals: we used the primary data, collected by the students, in our ongoing research and at the same time, we created effective learning environment for the students, who were directly involved

in the project. By directly involving the students in the research process, we used "students as researchers" pedagogical approach (Walkington, 2015), which has a multitude of clear benefits for the students in terms of developing their higher thinking skills (e.g., Pilkington, 2010) and giving them first-hand practice of ongoing research (Healey and Jenkins, 2009).

Although the practice of involving undergraduate students into research process as co-researchers received substantial attention in pedagogy in the recent years (e.g., Pilkington, 2010; Walkington, 2015), to date there is no published record of quantitative analysis of the effect of such practice in the college setting in the UAE.

This article aims to quantitatively analyze the effect of undergraduate student participation in the ongoing applied research project on the student attainment rates in the Research Methods course.

Methodology

The applied research project on plastic waste was integrated into the Research Methods course, which was taught by the members of the research team. We used voluntary sampling method, i.e., the students volunteered for the project groups. It was not possible to recruit the entire student cohort in the study. The students on this course were offered several topics directly related to the plastic-waste project during two spring semesters, in 2020 and 2021. The members of the research team liaised with all the students on the course, who chose to participate in the project: the aims of the research project were clearly communicated to the project students and the project students were given a task of collecting primary data through survey. The project students were given two questions from the research team in addition to the questions, which they developed themselves. Students then analyzed their primary data, drew conclusion, and produced research presentations within the framework of the Research Methods course. Typically, the student-led surveys included about 10 closed-ended questions, and 1–2 open-ended questions, please see [Supplementary Appendix](#).

All the projects (plastic and non-plastic) were graded using the same assessment tool across all campuses to ensure compatibility of grades.

The course was taught across all the campuses as this is one of the mandatory courses for students studying for majors in Business, Applied Media, Education, and Health Science. Usually, about 3,000 of first- or second-year undergraduate students take this course each semester (please see [Table 1](#) in the Results for the exact number of the students, who were involved in the course during the study period).

Target population for this research was 281 students in 2020 and 250 students in 2021 in the sections taught by contributing authors. Estimated sample size was calculated at as 90 at 95% confidence level. The actual sample size is approximately 50% of the estimated sample size. As the participation in the project group was kept voluntary, researchers did not wait to reach the desired sample size.

The scope of participation and support offered by teachers was explained to students at the start of their course work project. No extra credit or support from teachers was offered to participating students. This led to unbiased selection of project group participants.

The results of the student-led surveys were also integrated into the database of the applied research project and analyzed by the research team. By this means, the undergraduate students, who participated in the project, became co-researchers. Overall, the students engagement in the research project was at level 2 “Students are consulted and informed” according to classification by Walkington (2015, p 10). In the informal discussions with the project students, the teachers investigated the reasons behind student’s interest in the applied research project.

In this article, the students, who participated in the applied research project as co-researchers are referred to as “project students” and other students from the same study section are referred to as “non-project students.”

In order to quantitatively assess the effect of student involvement in research on student attainment, the following variables were used: final grades, coursework (CW) grades, final exam (FEG) grades, and the difference between the final exam grades and course work.

Attainment of the project students was compared with the attainment of non-project students in the same study section using the means of the aforementioned variables.

The following Null Hypothesis was tested. There was no difference between attainment of students in the two groups. We used independent samples *t*-test to examine the null hypothesis. All the analyses were conducted in MS Excel.

Results

Table 1 shows background information about “project” and “non-project” students together with the student participation rate in the project.

The number of participating students doubled in spring 2021 compared with spring 2020, however, the number of student sections, where students participated in research, decreased.

The project students gave informal feedback about the reasons for participating in the applied research project on

TABLE 1 Participation rate in the applied project in 2020 and 2021.

	2020	2021
Number of project students	24	48
% project students	1.4%	1.7%
Total number of students in project groups	281 students	250 students
Total number of the students in the course	1,682	2,704

plastic waste. The main reasons cited by the students include the following:

- General interest in sustainability issues;
- Desire to improve campus environment;
- Interest in reducing plastic waste and good understanding of issues associated with plastic waste, for instance, why plastic waste is harmful to the environment.

Figure 1 later inter-compares GPAs of project and non-project students.

Mean GPA of the project students was higher by 0.4 compared with non-project students in 2020 and 2021 (**Figure 1**).

In 2020 and 2021, the attainment of project students was higher compared with the non-project students (**Figure 2**).

Figure 2 clearly shows that the project students scored higher than non-project students, i.e., attainment of project students in 2020 and 2021 was higher compared to non-project students in all the parameters. The difference between course work and final exam grade was lower in the project students’ groups compared with the non-project student group. However, while the difference between project and non-project student attainment in 2021 was statistically significant at $p \leq 0.05$ in 2020 only final grades of the project group were higher than final grades of non-project students at $p \leq 0.05 \geq 95\%$ (see **Table 2**).

Discussion and conclusion

The results show a clear increase in attainment in all variables in both 2020 and 2021 albeit not all difference in 2020 was statistically significant at $p \leq 0.05\%$ (see **Table 2**). The reason for more robust statistical results in 2021 is the increase of the project students in relation to non-project students in the same study section (see **Table 2**). This implies that if this approach is expanded, i.e., more students are recruited as co-researchers, the student attainment rates in the project student group will increase.

There may be several reasons behind the higher attainment rates among project students.

First, the GPA of the project students was consistently higher by 0.4 in 2020 and in 2021 (see **Figure 1**) and this implies that more active and academically capable students

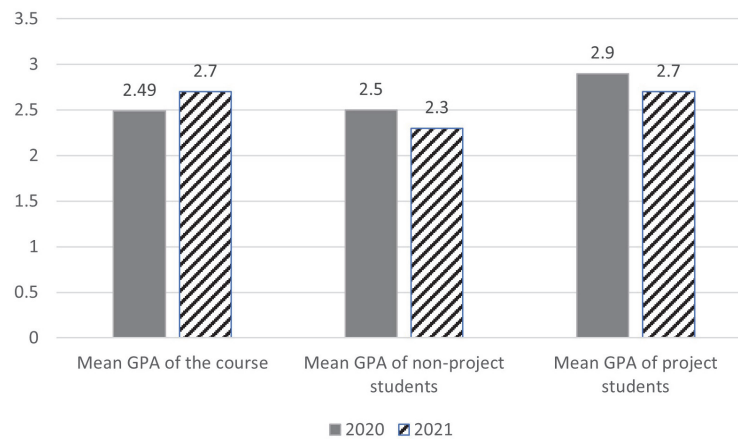


FIGURE 1

Student GPA: comparison between project and non-project students in 2020 and 2021.

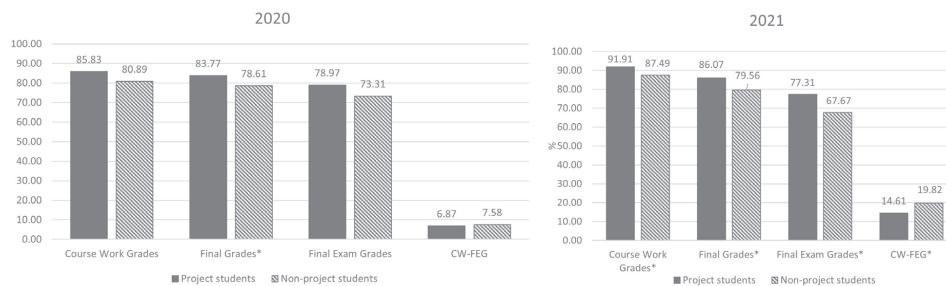


FIGURE 2

Attainment of project and non-project students in 2020 and 2021. CW-FEG is the difference between the mean final exam grades and the mean course work grades. * denotes significant value at $p \leq 0.05$. For other p -values please see Table 2.

TABLE 2 Student attainment variables and the results of t -test.

Variable		2020				2021			
		Project students	Non-project students	P -values	95% CI	Project students	Non-project students	P -values	95% CI
Course Work	Mean	85.83	80.89	0.058	[-0.5413, 11.8213]	91.91	87.49	0.018*	[0.2959, 8.5441]
	S.D.	9.15	15.14			6.74	14.2		
Final Exam Grade	Mean	78.97	73.31	0.055	[-4.4075, 7.7275]	77.31	67.67	0.001*	[3.5171, 15.7629]
	S.D.	15.08	16.76			14.45	20.59		
CW-FEG**	Mean	6.87	7.58	0.38	[-3.9245, 5.3445]	14.61	16.26	0.020*	[-2.874, 6.174]
	S.D.	9.70	11.18			14.52	14.60		
Final Grade	Mean	83.77	78.61	0.047*	[-0.9044, 11.2244]	86.07	79.56	0.002	[2.1174, 10.9026]
	S.D.	10.35	14.78			7.76	15.07		

*Significant at $p \leq 0.05$.

**CW-FEG is a mean difference between course work grades and final exam grades.

chose to participate in the project. Clearly, this may have in turn impacted the attainment of the project students.

As informal feedback showed, project students became directly involved in the real-life applied project, because they were concerned about sustainability and the plastic waste issue and were keen to find workable solutions. Participation in the

project has given them this opportunity and at the same time made them feel responsible for the outcomes of the research. This may have resulted in the higher attainment rates. Higher sense of responsibility of the students directly engaged in research process was also described by Lambert (2009) and Healey et al. (2013) in the UK and Mohammed (2017).

It is also likely that the project students were engaged in more frequent and detailed discussions with the teachers about the ongoing applied research project compared to their peers. Participation in the project gave more opportunities for discussions and interactions with the teachers (e.g., [Messiou, 2014](#); [Walkington, 2015](#); [Mohammed, 2017](#)) and, in many ways, more effective learning environment was created for the students through their direct integration and engagement with the applied research and this has resulted in the measurable increase in student attainment.

Most likely a combination of all three reasons discussed above led to the higher attainment rates among the project students. This case study clearly demonstrated the benefits of research-based learning and engaging undergraduate students as co-researchers. However, further research is needed to better quantify the effects and benefits of engaging undergraduate students as co-researchers at the UAE higher education institutions.

Data availability statement

The original contributions presented in this study are included in the article/[Supplementary material](#), further inquiries can be directed to the corresponding author/s.

Author contributions

NS, AD, PK, and ST designed the study. NS and AD analyzed the data. NS wrote the manuscript with support from all the authors. All authors participated in data collection, contributed to the article, and approved the submitted version.

Funding

This research was funded by the SEED research grant, grant # 2352.

References

- Brondizio, E. S., Settele, J., Díaz, S., and Ngo, H. T. (2019). "Global assessment report of the intergovernmental science-policy platform on biodiversity and ecosystem services," in *Debating nature's value*, eds E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (Bonn: IPBES).
- El-Sakran, A., Salman, R., and Alzaatreh, A. (2022). Impacts of emergency remote teaching on college students amid COVID-19 in the UAE. *Int. J. Environ. Res. Public Health* 19:2979. doi: 10.3390/ijerph19052979
- Fielding, M. (2001). Students as radical agents of change. *J. Educ. Change* 2, 123–141.
- Fredricks, J. A., Filsecker, M., and Lawson, M. A. (2016). Student engagement, context, and adjustment: Addressing definitional, measurement, and

Acknowledgments

We thank all the students who participated in plastic waste projects in 2020 and 2021 within the Research Methods course. We are also grateful to the following teachers of Research Methods, who provided the details of the student participation in the project: Gail al Hadith; Parminder Gill; Lisa Kassem; Natalia Borisenko; and Malika Khelifa (posthumously). Approval for this publication was received from the research committee. We also thank the reviewers for their valuable comments and suggestions.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/feduc.2022.955873/full#supplementary-material>

methodological issues. *Learn. Instr.* 43, 1–4. doi: 10.1016/j.learninstruc.2016.02.002

Healey, M., and Jenkins, A. (2009). *Developing undergraduate research inquiry*. New York, NY: Higher Education Academy, 152.

Healey, M., Lannin, L., Stibbe, A., and Derounian, J. (2013). *Developing and enhancing undergraduate final-year projects and dissertations a national teaching fellowship scheme project publication*. York: Higher Education Academy, 1–94.

Lambert, C. (2009). Pedagogies of participation in higher education: A case for researchbased learning. *Pedagogy Cult. Soc.* 17, 295–309. doi: 10.1080/14681360903194327

- Messiou, K. (2014). Working with students as co-researchers in schools: A matter of inclusion. *Int. J. Incl. Educ.* 18, 601–613. doi: 10.1080/13603116.2013.802028
- Mohammed, N. (2017). Project-based learning in higher education in the UAE: A case study of Arab students in emirati studies. *Learn. Teach. High. Educ.* 14, 73–86. doi: 10.18538/lthe.v14.n2.294
- Orset, C., Barret, N., and Lemaire, A. (2017). How consumers of plastic water bottles are responding to environmental policies? *Waste Manag.* 61, 13–27. doi: 10.1016/j.wasman.2016.12.034
- Pilkington, R. (2010). Developing undergraduate research and inquiry. *Innov. Educ. Teach. Int.* 47, 247–248. doi: 10.1080/14703291003718976
- Prince, M. (2004). Does active learning work? A review of the research. *J. Eng. Educ.* 93, 223–231. doi: 10.1002/j.2168-9830.2004.tb00809.x
- Taylor, L., and Parsons, J. (2011). Improving student engagement. *Curr. Issues Educ.* 14, 1–32.
- TÜV Middle East (2017). *Waste management report higher colleges of technology*. Hanover: TÜV Nord.
- Walkington, H. (2015). *Students as researchers: Supporting undergraduate research in the disciplines in higher education*. York: The Higher Education Academy.



OPEN ACCESS

EDITED BY
Ana Luisa Rodrigues,
University of Lisbon, Portugal

REVIEWED BY
Antonio Matas-Terron,
University of Malaga, Spain
Chengjiu Yin,
Kobe University, Japan
Hai Zhang,
Northeast Normal University, China

*CORRESPONDENCE
Zhe Li
lizheritetu@163.com

SPECIALTY SECTION
This article was submitted to
Higher Education,
a section of the journal
Frontiers in Education

RECEIVED 20 September 2022
ACCEPTED 02 November 2022
PUBLISHED 17 November 2022

CITATION
Ding X and Li Z (2022) A review of the
application of virtual reality technology
in higher education based on Web of
Science literature data as an example.
Front. Educ. 7:1048816.
doi: 10.3389/feduc.2022.1048816

COPYRIGHT
© 2022 Ding and Li. This is an
open-access article distributed under
the terms of the [Creative Commons
Attribution License \(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use,
distribution or reproduction in other
forums is permitted, provided the
original author(s) and the copyright
owner(s) are credited and that the
original publication in this journal is
cited, in accordance with accepted
academic practice. No use, distribution
or reproduction is permitted which
does not comply with these terms.

A review of the application of virtual reality technology in higher education based on Web of Science literature data as an example

Xiaoqin Ding and Zhe Li*

Department of Educational Technology, Faculty of Education, Fujian Normal University, Fuzhou, China

In recent years, with the rapid development of information technology, the visualization and interaction of virtual reality technology has developed, making the application of VR technology in education more and more attractive to scholars. This paper adopts the literature analysis method, focusing on the application of VR technology in the field of higher education, selects 80 empirical studies in the Web of Science literature database, conducts in-depth reading and analysis of the papers, and summarizes the experience of applying VR technology in the field of higher education. In order to deepen the application of VR in higher education. The research results show that the research objects of VR application in higher education are mainly undergraduates, the main majors of application are science, engineering and medical related majors, and the application of humanities and social sciences is relatively rare. At present, the devices used for VR in higher education are mainly computers and headsets, which are not portable enough. In addition, students lack guidance and training in the use of VR equipment before class. Compared with traditional education, most of the studies show that the application of VR to higher education and teaching has positive effects, mainly by affecting students' behaviors to affect students' learning results. The researchers mainly use traditional evaluation methods to evaluate teaching effects, use questionnaires and tests to collect data, and use data analysis methods mainly difference analysis and descriptive analysis. Based on the research results, the researchers put forward some suggestions at the end of the paper.

KEYWORDS

virtual reality, higher education, empirical research, virtual environment, immersion learning

Introduction

VR is also called artificial environment. The definition of modern VR technology is using complex technology to form synthetic stimulation to replace real-world sensory information, which means that users enter the virtual scene and use special helmets, data gloves, or input devices such as keyboards and mice to interact with the virtual environment in real-time. VR can make the user feel like they are in a real environment (Shin, 2018). The core VR originated in the 1960s. In the early 1990s, the Interactive

Systems Project Working Group funded by the National Science Foundation of the United States made a systematic discussion of VR. But due to the underdeveloped technical equipment at that time and the high cost of VR-related equipment, VR technology has not been developed for a long time. Later, with the rapid development of technology and the emergence of affordable VR headsets and other devices for games and entertainment, VR ushered in the second spring. At present, a new generation of information technology represented by VR technology has been widely used in the field of education. VR can provide students with teaching aids that are closer to real life, rich and diverse personalized learning environments, and change the boring traditional classrooms. Students are also provided with opportunities for active exploration and interactive communication to promote active learning. Additionally, VR has been described as a learning aid for the 21st century (Rogers, 2019), with a study showing that students retain more information and are better able to apply what they learn after engaging in VR exercises (Krokos et al., 2019). With the use of VR to enhance potential learning, it is understandable why researchers, organizations and educators are now paying close attention to the technology.

Although the application of VR technology in education is not new, the development of VR technology in visualization and interaction in recent years has made the application of VR technology in education more and more attractive to scholars, especially in higher education field. The core characteristics of VR are immersion, interactivity, and imagination, and these three characteristics make VR a huge advantage in the field of higher education (Ryan, 2015). First of all, VR has immersion, using this technology can build a realistic virtual environment, students are immersed in it. Second, VR is interactive. In the VR environment, when students perform operations, the environment will give students corresponding feedback, and interaction can deepen students' impression of the classroom and master knowledge more efficiently. Third, VR has imagination, students can deeply understand related issues according to their own senses, cognitive methods and cognitive ability in the simulated VR environment, which also can expand students' innovative thinking awareness and effectively enhance students' creativity and imagination.

Due to the increasing attention of the academic community to VR technology, there have been some comprehensive overviews and systematic reviews of VR educational applications, but the research of many scholars has the following problems. First, many scholars have put together virtual reality, augmented reality and mixed reality to study the application of education in education (Alalwan et al., 2020; Duarte et al., 2020). Second, most of the research on the application of virtual reality technology to higher education starts from a theoretical perspective and studies the possibility of virtual reality technology in certain disciplines in the field

of higher education, and there are few empirical studies (Moore, 1995; Hoffman and Vu, 1997). Finally, most of the current research reviews are aimed at a certain discipline or a certain course of higher education, and few researchers have comprehensively analyzed the overall application of VR technology in higher education.

This study focuses on the application of VR technology in the field of higher education. Through the analysis of the Web of Science database literature, it comprehensively analyzes the application and existing problems of VR technology in higher education, and summarizes the application of VR technology in higher education. Finally, some suggestions are put forward to deepen the application of VR in higher education. This research mainly focuses on the following questions:

- Q1: Which majors in the field of higher education are VR mainly applied to, and what are the trends or characteristics?
- Q2: What are the main VR devices currently used in higher education?
- Q3: Compared with traditional education, what is the teaching effect of VR in higher education and what aspects mainly affect the teaching effect? What methods do scholars mainly use to evaluate the teaching effect of VR in higher education?
- Q4: What research methods are used to study the application of VR in higher education, and what data collection methods and data analysis methods are mainly used by researchers?

Research methods

This paper's research method the literature analysis method. The literature analysis method refers to an analysis method through which the collected literature data of a specific subject is studied to find out the nature or situation of the research object, and draw the researcher's point of view from it. This research method is the most commonly used research method in literature review. The main steps of this research are: first, determine the topic of application of virtual reality technology in higher education; second step, collect and screen relevant literature according to the literature inclusion rules of this study; third step, carry out historical analysis and research context of the literature Analysis, analysis of research results and analysis of research methods; Finally, write a review.

Data sources and screening methods

This study reviewed the literature on the application of VR technology in higher education in the past 10 years (2012–2021), and the main database used in this study is Web

of Science, and IEEE and Google Scholar are supplementary databases. The reason for choosing Web of Science as the main database is that the database has a strong interdisciplinary nature, which is consistent with the theme of this study. Two groups of keywords are used in literature retrieval. Keywords related to virtual reality technology are virtual reality, virtual teaching environment, virtual classroom. Keywords related to higher education is higher education. The keywords of the two groups are combined as search characters. The time span of the literature was set from January 1, 2012 to December 31, 2021, and 2590 related literatures were retrieved. During the analysis of this study, the following criteria were used for the inclusion and exclusion of literature: (1) Only empirical research on the application of VR in advanced fields was included, and research results such as review papers and conference abstracts were excluded. (2) The technology used in the research must be VR, and the literature on augmented reality and mixed reality is excluded. (3) The object of the research must be the object of higher education, which means that including junior college students, undergraduate students, master students, and doctoral students. According to the above principles, a total of five researchers participated in the literature screening. After three rounds of screening, the researchers finally took out the uncertain literature and discussed them together, and finally got 80 relevant literatures. The literature screening flowchart is shown in [Figure 1](#).

Code analysis method

This paper uses the coding table shown in [Table 1](#) to quantify the 80 documents obtained by screening. [Table 1](#) is divided into three first-level dimensions, namely research context, related technology and teaching effect evaluation. Each first-level dimension is divided into 2–4 second-level dimensions.

Results

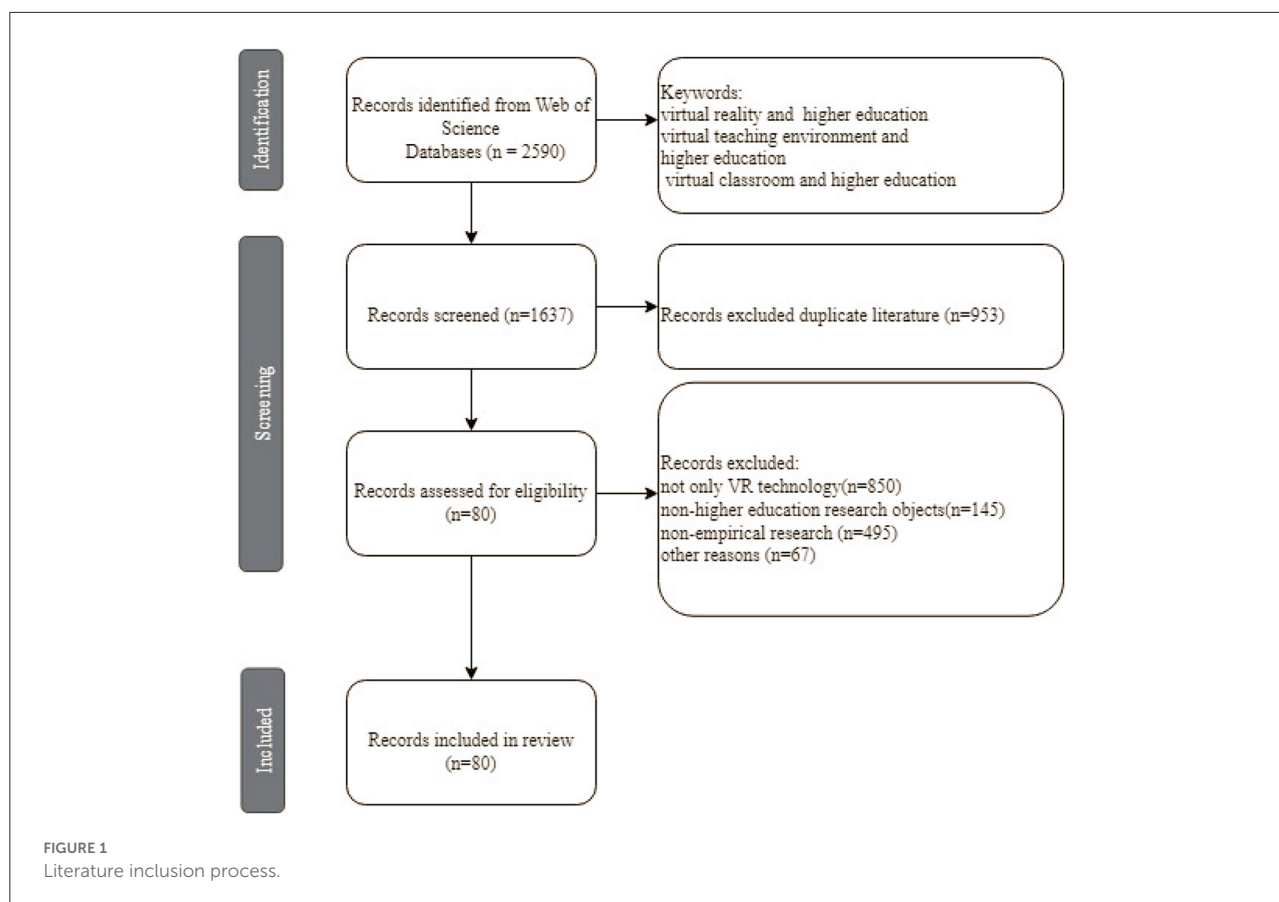
Analysis of the annual distribution of literature

Statistical statistics of the 80 selected literatures were carried out, and the trend graph of the number of empirical literatures with years was obtained as shown in [Figure 2](#). The horizontal axis represents the year, and the vertical axis represents the number of articles per year. Observing [Figure 2](#), we can see that from 2012 to 2017, researchers were not enthusiastic about the application of VR in higher education, but from 2018, the number of papers published showed a clear upward trend. The number of papers published in 2020 has reached its peak in the past decade, reaching ten times the number of papers published in 2012. To analyze the reasons, the first is the development of

VR technology. After 2018, VR technology has matured, and the price of related equipment has become relatively cheap, and many colleges and universities have been able to purchase equipment. Second, since the outbreak of the new crown epidemic from the end of 2019, many college students have been unable to enter the school to study due to other reasons such as being in a risk area or the school is in a risk area, but the practical skills of college students must be mastered in the syllabus, so the researchers turned their attention to VR technology. Its 3I characteristics can just solve the problem, allowing students to complete related skills training without returning to school.

Analysis of the research context

The empirical research papers are classified to obtain a statistical graph of VR applied to related majors in the field of higher education, as shown in [Figure 3](#). Observing [Figure 3](#), it is obvious that VR technology is widely used in medical education in the field of higher education. Among the 80 literatures, there are 53 empirical studies on medicine, accounting for 66%, followed by engineering, Science, Physical Education, Art, History and others. In addition, VR technology can also be applied to the teaching of higher education open courses and other skills training, such as ideological and political teaching, English teaching and speech training. After classifying the research objects, it is found that the research objects of VR technology application and higher education are mainly undergraduates. Among the 80 literatures, 77 research objects are undergraduates, 3 are graduate students. The number of empirical studies taking junior college students and doctors as research objects is 0. Higher medical education is an important part of higher education and shoulders the important mission of cultivating medical talents and maintaining and promoting human health. Using VR technology can help medical students to repeatedly train their skills without considering the issue of experimental resources. For example, Jung et al. integrated VR technology to learn basic skills of laparoscopy, students repeatedly learned the basic skills of operation through the laparoscopic simulator ([Jung et al., 2012](#)). In addition, VR technology can also help medical students improve their empathy skills, so that they can treat patients in a more appropriate way. For example, some researchers have applied VR technology to elderly nursing teaching, and the results show that students show higher understanding and empathy for elderly people with aging diseases such as macular degeneration and hearing loss ([Dyer et al., 2018](#)). Immersive VR courses have improved medical students' ability to assess patients with dyspnea ([Zackoff et al., 2020](#)), allowing timely escalation of care for patients with signs of respiratory failure. There are some necessary skills that need to be mastered in the teaching objectives of science and engineering majors in higher education. Researchers can use VR technology to conduct



virtual training or virtual experiments. Virtual practical training is skill training in a virtual environment, such as applying VR technology to welding courses. The research results show that most students' final exam scores for welding practice are significantly higher than their mid-term exam scores, and students' learning effect on VR-assisted welding courses is also high. Expressed an obvious affirmation (Huang et al., 2020); Applying VR to machine tool training, the results show that the effect of machine tool training in virtual environment is greatly improved (Chen et al., 2019). Compared with the training room in the real environment, virtual training can not only save teaching costs and avoid safety risks, but also stimulate students' interest in learning, turn students into subjects, and promote students' active learning. Virtual experiment is to imitate the virtual environment to conduct experiments, such as physics and chemistry experimental teaching due to site restrictions or dangers cannot carry out practical operations, students can use VR equipment to conduct experiments. It can be seen from the research results that the main target of VR application in the field of higher education is undergraduates, the majors of application are mainly science, engineering and medicine-related majors, and the application of humanities and social sciences such as history and art is relatively rare.

Research on VR equipment

The main devices for VR applications in the field of higher education include computers, headsets, VR simulators, mobile phones and so on. Computers are the main equipment for VR applications in higher education. Through computers, virtual laboratories can be made, VR games can be developed, and so on. The VR head-mounted device uses the head-mounted display device to block people's vision and hearing of the external environment, and guide the user to have a feeling of being in a virtual environment. Head-mounted virtual reality devices can bring an excellent real experience, making the content in the book touchable, interactive, and perceptible. VR headsets can be divided into three categories: external headsets, all-in-one headsets, and mobile headsets. VR simulators are the main equipment for VR applications in higher education. The latest VR head-mounted displays, the HTC Vive and Oculus Rift, not only allow users to experience a high degree of immersion, but also provide interactivity. VR headsets generally have a Bluetooth connection function, and users can experience interaction by operating Bluetooth devices such as external controllers. The advantage of this type of interaction is that the handle operation is more familiar to the user. In addition,

TABLE 1 Coding table.

First dimension	Secondary dimension	Coding situation
Research context	Research object	College students, undergraduate students, master students, doctoral students
	Research discipline	Science, engineering, agriculture and medicine, humanities and social sciences, arts
Related Technology	Equipment	Mobile phones, headsets, VR glasses, computers, others
	Immersion	Full immersion, semi-immersion
	Interaction	Virtual world, real world
	Imagination	None, low, high
Instructional design	Equipment teaching function	Attract interest, teach content, practice exercises, teaching evaluation, other
	Level of inquiry	High, medium, low
	Study guide	Operation manual self-study, instructor-led, hybrid, none
Teaching effect evaluation	Data collection method	Questionnaires, tests, interviews, observations and experiments
	Evaluation method	Paper test, questionnaire survey, interview method, observation method
	Data analysis method	Correlation analysis, difference analysis, others

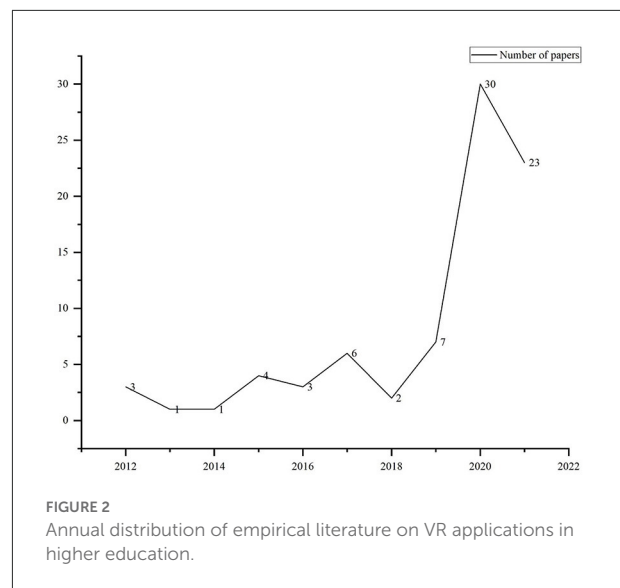


FIGURE 2 Annual distribution of empirical literature on VR applications in higher education.

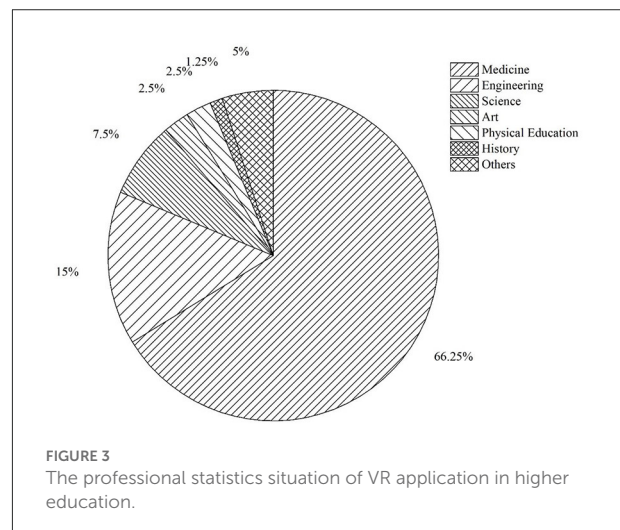


FIGURE 3 The professional statistics situation of VR application in higher education.

the range of motion of such equipment is small, and the comfort level will be increased. However, the current type of external Bluetooth handle device also has some disadvantages. For example, there are too many buttons, and many buttons in the device cannot be used by the user; the operation is unreal. In the real world, if you want to pick up something on the ground, the user needs to squat down and open his palm, but in the virtual world, it can only be achieved by moving a finger and pressing a button, which is a bit contrary to the immersion of VR equipment. VR equipment is divided into three categories: non-immersive - desktop VR such as some 3D interactive animation; immersive - cave-based VR such as immersive experience under the surround wall screen in a closed room and fully immersive - full Immersive VR systems such as Google Cardboard. This study compares VR devices according to the classification of VR device immersion in the literature.

In this study, VR simulators mainly refer to medical simulators, which are mainly used for basic teaching and skill training in medical education. Typical simulators include laparoscopic simulators, oral simulators, clinical puncture simulators, and so on. Traditional medical training is based on see one, do one, teach one model. However, this traditional model does not work in the world of modern medical technology. For example, laparoscopic VR simulators allow medical students to perform training in laparoscopic and gynecological surgery in a hyper-realistic and risk-free environment (Mulla et al., 2012); Oral simulator Moog simodon allows medical students to conduct repeated training of dental restoration skills in the event of accidental injury (Murbay et al., 2020). Scientific studies have proven that the application of simulators greatly improves training results compared to traditional methods. A high-quality simulation experience allows trainees to lessen their doubts and immerse themselves in the training scenarios. For example, if a virtual patient bleeds suddenly during training, its performance can be visually and sensory enough for the doctor to feel real enough for the trainee to engage in the training to find a quick solution. The laparoscopic simulator can also record trainee behavior with millimeter precision, which can provide valuable feedback not only on how the trainee is performing during the procedure, but also on the potential behavioral outcomes of the simulated patient.

Compared with VR headsets, mobile phones are more portable. The combination of mobile phones and VR glasses creates a VR environment, and students can access the system through mobile terminals for learning. For example, Kader et al. created a VR crime scene activity through Web VR software such as Uptale, where students can participate remotely through mobile devices to investigate virtual reality crime scenes and collect evidence for subsequent analysis (Kader et al., 2020). This paper conducts statistics and analysis on the VR devices used in the obtained 80 literatures, and the statistical results are shown in Figure 4. Looking at Figure 4, it can be seen that the number of VR devices in 2017–2021 has increased significantly compared to 2012–2016. In the 5 years from 2012 to 2016, the main device for VR application in higher education was the computer, followed by simulators, head-mounted devices, etc. However, in the 5 years from 2017 to 2021, headsets have become the main equipment for VR applications in higher education, and the proportion of teaching using VR simulators has also been greatly reduced. Analyzing the reasons, due to the rapid development of science and technology, researchers are more inclined to use devices with lower prices and higher interactivity, which can make users highly immersed in the virtual environment. In addition, according to the results of literature analysis, it is found that many studies are biased toward practical application, and lack relevant standards for technical index evaluation and operating environment evaluation. This part

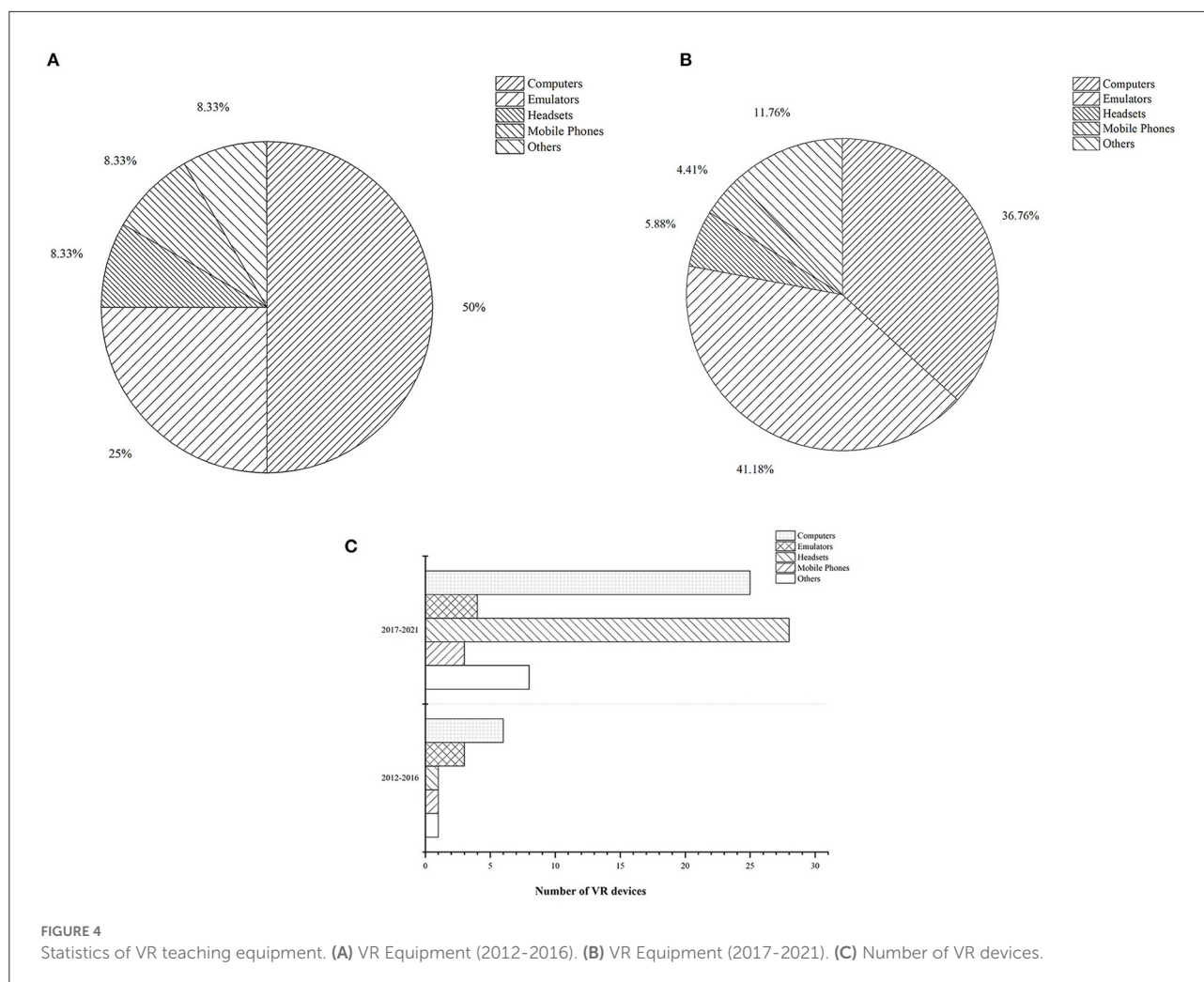
of the content deserves in-depth attention of researchers in the future.

Research on the effect of VR teaching

The teaching effect is a common concern of researchers. As shown in Figure 5, the researchers used a variety of evaluation methods to evaluate the teaching effect of VR in higher education, including traditional evaluation, embedded evaluation and hybrid evaluation. The traditional evaluation includes questionnaires, test papers and various tests, while the embedded evaluation can be completed in the VR environment. The mixed evaluation includes both traditional evaluation and embedded evaluation. Observing Figure 5, it can be found that when studying the application of VR in higher education, researchers mostly use traditional evaluation to evaluate the teaching effect, a total of 64 papers, accounting for 80% of the research literature. For example, Samosorn et al. used questionnaires and tests to understand the effect of the intervention after training nursing students in the use of VR intervention for difficult airway management (Samosorn et al., 2020). Followed by the embedded evaluation, a total of 9, accounting for 11.25% of the research literature. Four studies used mixed assessment to evaluate the teaching effect, and three studies did not evaluate the teaching effect. In the 80 literatures, the teaching effect of most of the research is positive. For example, the research results of Arif et al. show that in the virtual reality environment, students show stronger concentration (Arif, 2021); However, some research results show that the teaching effect of VR in higher education is not so ideal. For example, Harrison et al. research results showed that in the teaching of surgical preparation, the application of VR technology did not show a perceptible advantage compared with traditional video teaching (Harrison et al., 2017). In addition, this paper also studies the impact of VR technology teaching on students' learning results, and analyzes 80 literatures that were finally screened. The application of VR technology in higher education mainly affects students' learning results by affecting students' behavior ($n = 35$), followed by affecting students' cognition ($n = 22$), and finally affecting students' learning outcomes ($n = 6$) by affecting students' emotional attitudes.

VR research methods

This paper also sorts out and categorizes the research methods of related literature. The number of these articles is larger than the total number of research literature after measurement, because an article may contain more than one research design category, one data collection method and one data analysis method. The research results show that there are 63 empirical quantitative studies, 13 empirical qualitative



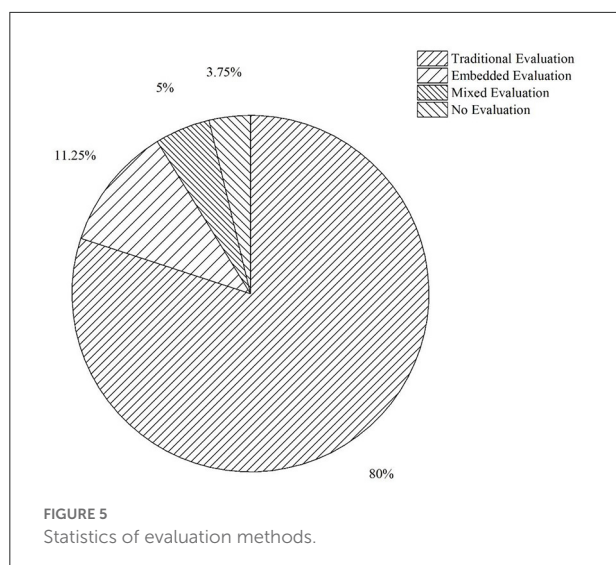
studies, 29 design-oriented studies, and 5 without methods in the literature studied. The data collection methods used in the research literature mainly include questionnaires, tests, interviews, observations and experiments. The main data collection methods are questionnaires ($n = 39$) and tests ($n = 39$). Semi-structured questionnaires are between structured questionnaires and unstructured questionnaires. The answers to the questions include both pre-set, fixed, and standard options types, as well as questions that the respondents can answer freely. Therefore, semi-structured questionnaires have the advantages of both structured and unstructured questionnaires, and such questionnaires are widely used in research surveys. In addition to questionnaires and tests, the data collection methods in some literatures are the interview method ($n = 8$) and the observation method ($n = 5$), most of which are used for qualitative research. The data analysis methods used in the research literature mainly include descriptive analysis ($n = 25$), difference analysis ($n = 57$) and correlation analysis ($n = 2$). Difference analysis mainly includes t -test, ANOVA, ANCOVA, chi-square test,

Mann-Whitney U -test and other analysis methods, correlation analysis methods include correlation coefficient, regression model, factor analysis and other methods. Among all the 57 articles that used the method of difference analysis, the t -test ($n = 24$) was the most commonly used method for quantitative data analysis, and the other analysis methods averaged only 10–12 articles. Most of these findings are that VR-generated interventions are positive and improve teachers' teaching effectiveness.

Discussion

Answer to questions

This paper organizes and analyzes the relevant literature on the application of VR technology in the field of higher education. The research results show that the main objects of VR application in the field of higher education are



undergraduates, and the majors of application are mainly related to science, engineering and medicine, history, art and others. Humanities and social science majors have relatively few applications. The main devices for VR applications in the field of higher education include computers, headsets, VR simulators, mobile phones and so on. Due to the development of technology, head-mounted devices have become the main equipment for VR applications in higher education. Because researchers are more inclined to use devices that are less expensive and more interactive, allowing users to be highly immersed in a virtual environment. Compared with traditional education, the vast majority of studies show that the application of VR to higher education and teaching has positive effects, mainly by affecting students' behaviors to affect students' learning results, secondly by affecting students' cognition, and finally by affecting students' learning. Affect students' emotional attitudes to affect students' learning results. Analysis of the reasons, due to the immersion and interactivity of the VR environment, VR is often used in higher operability courses in higher education, such as medical anatomy courses, dental and dental repair courses, machine tool operation training courses, and so on. In addition, scholars mainly use objective test questions and subjective questionnaires to evaluate the teaching effect of VR, and a small number of researchers use embedded evaluation to evaluate the teaching effect. The research results show that the main research method of the researchers to study VR application and higher education is quantitative research, the main data collection methods selected are questionnaires and tests, and most of the questionnaire surveys are mainly semi-structured questionnaires. The data analysis methods used in the research literature mainly include descriptive analysis and variance analysis. Among all 57 articles using variance analysis

methods, *t*-test is the most commonly used quantitative data analysis method.

Suggestions

Based on the relevant findings of this study, researchers put forward the following suggestions, hoping to provide some references for the application of VR in the field of higher education. First of all, VR is mainly applied to undergraduates in higher education, and the applied majors are mainly science, engineering and medical related majors. The application of history, art and other humanities and social science majors is relatively less, so researchers can turn their attention to the teaching of humanities and social science majors. It is hoped that future researchers will make full use of these advantages and deepen the application of VR in the overall field of higher education.

Secondly, it can be seen from the review results that the current VR related devices applied in the field of higher education are mainly computers and head-mounted displays. Compared with the past, the immersion and interaction of devices are improved, but there is still a lot of room for development. The portability of the device is not enough, and students cannot use the device to study anytime, anywhere. Mobile devices such as mobile phones, although portable, must be combined with other devices such as VR glasses to simulate the VR environment. The immersion and interaction of this VR environment will be greatly reduced, and it is expected that researchers in the future can break through the technical difficulties and solve this problem. Third, in the literature studied, only a few researchers have conducted VR training and teaching guidance for students before class. The lack of guidance will cause students to operate equipment irregularly and cause some unnecessary problems. First of all, if students do not receive relevant guidance in advance, they will aimlessly explore VR equipment in class, which not only wastes teaching time, but also has a negative impact on teaching effectiveness. In addition, the screen of the VR equipment covers most of the student's field of vision, and the immersion brought by the equipment is very strong, which is easy to cause 3D vertigo. Therefore, in the process of VR teaching, it is very necessary to provide training or guidance to students. Finally, most researchers need to develop, test, and continuously improve VR educational resources before applying them to teaching, which is time-consuming and labor-intensive. In the future, researchers can develop more professional and mature VR educational resources according to the teaching objectives of different majors in higher education, and directly apply them to the teaching of higher education, promoting the deep integration of the entire higher education teaching field and VR technology.

Limitations

Due to the nature of the review, selection, and filtering process, our work has several limitations. First of all, this paper does not deeply explore the application of VR technology to the various majors in higher education mentioned in the text, but only elaborates on the application of some representative majors. Secondly, this study does not focus on some obstacles when VR is applied in teaching, such as adverse reactions after students use VR equipment, and network conditions of VR equipment. But these obstacles are related to technology, and we believe that the development of technology will solve these problems soon.

Conclusion and future research

In this paper, the researchers focus on the application of VR technology in higher education. The teaching contexts, VR devices, teaching effects, and research methods used in the recent literature on educational VR applications are studied. The results of the review show that people are very interested in the application of VR technology in higher education. Many researchers believe that VR technology is a very useful teaching tool, and they have conducted many experimental studies. But the maturity of VR use in higher education is still uncertain, including the VR technology used and the teaching resources developed by educators. In addition, most researchers use VR technology to teach teaching practice, which also implies that VR technology is mostly used in higher operability majors. This paper also points out the problems and puts forward some suggestions. Our work will continue with an analysis of VR technologies available for higher education, followed by an in-depth survey of higher education workers to gain a more detailed understanding of the current state of adoption. Our goal is to deepen the application of VR in higher education.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

References

Alalwan, N., Cheng, L., Al-Samarraie, H., Yousef, R., Alzahrani, A. I., and Sarsam, S. M. (2020). Challenge and prospects of virtual reality and augmented reality utilization among primary school teachers: a developing country perspective. *Stud. Edu. Evaluat.* 66, 100876. doi: 10.1016/j.stueduc.2020.100876

Author contributions

XD and ZL contributed to conception and design of the study. XD organized the database, performed the statistical analysis, and wrote the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

Funding

This paper was supported by Fujian Province Educational Science Plan 2021 key special project for high-quality development of basic education, project name is Fujian Province Robot Education Application Research under the National Intelligent Manufacturing Industry Policy (Grant No. FJWTZD21-06). This paper was supported by 2022 Fujian Provincial Social Science Fund, project title is Research on the construction of foreign language teaching model based on educational robots (Grant No. FJ2022BF015).

Acknowledgments

We thank ZL for his guidance on the manuscript.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

- Chen, L. W., Tsai, J. P., Kao, Y. C., and Wu, Y. X. (2019). Investigating the learning performances between sequence-and context-based teaching designs for virtual reality (VR)-based machine tool operation training. *Comput. Appl. Eng. Edu.* 27, 1043–1063. doi: 10.1002/cae.22133
- Duarte, M. L., Santos, L. R., Júnior, J. G., and Peccin, M. S. (2020). Learning anatomy by virtual reality and augmented reality. A scope review. *Morphologie* 104, 254–266. doi: 10.1016/j.morpho.2020.08.004
- Dyer, E., Swartzlander, B. J., and Gugliucci, M. R. (2018). Using virtual reality in medical education to teach empathy. *J. Med. Library Assoc. JMLA* 106, 498. doi: 10.5195/jmla.2018.518
- Harrison, B., Oehmen, R., Robertson, A., Robertson, B., De Cruz, P., Khan, R., et al. (2017). “Through the eye of the master: the use of virtual reality in the teaching of surgical hand preparation,” in *2017 IEEE 5th International Conference on Serious Games and Applications for Health (SeGAH: IEEE)*. p. 1–6. doi: 10.1109/SeGAH.2017.7939269
- Hoffman, H., and Vu, D. (1997). Virtual reality: teaching tool of the twenty-first century?. *Acad. Med. J. Assoc. Am. Med. Colleges* 72, 1076–1081. doi: 10.1097/00001888-199712000-00018
- Huang, C. Y., Lou, S. J., Cheng, Y. M., and Chung, C. C. (2020). Research on teaching a welding implementation course assisted by sustainable virtual reality technology. *Sustainability* 12, 10044. doi: 10.3390/su122310044
- Jung, E. Y., Park, D. K., Lee, Y. H., Jo, H. S., Lim, Y. S., and Park, R. W. (2012). Evaluation of practical exercises using an intravenous simulator incorporating virtual reality and haptics device technologies. *Nurse Edu. Today* 32, 458–463. doi: 10.1016/j.nedt.2011.05.012
- Kader, S. N., Ng, W. B., Tan, S. W. L., and Fung, F. M. (2020). Building an interactive immersive virtual reality crime scene for future chemists to learn forensic science chemistry. *J. Chem. Edu.* 97, 2651–2656. doi: 10.1021/acs.jchemed.0c00817
- Krokos, E., Plaisant, C., and Varshney, A. (2019). Virtual memory palaces: immersion aids recall. *Virtual reality* 23, 1–15. doi: 10.1007/s10055-018-0346-3
- Moore, P. (1995). Learning and teaching in virtual worlds: implications of virtual reality for education. *Aust. J. Edu. Technol.* 11:92–102. doi: 10.14742/ajet.2078
- Mulla, M., Sharma, D., Moghul, M., Kailani, O., Dockery, J., Ayis, S., et al. (2012). Learning basic laparoscopic skills: a randomized controlled study comparing box trainer, virtual reality simulator, and mental training. *J. Surg. Edu.* 69, 190–195. doi: 10.1016/j.jsurg.2011.07.011
- Murbay, S., Chang, J. W. W., Yeung, S., and Neelakantan, P. (2020). Evaluation of the introduction of a dental virtual simulator on the performance of undergraduate dental students in the pre-clinical operative dentistry course. *Eur. J. Dental Edu.* 24, 5–16. doi: 10.1111/eje.12453
- Rogers, S. (2019). “Virtual reality: the learning aid of the 21st century” in *Secondary Virtual Reality: The Learning Aid of the 21st Century*, New York.
- Ryan, M. L. (2015). *Narrative as Virtual Reality 2: Revisiting Immersion and Interactivity in Literature and Electronic Media*. Baltimore: JHU press.
- Samosorn, A. B., Gilbert, G. E., Bauman, E. B., Khine, J., and McGonigle, D. (2020). Teaching airway insertion skills to nursing faculty and students using virtual reality: a pilot study. *Clin. Simulat. Nursing* 39, 18–26. doi: 10.1016/j.ecns.2019.10.004
- Shin, D. (2018). Empathy and embodied experience in virtual environment: To what extent can virtual reality stimulate empathy and embodied experience? *Comput. Hum. Behav.* 78, 64–73. doi: 10.1016/j.chb.2017.09.012
- Zackoff, M. W., Real, F. J., Sahay, R. D., Fei, L., Guiot, A., Lehmann, C., et al. (2020). Impact of an immersive virtual reality curriculum on medical students’ clinical assessment of infants with respiratory distress. *Pediatric Critical Care Med.* 21, 477–485. doi: 10.1097/PCC.0000000000000249



OPEN ACCESS

EDITED BY

Ana Luísa Rodrigues,
University of Lisbon,
Portugal

REVIEWED BY

Anna Friesel,
The European Association for Education in
Electrical and Information Engineering,
Denmark
David Fernando Novella Rodriguez,
University of Monterrey, Mexico

*CORRESPONDENCE

Luis C. Félix-Herrán
✉ lcfelix@tec.mx

SPECIALTY SECTION

This article was submitted to
Higher Education,
a section of the journal
Frontiers in Education

RECEIVED 19 August 2022

ACCEPTED 06 December 2022

PUBLISHED 09 January 2023

CITATION

Navarro-Durán D, Félix-Herrán LC,
Membrillo-Hernández J, Craig KC,
Ramírez-Cadena MJ and
Ramírez-Mendoza RA (2023) Active
learning to develop disciplinary
competencies related to automatic control
in engineering curricula using low cost
do-it-yourself didactic stations.
Front. Educ. 7:1022888.
doi: 10.3389/feduc.2022.1022888

COPYRIGHT

© 2023 Navarro-Durán, Félix-Herrán,
Membrillo-Hernández, Craig, Ramírez-
Cadena and Ramírez-Mendoza. This is an
open-access article distributed under the
terms of the [Creative Commons Attribution
License \(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use, distribution or
reproduction in other forums is permitted,
provided the original author(s) and the
copyright owner(s) are credited and that
the original publication in this journal is
cited, in accordance with accepted
academic practice. No use, distribution or
reproduction is permitted which does not
comply with these terms.

Active learning to develop disciplinary competencies related to automatic control in engineering curricula using low cost do-it-yourself didactic stations

David Navarro-Durán¹, Luis C. Félix-Herrán^{1*},
Jorge Membrillo-Hernández^{1,2}, Kevin C. Craig³,
Miguel J. Ramírez-Cadena¹ and Ricardo A. Ramírez-Mendoza¹

¹Tecnologico de Monterrey, School of Engineering and Sciences, Monterrey, Mexico, ²Institute for the Future of Education, Tecnológico de Monterrey, Monterrey, Mexico, ³School of Engineering and Applied Sciences, Hofstra University, Hempstead, NY, United States

Introduction: In general, in automatic control courses, the process of designing and testing a control system includes applying physical laws to model the system, working with virtual models, building one or various prototypes, and testing the control algorithms. However, in the industry, the approach must be more pragmatic because the design and implementation time must be shorter, and the success of the solution must be ensured.

Methods: Challenged with this problem, a black-box model from which data are generated turns into a convenient starting point to design and implement the automation, and this approach is addressed in this research. The herein proposal is the design and implementation of didactic stations and their application in undergraduate automatic control courses. In the context of active learning, by using the stations to identify the model's dynamics, and subsequently, design and implement an automatic system, students reinforce the theory and receive another stimulus for the development of competencies in automatic control.

Results: The didactic stations emulate those cases in the industry where the hardware is already working, and it is necessary to automate or improve some process following a practical approach. During the first phase, students, guided by professors, designed and implemented four electromechanical prototypes. The second phase was using the prototypes in the curricular courses Control Engineering and Computerized Control to implement and evaluate controllers. The research included a control group and an experimental group. The group using the stations had a higher final course average grade than the control group.

Discussion: The findings encourage the application of this type of approach to complement the teaching of automatic control, which could positively impact the professional performance of future control engineers.

KEYWORDS

educational innovation, active learning, problem based learning, competencies, automatic control systems

1. Introduction

In the industrial domain, it is common for a control engineer to improve the performance of a process or a system. In general, engineers have a working solution and it is needed to reduce the production time and/or improve the quality of what is produced through automation, partial or total, of the production system. As a restriction, moving from the current situation to the new version must be done in a short time to impact the production process as little as possible. What is the engineer going to do when challenged with this problem?

Unlike the academy, there is not enough time in the industry to follow the same approach regarding the design and implementation stages reviewed in automatic control courses. Although in the academy, a methodology is followed that includes modeling based on physical laws; simulation, possibly by the use of virtual prototypes; and the construction of a representative scale system to model, analyze, and test the control, in the industry, it is necessary to be pragmatic and agile. The hardware is already in place and available for work, so the challenge is to quickly apply the theory of control to automate the solution or achieve the requested performance. In this context, using teaching stations with ready-to-use hardware for solving a specific problem could help to develop a pragmatic approach relevant to professional life, while it motivates the ‘know-how’ in engineering students.

In educational institutions, active learning has proven its relevance because it focuses on developing analysis, synthesis, and evaluation skills through the effective participation of students. This learning strategy is based on scholars “doing/participating” instead of just “seeing and/or hearing,” and it demands an atmosphere that keeps students engaged, self-motivated, and eager to learn. Moreover, it requires one or more didactic techniques to implement the learning activities and achieve strategic outcomes (Bonwell and Eison, 1991). It is known that many didactic techniques can be deployed inside an active learning context, such as problem-based learning (PBL), project-oriented learning (POL), flipped classroom (FC), and collaborative learning (CL). Due to the cooperative use of workstations where there is a problem to be solved, the educational proposal presented herein takes the advantage of CL (Pardjono, 2016) and PBL (Mora et al., 2017) within the framework of active learning.

Collaborative learning (CL) is a didactic technique centered on learning through small groups. In CL, teams of students carry out learning sequences to acquire knowledge and develop competencies on certain content. This technique was conceived as a team of persons collaborating to learn a topic (Bonwell and Eison, 1991). Current CL strategies also include new ingredients such as the development of competencies, participants’ roles, evaluation proposals, and remote collaborative environments. In all cases, the basic idea is teamwork, where each member contributes and cooperates to achieve the learning outcomes, and team members are responsible for their learning (Pardjono, 2016). CL also considers that students share and discuss their findings as

part of the process to develop the competencies (Aldrin Menezes et al., 2021; Estriegana et al., 2021; Rafique et al., 2021).

Problem-based learning (PBL) is a didactic technique where small teams of students work on real problems and are guided by an instructor. The problem itself is the way to address the theoretical and procedural aspects. Some reported advantages of PBL are the acquisition of knowledge, the development of skills to solve real problems, being self-taught, and the identification of problems (Mora et al., 2017). In a PBL environment, students must have an active role during the entire learning process, from identifying and understanding the problem to proposing and evaluating potential solutions. Moreover, PBL is a didactic technique highly oriented to collaborative work (Mabley et al., 2019), to the development of competencies (Webster, 2022), and with a focus on scenarios related to real problems (Jaeger et al., 2021); thus, it has very relevant elements for the research work that is developed herein.

Experiments have been reported where active learning has been applied to improve skills in STEM, and the advantages and disadvantages have been also detected. For computational sciences, the development of Practical Active Learning Stations (PALS) has been reported to reduce the costs involved in active learning, which generally requires the use of equipment or workstations (Eickholt et al., 2017). Another reported experiment with classrooms equipped with low-cost PALs refers to having improved programming skills in introductory courses with performance measures of the course grades (Eickholt et al., 2021). Moreover, ways of equipping active learning with new tools have also been developed; for example, artificial intelligence (AI) algorithms guide the experiments carried out by students and trigger self-reflection and feedback (Yannier et al., 2020). These are some applications and improvements of this didactic approach that have been in use for decades (Renkl et al., 2002), and applying adequate didactic techniques with teaching stations could improve various aspects of the teaching–learning process (Hakimzadeh et al., 2011).

Automated control courses in undergraduate curricula are usually considered difficult and full of theory and complex classes. Moreover, it has been observed that the development of disciplinary competencies related to the analysis and design of automatic control systems is troublesome due to the extensive list of topics in the course. Besides, either most control theory courses do not consider practical work or the activities are limited to simulation assignments, so it is not possible to employ theory in real applications. In this context, the objective of laboratory activities is the implementation of control systems where theoretical tools are applied and verified.

To bring theory closer to practice, didactic stations have been used to implement active learning in automatic control courses. This could have arisen as a need to have practical experiences that favor the development of professional skills appreciated in the industrial field (Morales-Menendez and Chávez, 2006). Based on this idea, research results have been reported, such as low-cost stations where the airflow is controlled by means of PID and fuzzy

controllers (Pilatasig et al., 2019) or others for the development of automatic flight systems in aerospace systems (Castaldi and Mimmo, 2019). Stations are typically built with industrial components, such as controllers, and allow various control strategies to be tested for academic, research, or professional training purposes (Vásquez et al., 2019). The resources applied in these research efforts have been acquired functional and are ready to use, some of them are available at a considerable economic cost, and it is in this situation that an opportunity is observed to apply a different approach when using didactic stations.

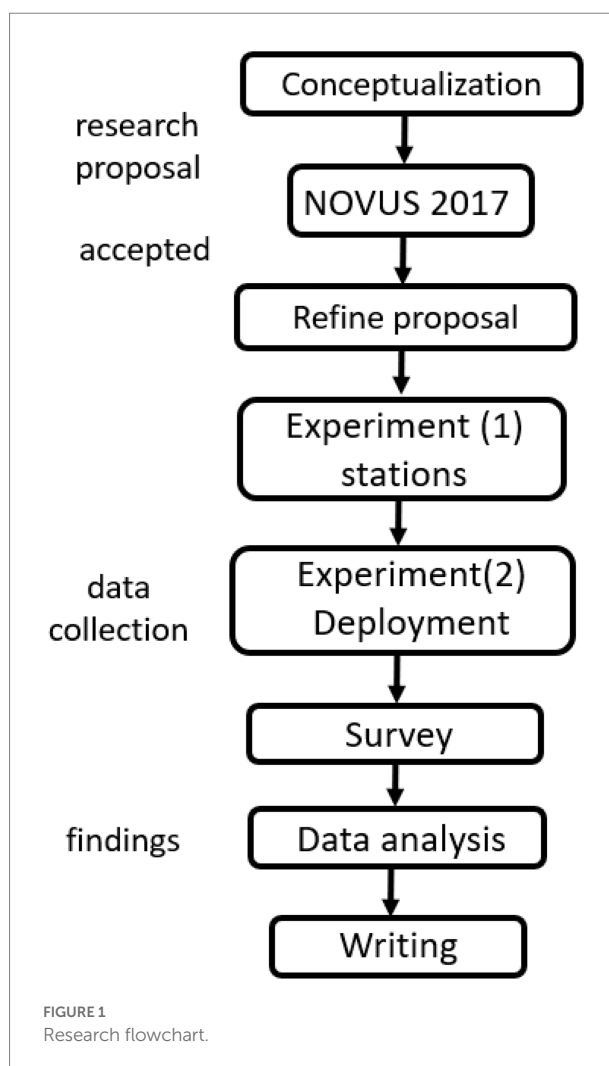
This research proposes the use of didactic stations in automatic control courses to emulate automation situations where the focus is to obtain a functional solution in a short time. In addition, the research includes a previous stage where students and teachers work as a team to design, build, and test the teaching stations. Then, the academic systems are employed in automatic control courses as a complement to theory and for the future implementation of industrial control systems. The investigation endeavor includes the application of a research methodology to give structure, support, and theoretical support to this work.

2. Materials and methods

2.1. Research methodology

This section develops the applied educational research methodology. The study considered the following guiding hypothesis: the implementation of different controllers on didactic stations within automated control courses (stimulus) contributes to reinforcing the developed competencies established for the course (response). Besides, the investigation included the following items: research methodology, data collection instruments, population selection, and research procedure. Furthermore, a mixed and sequential research methodology was considered (Gay et al., 2006). The flow of the research, from its conceptualization to the writing of the article, is presented in Figure 1. The flowchart depicts the actions carried out, in chronological order, throughout the entire research endeavor. Each milestone of the process will be explained in the following paragraphs.

As part of the methodology, it is important to define the objective pursued by the MR2004 Control Engineering and MR2007 Computerized Control courses. As established in the official curricula of the engineering bachelor Mechatronics Engineering, version 2011, at Tecnológico de Monterrey, after the completion of MR2004, students should be able to analyze, model, design, and evaluate closed-loop continuous control systems for analog processes, which achieve the desired performance according to specifications for regulatory control applications for products and processes (Tecnológico de Monterrey, 2022a); moreover, after the completion of MR2007, students should be able to analyze, implement, and evaluate the computerized product and process control systems with a focus on practical



application (Tecnológico de Monterrey, 2022b). These guidelines provide an accurate idea of what they are supposed to learn.

The first actions were conceptualization and focus on gathering financial resources. The problem statement, the guiding hypothesis, and an outline of the mixed-method research methodology that would be applied were clarified. As the research was going to require financial resources, an opportunity arose to participate in the 2017 NOVUS Educational Innovation Fund of the Tecnológico de Monterrey (NOVUS, 2022). NOVUS is an initiative to encourage educational innovation by professors within the Tecnológico de Monterrey.

There was a record that the program NOVUS had supported active learning projects and educational stations, so a proposal was generated with the requirements of the initiative and submitted. Previously supported proposals with didactic stations during automatic control are electromechanical equipment adapted to carry out practical activities in an undergraduate control course (Aguayo and Navarro, 2014), and the design and build of robotic manipulators as part of a challenge in which students developed disciplinary and transversal skills. These

manipulators, along with the manuals to build them, were used as a reference for students of other courses to develop them during the semester (Gutiérrez et al., 2014). The difference between these proposals is that now the students will be the ones who completely build the didactic stations from the prototypes, also generated by students during the August–December 2017 semester. The learning of the experimental groups includes the manufacture of the stations.

In the summer of 2017, the proposal was accepted by NOVUS, and feedback was received to improve the research. The next step was the design of the didactic stations, and this enterprise required the participation of students during part of 2017 and 2018. The participation of some students was a part of the course's activities, whereas others did it as an external activity not linked to educational credits. The equipment was purchased and stations were assembled and tested in open-loop and closed-loop; all this was part of the first stage of the experiment. The second part was carried out between 2018 and 2020, which consisted of using the stations in automatic control courses as part of the activities with weight in the grade of each course. This deployment of the experiment allowed the collection of data for quantitative analysis.

At the end of each course where the didactic stations were used, an anonymous survey was conducted on students to know their learning experience, their perception of using the stations, and the skills acquired, always considering the link between theory and practice. The data collected from these surveys were used for qualitative analysis, and together with the quantitative ones, they would lead to the research findings. The last step was the writing of the article to share the research effort and its results.

The participants are all the students and professors who were involved in the experiment. In the first part, students of the course MR2023 Automatic Control Laboratory designed and implemented the didactic stations, although, on another campus, the student's participation was not linked to any course of the curricula. In this phase, the professors served as guides during the design, implementation, and testing process.

There were two groups of populations for the deployment of the experiment: the reference group that worked with the traditional scheme and the experimental one that was impacted by educational innovation. The data were collected in two ways: quantitative (individual final exams) and qualitative (surveys). Moreover, the participants were the students of MR2004 Control Engineering and MR2007 Computerized Control at Tecnológico de Monterrey in Mexico City (CCM) and Hermosillo (CSN) campuses. The activities were implemented between 2018 and 2020. Furthermore, in CCM, individual final grades were used to generate a quantitative comparison between the base and experimental groups. The evaluations were of the same type and with a similar degree of difficulty, besides, the same teacher taught both groups (base and experimental).

The budget and human resources to build the stations impacted the development of the experiment. These elements have to be considered in the pedagogical context of the research methodology. The initial idea was to have more teaching stations

for more students, but the expected number of stations could not be built. In a certain way, this eventuality influenced the deployment of the experiment.

In education, it is very important to keep the educational programs updated and aligned with current society and industry requirements. For instance, Tecnológico de Monterrey is undergoing a change in the implementation of a new educational model, and comparative analysis of students with different didactic approaches is a relevant matter of study. The circumstances of the implementation of a new educational model allow this type of study that could be of great value for those researchers interested in educational strategies.

The next subsection explains how the research was divided into two stages: the design and construction of the prototypes and the application of the stations in the courses to collect the data. After gathering the data, statistical analyses were accomplished to obtain findings and to discuss their impact on the teaching–learning process.

2.2. Stage 1: Stations design and construction

The main objective is to develop didactic stations to enhance students' outcomes on the automatic control, and for this reason, the stations selected are a pneumatic levitator, a ball and beam, an inverted pendulum, and a propeller–arm system. According to the research, the stations were selected because of the low-cost materials to be built and the ease of implementing a control algorithm.

The design and construction of the first prototypes took place from January to May 2018 (JM-2018) semester. The professors involved in the project developed the first prototypes based on a Computer Assisted Design (CAD) model. A brief description of the function and control objective for each prototype is given in the next paragraph.

The pneumatic levitator of a tube is coupled to a blower fan, and in the center, there is a ball that can be raised due to the force of the air. The main control objective is to keep the ball in the position that the user indicates. The ball and beam consist of a beam that can modify its inclination and a sphere moves over it. Depending on the inclination, the control objective of this experiment is to maintain the sphere in the desired position only by moving the inclination of the bar. Furthermore, the inverted pendulum is an experiment with a pendulum that must be kept at the top, and this is achieved by placing a motor with a mechanism that allows it to swing the pendulum and reach the top position. In addition, the propeller–arm system consists of a propeller placed in a rotatory arm, and by increasing the speed of the motor; the propeller generates a force that can move the arm. The control objective of this experiment is to maintain the arm at a specified angle set by the user.

After developing the design models, a proper search of components was performed to build the first prototype of stations.

As shown in Figure 2, the result of the prototypes is presented. The ball and beam and the pneumatic levitator were developed in CCM, and the inverted pendulum and the propeller-arm system were developed in CSN. The prototypes were tested before implementation to validate the viability of course implementation, and the four prototypes were ready to perform tests on groups in the semester of August–December 2018 (AD-2018). So, in the next section, the deployment to apply the didactic stations in the courses on AD-2018 will be explained.

2.3. Stage 2: Stations implementation on courses

The stations were implemented on two campuses, Hermosillo and Mexico City, on the courses MR2004 Control engineering and MR2007 Computerized control. The didactic stations were assigned to teams with a maximum of three students to allow them to collaborate and use the stations. The experiment took place as follows: in the August–December 2018 (AD-2018) semester, there were two groups of MR2004 control engineering and one group of MR2007 computerized control, and all of them were imparted on CCM. In the semester of January–May 2019 (JM-2019), there were two groups of MR2004 and one group of MR2007 imparted on CCM, and in CSN, there was a group of MR2004. In the semester of August–December 2019 (AD-2019), there were two groups of MR2004 and one group of MR2007 imparted on CCM, and in CSN, there was a group of MR2007. Finally, in the intensive period of winter 2020 (W2020), which took place in January 2020, there was a group of MR2004 on CCM.

The way the experiment was deployed on the semesters and groups previously mentioned is as follows: the stations that were built on each campus could accommodate properly just one group at a time, and that is the reason there was one experimental group and one control group. For this study, it is of particular interest that the groups of MR2004 on CCM were imparted by the same teacher, and this means that the only difference was the stimulus of the didactic stations. In the case of the MR2007, there were alternating control groups on CCM and CSN, but the main difference was that different professors were teaching the course. The general working plan implemented in the experimental groups is presented in Figure 3. Notice that the didactic stations were submitted into a continuous improvement process, and that is the reason why there are three versions of the pneumatic levitation system in Figure 2C.

As it was mentioned on CCM that the course MR2004 was imparted by the same teacher, the only difference in those groups was the didactic stations. In the experiment, there were four periods in which the stations were implemented as is shown in Table 1. The total number of students in the experiment was 191, considering that 86 participated in the control group and 105 in the experimental group. Teamwork is essential in developing the didactic station applications, and for this reason, teams with a maximum of three

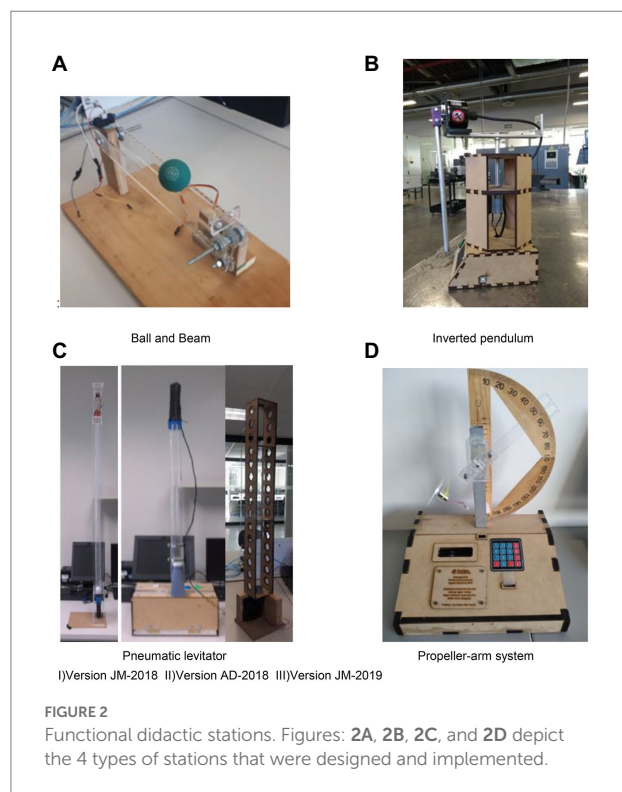


FIGURE 2

Functional didactic stations. Figures: 2A, 2B, 2C, and 2D depict the 4 types of stations that were designed and implemented.

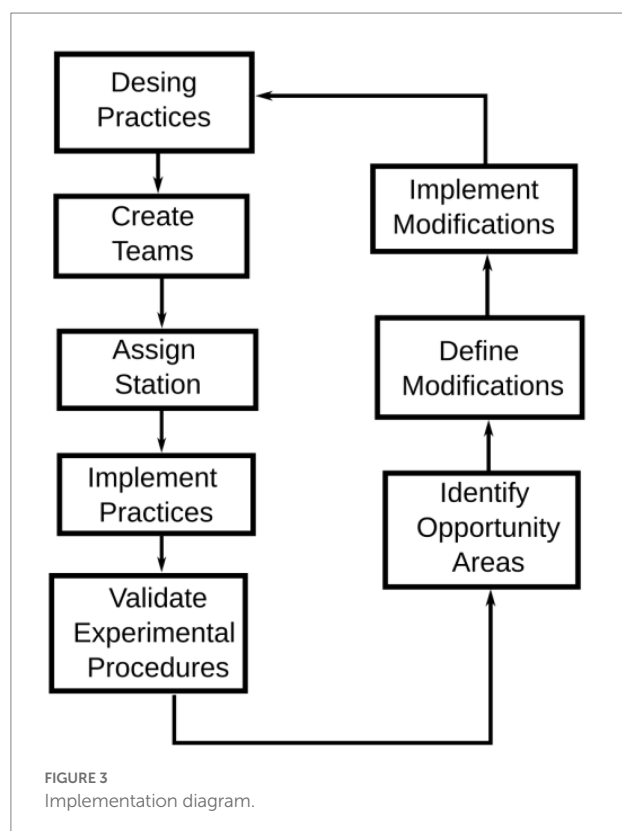


FIGURE 3

Implementation diagram.

students were assigned to work in each station. In some cases, the students prefer to work in couples, or, in some rare cases, the students work with the stations individually.

TABLE 1 Students in MR2004 courses.

Period	Control group	Experimental group
AD-2018	29	29
EM-2019	26	26
AD-2019	31	28
W2020	0	22

To implement the didactic stations, a planning process was developed in which the first step was to find the key concepts and topics to be implemented in the stations. After discussing with some colleagues who imparted automatic control systems, the common concepts to be implemented in the stations were as follows: (1) transient response, (2) open and close loop, (3) system identification, and (4) PID controller design and implementation. Based on these topics, there was a process to prepare the practices with the stations and relate the theoretical concepts.

In both courses, the methodology and the teaching process were the same. The only difference was that in the control group, there were only mathematical demonstrations and simulation analyses that were commonly developed on Matlab® and Simulink®; meanwhile, in the experimental group, the only difference was that it added the stimulus of the didactic stations as practices to reinforce the knowledge from the mathematical demonstrations and the simulation analysis. The practical activities that could be performed with the different stations and the matching of the topics are presented in Table 2. In all the courses, the topic was explained in the course and then it was reinforced by the activity using simulation stimuli such as Matlab® and Simulink®, and for the experimental group, it was added to the application of the didactic station. The learning process implemented in each group is presented in Figure 4. It is important to mention that at the end of each topic, the student received feedback for the simulation or validation of the concepts in the didactic stations.

Some of the topics cannot be applied directly to many stations, for example, transient response, system identification, and Ziegler–Nichol’s method are not appropriate for the ball and beam, propeller and arm, and inverted pendulum. As an example, the implementation of the different topics can be achieved in a single station that is the pneumatic levitation system. A system identification using a frequency response can be performed using different sinusoidal inputs to obtain a linear behavior of the system according to the restrictions mentioned by Escano et al. (2005). As is presented in Escano et al. (2005), the pneumatic levitation system is a complex model, but with proper considerations, a linear system can be set to several equilibrium points. Using the results presented in Escano et al. (2005), it is possible to simplify the dynamics of the system and use the fourth-order linear system, which gives a pair of dominant complex conjugate zeros that cause some oscillations. Also using this kind of identification, a Ziegler–Nichol’s using the transfer function that simplifies the model and with the transfer function, it is possible to develop some controllers that allow control of the

pneumatic levitation system, considering the restrictions imposed by linearizing the system.

In the case of the other stations, it is possible to implement different methodologies to develop a controller but it depends on the characteristics of the system. The main idea is that with the whole set of stations; the student can get a practical approach to designing and implementing different controllers in the system.

Following the explanation of the methodology in Table 2 and Figure 4, experimental data were gathered from each semester and stored in files for further analysis and using the data collected, statistical analysis was performed to convert the data into valuable information for this research. The findings and the data provided will be discussed in more detail in the next section and the discussion.

3. Results

In this section, the results obtained from the implementation of the didactic stations on the courses MR2004 control engineering and MR2007 computerized control are presented. The period considered in the study is three semesters AD-2018, JM-2019, and AD-2019. In each course, there was an experimental group that used the didactic stations and a control group that was taught in a traditional classroom.

It should be noted that a traditional Control Engineering or Computerized Control course is usually 100% theoretical. Due to the large number of topics to be studied, these courses focus on reviewing the theory and the procedures to follow to solve examples and exercises on paper or, in the best of cases, with the support of simulators. The practical work as a means to reinforce the theory is applied until the laboratory course MR3029 Integral Automatic Control Laboratory (Tecnológico de Monterrey, 2022c).

The results are divided into quantitative results involving the performance of the student measured with the final score, qualitative results measured by a survey the students answered, and finally, the results from an external institution called Centro Nacional de Evaluación para la Educación Superior (CENEVAL in Spanish) are presented to support the results on the study.

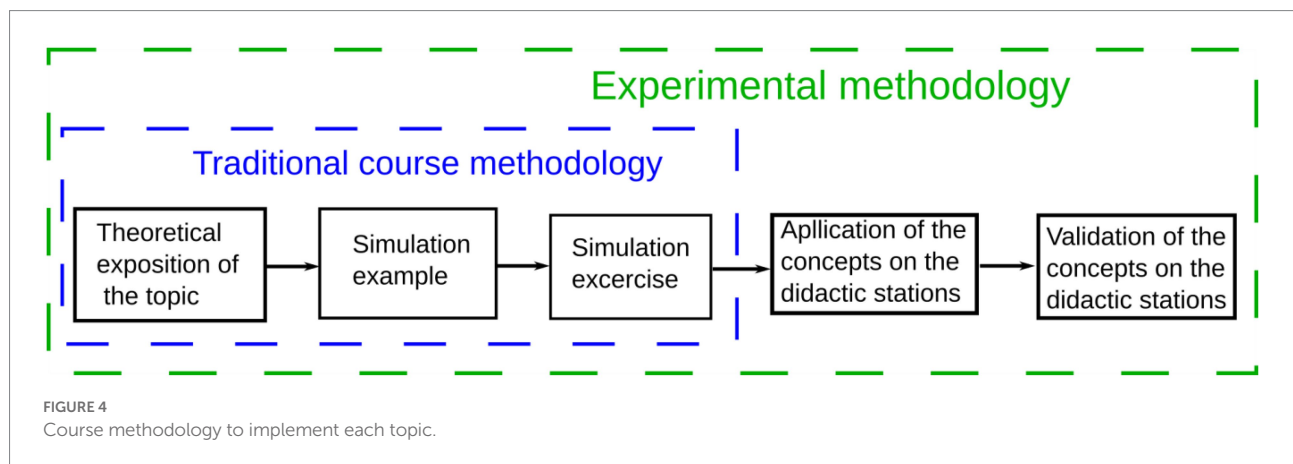
3.1. Quantitative results: Course grades

The final score of the course was used as the instrument to measure the impact of the application of the didactic stations. It was considered that the final score was a consequence of using the stations to develop the disciplinary competencies of the students. The most significant scenario is presented in the course MR2004 control engineering in CCM, in which the same professor was teaching both groups, the experimental and the control group. This means that the only difference was the implementation of the didactic stations as a stimulus for the student’s performance.

This study involved seven groups in which 191 students participated, 105 students were impacted by the implementation

TABLE 2 Activities comparison.

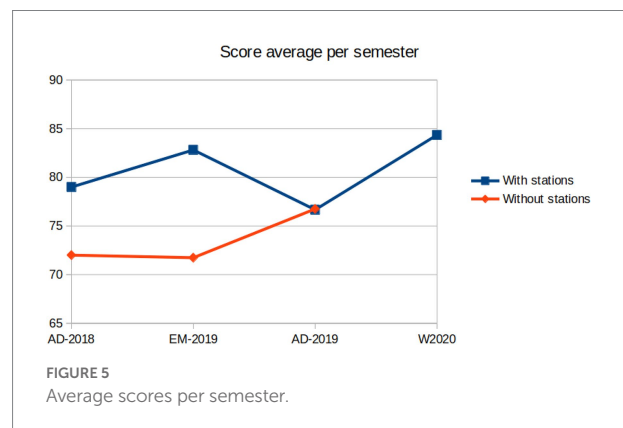
Topic	Control group activity	Experimental group activity
Transient response	Simulation of first and second order systems	Obtain the transient response from the didactic stations
Open and close loop	Simulate open and closed loop systems and compare performance.	Implement an open loop response and compare it to the close loop with proportional gain on the didactic stations
System identification	Obtain the model of a Blackbox model from a Simulink® simulation	Measure input and output from the didactic station and perform system identification with the data.
PID controller design	Design of a PID controller by Ziegler-Nichol's method and root locus design on simulation	Design a PID controller using Ziegler-Nichol's method and root locus to be applied to the didactic stations
PID controller implementation	Implement on simulation a PID controller to evaluate the system performance.	Implement on the didactic stations a PID controller to evaluate the system performance.



of the didactic stations in the experimental group, and 86 students participated in the traditional learning experience in the control group. The experiment took place in the semesters AD-2018, EM-2019, and AD-2019 in which there were two groups, one group was the control group and the other an experimental group, with the same professor. A winter course in 2020 (W-2020) implemented the didactic stations, but in such a period, there was no control group for comparison.

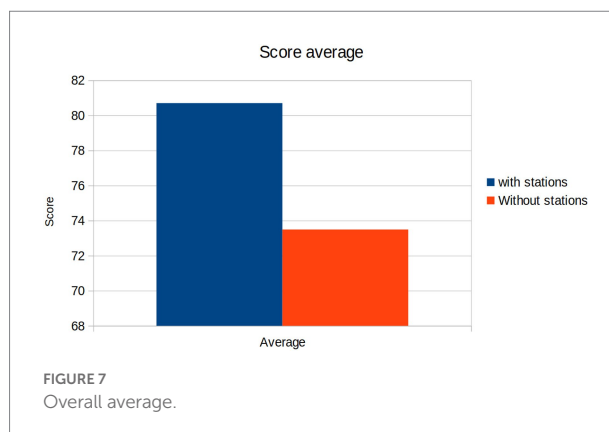
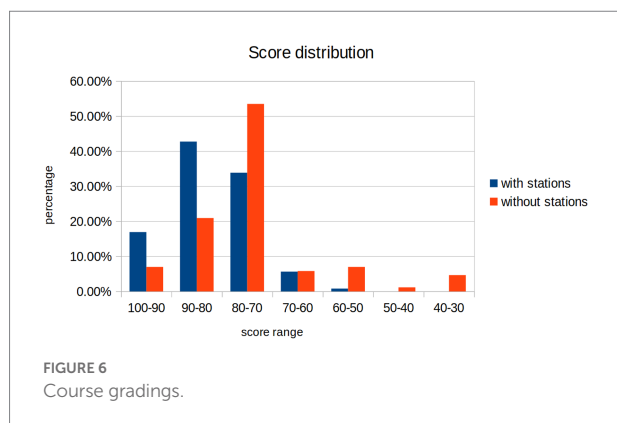
In Figure 5, the average of the final score obtained by each group is presented. Notice that the results from the semesters AD-2018 and JM-2019 obtained better scores in the groups with the stimulus of the stations. Moreover, in the case of the semester AD-2019, the result is almost the same with or without the stations. In the winter course 2020, there was only the experimental group, and it can be observed in Figure 5 that the average obtained by the group increased significantly up to a score of 85. From the overall perspective, the results mainly presented that the students developed and implemented control systems more efficiently with the didactic stations.

In Figure 6, the grading is presented on the different ranges obtained by the students at the end of the courses. As can be seen, the students with better performances in the course are the ones in whom the didactic stations were implemented. On one hand, the highest frequency with didactic stations is in the range from 90 to 80, with 42.74% of students, on the other hand, without



didactic stations, the highest frequency is presented in the grading range from 80 to 70 representing the 53.49% of the students.

Also, from Figure 6, it can be noticed that the students with the stimulus of the didactic stations fail the course with better notes, almost ranging from 70 to 60. But that is not the case without stations in which there are students that obtained grades lower than 50. It is important to point out that the failing percentage without the didactic stations is 18.6%. The stations helped the students develop disciplinary competencies, and as a result, the failing percentage is reduced significantly to 6.45%. This



is another effect of the practical implementation of control systems, and it is presented that if the competencies of a course are developed, the result on academic performance will be improved, as the previous results demonstrate.

Figure 7 presents the overall average of the courses, considering the AD-2018, EM-2019, AD-2019, and W2020 courses. Notice that the average using the didactic stations is 80.707 and without the stations, it is 73.495, this means that a difference of 7.212 points is present, and consequently, it is possible to conclude that the application of the theoretical concepts to a practical application improves the knowledge and development of the skills the students will require.

Over the different results obtained by the application of the stations in the group, it was noticed that the standard deviation was higher in the control group than in the experimental group. It can be noticed in Table 3 that the standard deviation of the experimental groups is lower than 9, but on the other hand, the standard deviation of the control group is higher than 10. It is important to note that the grades are not only higher with the didactic stations, but the standard deviation is also another parameter that allows measuring the performances of the student, showing that the differences are lower in students with the use of didactic stations than in the students without the use of the didactic stations.

3.2. Qualitative results: Student survey

The qualitative results were obtained with a survey answered by the students that used the didactic stations. The survey included the following questions “The use of didactic stations helped to relate theory to practice,” “A control system with moving parts reinforces the understanding of the following concepts: reference, process variable, error and manipulation,” “In alignment with the intention of the course described in the syllabus, it is preferable to work with ready-to-use didactic stations, instead of building them in the classroom,” and “The didactic stations cover everything necessary for the proposed practices and practically do not have areas of opportunity.” The survey included seven items, and this

inquiry gathered information from the four closed questions to be responded to on the Likert scale.

The survey was intended to obtain information about the student perception of the stations and the benefits obtained by using them in the course. In this study, 77 students from the AD-2019 semester answered the survey, of which 70.1% were from the Mexico City campus and 29.9% were from the Hermosillo campus. A total of 80.5% of students were on the MR2004 control engineering course and 19.5% on the MR2007 course. The result of each one of the questions will be explained according to the corresponding graphic.

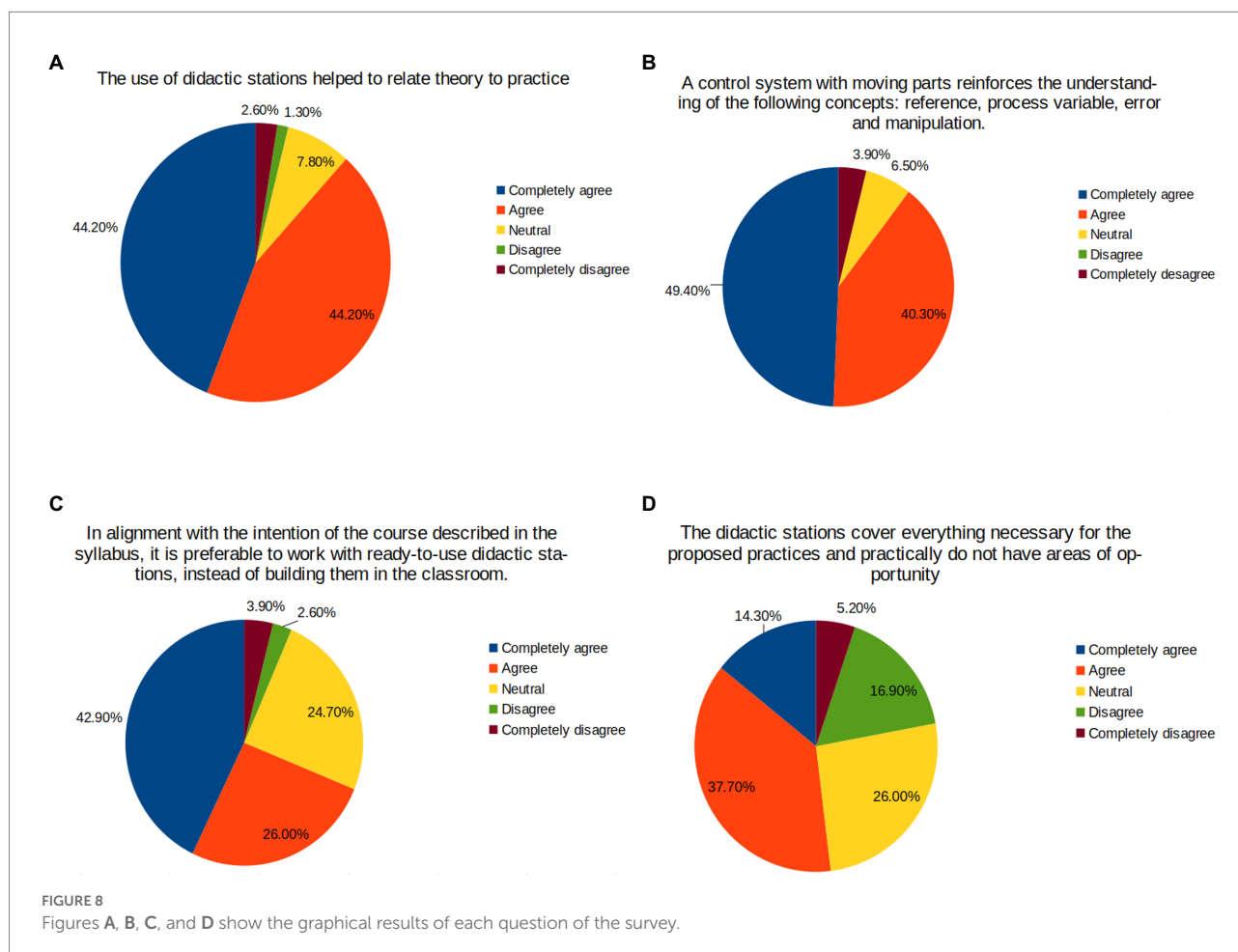
Figure 8A presents the result to the question “The use of didactic stations helped to relate theory to practice.” As can be observed, 88.4% of the students who participated in the survey agree and completely agree with the fact that the application of the concepts to a practical case of study helps them to understand the practical application of the theoretical concepts. It can be found that 7.8% maintain a neutral posture and 3.9% did not find any relation between theory and practice.

In Figure 8B, the question explored the perception of the students to basic concepts in control engineering such as reference, process variable, error, and manipulation. From Figure 8B, it can be noticed that 89.7% of the students agree that the didactic stations help them to understand the basic concepts, 6.5% maintain a neutral posture, and 3.9% completely disagree. As it can be observed, a major part of the students perceived they had a better understanding of the basic concepts because of the implementation of the didactic stations.

In Figure 8C, the question measured the perception of the student of using a prebuilt station or developing their own on the course. As can be seen in Figure 8C, 68.9% of the students agree that it is better to work in a ready-to-use didactic station. The other 24.7% presented a neutral attitude and 6.5% disagreed that it is better to use a prebuilt station than to build their own. It can be observed that the majority of the students prefer to work directly in a didactic station and avoid the design process; this helps the student focus on the control engineering concepts instead of the mechanical and electrical concepts required to build the prototype.

TABLE 3 Standard deviation per academic period.

Period	AD-18 Control	AD-18 Experimental	JM-19 control	JM-19 Experimental	AD-19 control	AD-19 Experimental	W-2020
Standard deviation	14.21	8.91	13.85	6.64	10.96	7.54	7.16



Finally, [Figure 8D](#) presents the result of how the students perceived the stations, considering if there are any areas of opportunity. In this case, there was more dispersion in the results than in the previous questions. As can be seen, 52% of the students agree that the stations satisfy the basic needs and are ready for testing; 26% present a neutral position, considering that neither the stations are ready nor do they have opportunity areas; 22.1% disagree that the didactic stations cover the necessary aspects to be implemented in the courses. It is understandable that the stations can be upgraded for better performance and better user experience.

Overall, the quantitative and qualitative results present that the use of the didactic stations had a positive impact on student performance in the course. As can be seen, the implementation of the different concepts and the practical application of controllers

to the black-box model prepare the students for the challenges they will be facing in the industry.

3.3. CENEVAL-EGEL exam for mechatronics engineering

The Centro Nacional de Evaluación para la Educación Superior (CENEVAL in Spanish) is a non-profit Mexican association that performs as an Evaluation Center for Higher Education. The CENEVAL does not depend on any educational institution and is focused on designing and applying evaluation instruments in high school and bachelor education ([CENEVAL, 2022](#)). The General Examination for Bachelor's Degree (EGEL in Spanish), designed and applied by CENEVAL, is an exit

examination that students take in the last semester of their degree and is applied in many universities in Mexico. The purpose of the exam is to measure the student's performance in work-life situations, i.e., measure to some degree if the future graduates have the required competencies to successfully start their professional life. Despite being a paper test, the exam items are focused on making decisions in real scenarios.

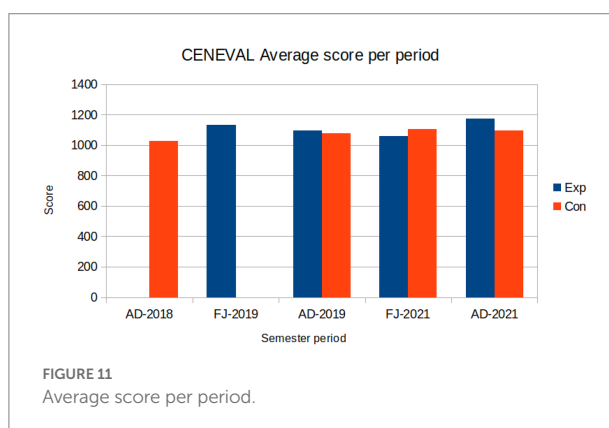
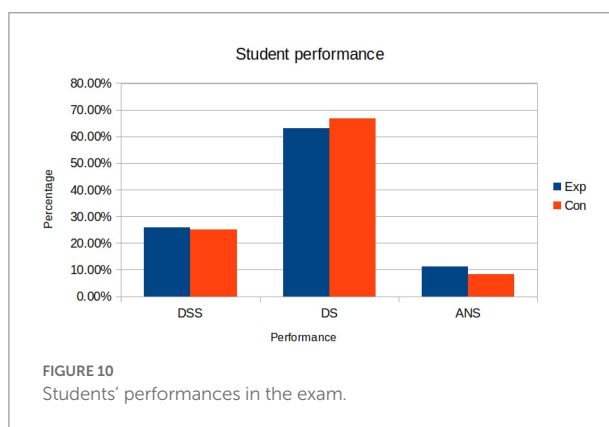
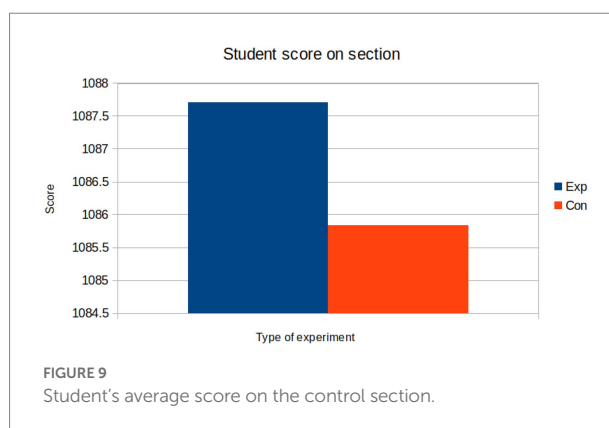
The CENEVAL-EGEL exam for Mechatronics Engineering, which is considered in this study, is made up of the following sections and subsections in parentheses: Integration of technologies for mechatronic design (Technologies for the solution of a mechatronic problem and Design of mechatronic models and prototypes), Systems automation (Instrumentation and supervision of systems and Industrial control), and Development and coordination of mechatronic projects (Project research methodology, mechatronics and technological innovation, Coordination of mechatronics projects, and Evaluation of mechatronics projects; EGEL, 2022).

For more than a decade and without interruption, the students of the academic program of Mechatronics Engineering at Tecnológico de Monterrey have taken the CENEVAL-EGEL exam, and for the purpose of this experiment, it was used as an instrument to collect quantitative data. The students who participated in the control or experimental groups for this research took the CENEVAL-EGEL exam in one of the applications between December 2018 and December 2019 and the application in 2021.

Of the 191 students who participated in the experiment, only 39 graduated in the period that the CENEVAL-EGEL exam was presented. The reason is that many of the students graduated in 2020, and due to the restrictions of the pandemic, the CENEVAL-EGEL was suspended. Of the 39 students who presented the exam, there were 27 students in the experimental groups and 12 in the control groups. From the CENEVAL sections, this study considers the section "Systems Automation" in which the automatic control theory is evaluated. The average obtained by those students can be observed in Figure 9. Notice that the average from the experimental group is slightly higher than the control group by 1.87 points.

The EGEL-CENEVAL presents three different performance results: outstanding development (DSS) is obtained by a student with 1,150–1,300 points, satisfactory development (DS) is obtained by a student with a score from 1,000 to 1,149, and not satisfactory yet (ANS) is obtained with a score from 700 to 999 points. In Figure 10, it can be observed that the results from the DSS are higher in the experimental groups than in the control group. But the results in the control groups are higher in DS development. In the ANS performance, the students in the experimental group present three students failing the exam compared to the control group which corresponds to one student.

Figure 11 presents the average score obtained by the students in each period. Notice that in the AD-2018 and FJ-2019, only one student from the control group and two from the experimental



group presented the exam, but the student who presented in the experimental group obtained a better score. In the subsequent semesters, both the control and experimental group presented the exam, and it can be noticed that in almost all the periods, the results from the students in the control groups are higher than the ones in the experimental group.

The results presented in this subsection are preliminary because, from the sample of 191 students in the experiment, only 39 presented the exam. It is important to mention that from those 39 students who presented EGEL CENEVAL, 12 students were in the control group and 27 in the experimental group. Of the whole

population involved in the experiment, only 20.41% of students presented the EGEL CENEVAL. Considering that 13.95% of the students in the control group presented the CENEVAL exam and 25.71% of the students presented the CENEVAL exam in the experimental group, the first result on the impact of implementing the didactic stations on the course is presented. It presents that the didactic stations help the students to retain knowledge and get a better comprehension of the theoretical content. Moreover, a more balanced sample between control and experimental groups will provide solid results. To complement these results, it is important to continue experimenting according to the methodology previously proposed to get more information on the outcome skills the students get at the end of their bachelor studies.

4. Discussion

In the results section, the quantitative and qualitative results obtained by analyzing the final score and the survey the students answered are presented. It can be concluded that the didactic stations are proper support to teach control engineering subjects, even though the stations have opportunity areas to be improved. In addition, students' perceptions support that the active learning obtained by the implementation of the controllers and concepts on the stations allows them to understand and develop the necessary skills.

As can be observed, the quantitative results support the fact that the didactic stations help the students obtain better grades. This event is a consequence of the active learning experience that supports the practical application of the concepts and the required procedures to implement a controller so that students can have a better understanding of the theory. It can be observed in Figure 5 that all the grades from the experimental groups were moved to a higher grading, and the control groups obtained poor grades at the end of the course. Another important consequence is that the failing percentage with the didactic stations is reduced to one-third compared to that without the didactic stations. Due to the good approach obtained in the final grade by the students, it would be important to evaluate the previous knowledge as an important factor for the success of the course and not only the final grade.

The quantitative results present the perception of the professor on the implementation of the didactic stations, but it is also important to consider the students' viewpoints. The qualitative results obtained from the survey examine the students' opinions, and this makes the research study more valuable. As presented in the result section, the survey consisted of four questions in which it was presented that the students feel more confident about the control concepts because of the practical application in the station. Considering the reinforcement of the basic concepts and the practice and theory relationship, more than 85% of the respondents demonstrate that active learning combined with the PBL presented a positive impact on their learning process.

With the qualitative results, the station's readiness was evaluated. From the perception of the students, it is shown that it is better to use a prebuilt station instead of developing the whole

system. It is commonly observed that if the system or station is built on the course alongside the control implementation, not in all cases, the control theory is applied to the prototype. The other aspect that is important to resemble is although the stations are student-based models, they satisfy almost all the requirements needed to implement a controller. In some cases, the stations require some components that students must give to implement the controller and let the stations work properly, such as motor drives or programmable microcontrollers.

The COVID-19 pandemic had a negative impact on the experience. Of the universe of participants, those who graduated in June 2020 and December 2020 did not take the CENEVAL-EGEL exam because the assessment was suspended nationwide in 2020. These data could not be collected, which would have reinforced the results presented in Figures 9–11 when comparing the performance in the CENEVAL-EGEL exam.

It is considered to continue applying the experiment and keep updating the activities deployment. To have more reliable results, it is necessary to continue collecting data and generating comparative grade results for more semesters. This would reinforce the trends of average score per semester, score grading distribution comparative, and overall average presented in Figures 5–7. Furthermore, as part of the continuous improvement process, it is necessary to check that the deployment of activities continues to be adequate for the teaching–learning environment after the COVID-19 pandemic.

In future works, the process of continuous improvement of the didactic stations will be presented. There is an interest in working with the feedback provided by the students and detecting opportunity areas to improve the prototypes. In addition, the findings would be reinforced with those expected to be collected in AD2022 to further identify result behaviors over time. It is likely that a trend will be detected, and the hypothesis reaffirmed or refuted, etc.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study involving human participants in accordance with the local legislation and institutional requirements. Written informed consent to participate in this study was not required from the participants in accordance with the national legislation and the institutional requirements.

Author contributions

DN-D and LF-H contributed to the conception and design the didactic stations. LF-H, KC, JM-H, and RR-M participated on the

methodology used to implement the experiment. DN-D, MR-C, and RR-M participated in validating the experiment. MR-C and D-ND participated in implementing the experiment and the data collection and data analysis. JM-H and LF-H participated on the research proposal. LF-H, KC, JM-H, and DN-D participated on writing the original draft. MR-C and RR-M reviewed and edited the paper. All authors contributed to the article and approved the submitted version.

Acknowledgments

The authors first thank José de Jesús Barajas Cid for having participated as leader of the NOVUS proposal at the start of the project. They also thank all the students who participated in the design and implementation of the didactic stations. In CCM, the authors are grateful to the Mechatronics students of the MR3029 class of the EM2018 semester and to the students who participated in the improvement of the stations in the AD2018 and EM2019 semesters. In CSN, the authors extend their thanks to the five mechatronic students who carried out their scholarship service in these activities. Thank you all for being part of this educational innovation project. Furthermore, The authors wish to acknowledge

the financial and technical support of the Writing Lab, Institute for the Future of Education, Tecnológico de Monterrey, Mexico, in the production of this work. Besides, The authors acknowledge the financial support of Novus Grant with PEP No. PHHT032-17CX00009, TecLabs, Tecnológico de Monterrey, Mexico, in the production of this work.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

- Aguayo, E., and Navarro, M. (2014). "Adaptación de un equipo electromecánico para la enseñanza de Ingeniería de Control Automático (in Spanish)." in Proceedings of 3rd International Congress Education Innovation (CIEE). Available at: https://www.editorialdigitaltec.com/materialadicional/Reportedeavanceeninnovacioneducativa_2014.pdf (Accessed February 20, 2017).
- Aldrin Menezes, F., Rodrigues, R. L., and Kanchan, D. S. (2021). Impact of collaborative learning in electrical engineering education. *J. Eng. Educ. Transf.* 34, 116–120. doi: 10.16920/jeet/2021/v34i0/157117
- Bonwell, C., and Eison, J. (1991). Active learning: Creating excitement in the classroom. Washington, USA: ASHE-ERIC Higher Education Reports, ERIC Clearinghouse on Higher Education.
- Castaldi, P., and Mimmo, N. (2019). An experience of project based learning in aerospace engineering. *IFAC Papers* 52, 484–489. doi: 10.1016/j.ifacol.2019.11.290
- CENEVAL (2022). Centro Nacional de Evaluación para la Educación Superior (website in Spanish). Available at: <https://ceneval.edu.mx/> (Accessed July 31, 2022).
- EGEL (2022). Exámenes Generales Para el Egreso de la Licenciatura (website in Spanish). Available at: <https://ceneval.edu.mx/instituciones-egel/> (Accessed July 31, 2022).
- Eickholt, J., Johnson, M. R., and Seeling, P. (2021). Practical active learning stations to transform existing learning environments into flexible, active learning classrooms. *IEEE Trans. Educ.* 64, 95–102. doi: 10.1109/TE.2020.3009919
- Eickholt, J., Roush, J., Seeling, P., Vedantham, T., and Johnson, M. (2017). "Supporting active learning through commodity and open source solutions." Proceedings. Frontiers in Education Conference (FIE), 1–5.
- Escano, J. M., Ortega, M. G., and Rubio, F. R. (2005). "Position control of a pneumatic levitation system" in 2005 IEEE Conference on Emerging Technologies and Factory Automation. pp. 6–528.
- Estrigiana, R., Medina-Merodio, J.-A., Robina-Ramírez, R., and Barchino, R. (2021). Analysis of cooperative skills development through relational coordination in a gamified online learning environment. *Electronics* 10:2032. doi: 10.3390/electronics10162032
- Gay, L.R., Mills, G.E., and Airasian, P. (2006). *Educational Research: Competencies for Analysis and Applications*. Columbus, USA: Merrill Prentice Hall.
- Gutiérrez, J., Arzate, O., Elias, M., Alencastre, M., Muñoz, L., and Maqueo, M. (2014). Manipuladores robóticos e interfaces humano máquina accionados mediante músculos artificiales y sensores externos (in Spanish). Proceedings 3rd International Congress Educational Innovation CIEE. Available at: https://www.editorialdigitaltec.com/materialadicional/Reportedeavanceeninnovacioneducativa_2014.pdf (Accessed February 20, 2017).
- Hakimzadeh, H., Adaikkalavan, R., and Batzinger, R. (2011). Successful implementation of an active learning laboratory in computer science. *Proc. Ann. ACM SIGUCCS Conf. User Serv.*, 83–86. doi: 10.1145/2070364.2070386
- Jaeger, M., Nagimova, A., and Adair, D. (2021). Perspectives on engineering competencies and competency development approaches—early-career engineers versus managers of engineers. *Int. J. Eng. Educ.* 37, 769–784.
- Mabley, S., Ventura-Medina, E., and Anderson, A. (2019). I'm lost—a qualitative analysis of student teams' strategies during their first experience in problem-based learning. *Eur. J. Eng. Educ.* 45, 329–348. doi: 10.1080/03043797.2019.1646709
- Mora, C. E., Añorbe, B., González, A., Gutiérrez, J., and Jones, B. (2017). Motivational factors to consider when introducing problem-based learning in engineering education courses. *Int. J. Eng. Educ.* 33, 1000–1017.
- Morales-Menendez, R., and Chávez, I. Y. S. (2006). Experimental process control education. *IFAC Proc.* 39, 410–415. doi: 10.3182/20060621-3-ES-2905.00071
- NOVUS (2022). Educational Innovation. Tecnológico de Monterrey. Available at: <https://novus.tec.mx/en> (Accessed May 07, 2022).
- Pardjono, P. (2016). Active learning: the Dewey, Piaget, Vygotsky, and constructivist theory perspectives. *Psychol. J. Ilmu Pendidikan* 9, 163–178. doi: 10.17977/jip.v9i3.487
- Pilatasig, M., Chacon, G., Tapia, V., Silva, F., and Acurio, A. (2019). Airflow station controlled by PID and fuzzy controllers using a low cost card for didactic uses in controllers' evaluation. *IMCIC Int. Multi-Conf. Complex Info. Cyber.* 2, 72–76.
- Rafique, A., Salman Khan, M., Hasan Jamal, M., Tasadduq, M., Rustam, F., Lee, E., et al. (2021). Integrating learning analytics and collaborative learning for improving Student's academic performance. *IEEE Access* 9, 167812–167826. doi: 10.1109/ACCESS.2021.3135309
- Renkl, A., Atkinson, R. K., Maier, U. H., and Staley, R. (2002). From example study to problem solving: smooth transitions help learning. *J. Exp. Educ.* 70, 293–315. doi: 10.1080/00220790209599510
- Tecnológico de Monterrey (2022a). MR2004 control engineering syllabus. Available at: https://drive.google.com/file/d/16F_7hTPZJlfWvyMJPFDhs33MQ9kPk7wL/view?usp=sharing (Accessed October 09, 2022).
- Tecnológico de Monterrey (2022b). MR2007 computerized control syllabus. Available at: https://drive.google.com/file/d/1Spte0s_t3zYT10IEGtB-AIKDjQ9J53OA/view?usp=sharing (Accessed October 09, 2022).

Tecnológico de Monterrey (2022c). MR3029 integral automatic control laboratory syllabus. Available at: <https://drive.google.com/file/d/16bcHYqgYFuZrHLfHPmvbrBZRgoFy6tv1/view?usp=sharing> (Accessed October 09, 2022).

Vásquez, R. E., Castrillón, F., Rúa, S., Posada, N. L., and Zuluaga, C. A. (2019). Curriculum change for graduate-level control engineering education at the Universidad Pontificia Bolivariana. *IFAC Papers* 52, 306–311. doi: 10.1016/j.ifacol.2019.08.225

Webster, R. (2022). Exploring engineering technology students' competencies in an introductory computer-aided drafting and design course: a follow-on study. *J. Technol. Manag. Appl. Eng.* 38, 1–16.

Yannier, N., Hudson, S. E., and Koedinger, K. R. (2020). Active learning is about more than hands-on: a mixed-reality AI system to support STEM education. *Int. J. Artif. Intell. Educ.* 30, 74–96. doi: 10.1007/s40593-020-00194-3



OPEN ACCESS

EDITED BY

Ana Luísa Rodrigues,
University of Lisbon,
Portugal

REVIEWED BY

Wahyu Hidayat,
Institut Keguruan dan Ilmu Pendidikan
Siliwangi,
Indonesia
Widodo Winarso,
Institut Agama Islam Negeri Syekh
Nurjati Cirebon,
Indonesia

*CORRESPONDENCE

Héctor Galindo-Domínguez
✉ hector.galindo@ehu.eus

SPECIALTY SECTION

This article was submitted to
Higher Education,
a section of the journal
Frontiers in Education

RECEIVED 22 December 2022

ACCEPTED 27 January 2023

PUBLISHED 14 February 2023

CITATION

Galindo-Domínguez H, Bezanilla M-J,
Campo L, Fernández-Nogueira D and
Poblete M (2023) A teachers' based approach
to assessing the perception of critical thinking
in Education university students based on their
age and gender.
Front. Educ. 8:1127705.
doi: 10.3389/feduc.2023.1127705

COPYRIGHT

© 2023 Galindo-Domínguez, Bezanilla,
Campo, Fernández-Nogueira and Poblete. This
is an open-access article distributed under the
terms of the [Creative Commons Attribution
License \(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use, distribution or
reproduction in other forums is permitted,
provided the original author(s) and the
copyright owner(s) are credited and that the
original publication in this journal is cited, in
accordance with accepted academic practice.
No use, distribution or reproduction is
permitted which does not comply with these
terms.

A teachers' based approach to assessing the perception of critical thinking in Education university students based on their age and gender

Héctor Galindo-Domínguez ¹*, María-José Bezanilla ²,
Lucía Campo ², Donna Fernández-Nogueira ³ and
Manuel Poblete ⁴

¹Department of Didactics and School Organization, Faculty of Education and Sports, University of the Basque Country, Vitoria-Gasteiz, Spain, ²Department of Education, Faculty of Education and Sports, University of Deusto, Bilbao, Spain, ³Department of Modern Languages, Faculty of Social and Human Sciences, University of Deusto, Bilbao, Spain, ⁴Department of Psychology, Faculty of Health, University of Deusto, Bilbao, Spain

In the 21st century, critical thinking (CT) is regularly presented as one of the most important competences to be developed by a majority of educational institutions. Teachers are expected to change and enrich their teaching and learning methodologies so that students could face future challenges. Nonetheless, few are the instruments that measure the perception of critical thinking based on teachers' conception. The aim of this study is to design and validate an instrument for the assessment of CT in university students based on the conception of CT that university teachers have. For this study, a total of 312 Spanish university students have participated. Based on a good model fit from a Confirmatory Factor Analysis and good reliability indices, the results provide strength to the theoretical model to evaluate critical thinking in university students formed by six dimensions (Analyzing/Organizing; Reasoning/Argumenting; Questioning/Asking oneself; Evaluating; Positioning /Taking decisions, and Acting / Committing oneself) and 42 items. Similarly, age was not a predictor variable for the different dimensions; while gender was statistically in favor of women in some of the dimensions, and tendentially, the dimension of Positioning/Taking decisions, in favor of men. However, despite these differences, the model guaranteed its factorial invariance. These findings have important pedagogical implications for universities in particular, and educational institutions in general, when developing curricula and teaching plans that focus on the development of students' critical thinking.

KEYWORDS

critical thinking, thinking skills, test validation, student evaluation, higher education, transversal competences

1. Introduction and theoretical background

We live in a globalized society, where information input is abundant, sometimes excessive, for the time available. Consequently, discriminating which information is truthful, adequate, or simply useful for our purposes is a difficult task. Therefore, critical thinking (henceforth, CT) may be considered an important and basic competence required in university education for the academic and labor success of students (Tremblay et al., 2012; Peeler, 2016; Bezanilla et al., 2021; World Economic Forum, 2021). There are, however, discrepancies in the literature, as some researchers

consider it a general domain competence, like reading or writing, and state that it may be taught regardless of a discipline, while other researchers consider it as a domain-specific competence that should be taught differently depending on the knowledge area (nursing, education, engineering...; Davies, 2013; Saturno et al., 2019).

Lai (2011) stated how CT had been conceptualized in different ways over the years depending on the view taken. The most relevant approaches were the philosophical approach that highlighted the qualities of an ideal critical thinker, the psychological approach that emphasized on the cognitive process of developing CT, and the educational approach that underlined the utility of CT. Regardless of the approach, Facione (1990b), after carrying out an expert consensus in the United States with researchers, educators, employers, and policymakers, agreed that the cognitive components of CT skills should include analysis, interpretation, judgment, evaluation, inference, and decision-making. Nevertheless, the disposition component of the CT was at the same time addressed with the skills component (e.g., Facione et al., 1995), as it was observed that CT disposition was also a crucial component for a critical thinker (Ennis, 1996). A disposition is a tendency of someone to do something in specific cases. Hence, it could be considered as an attribute or habit that is included into one's beliefs and actions to effectively solve problems and take solid decisions (Fitriani et al., 2018).

Some authors understand these dispositions as attitudes and behaviors when facing historical and social injustices and inequalities (Pennell, 2018; Cummings, 2019), as well as metacognition and self-regulation processes that may help in order to improve the rest of skills (e.g., Facione, 1991; Facione et al., 2016; Bezanilla et al., 2018). In fact, recent research has shown a significant association between CT skills and metacognitive abilities (e.g., Lukitasari et al., 2019).

Critical thinking could, therefore, be understood as the sum of skills and dispositions that facilitate the contrast to achieve trustful information and the orientation to decision-making processes (Akramova, 2017). Indeed, as commented by Fitriani et al. (2018), a good critical thinker combines empowerment of critical thinking skills by maintaining a solid critical thinking disposition.

In addition, previous literature has delved into the potential differences of CT skills and dispositions depending on the age and the gender of the students. First, with regard to the age, previous literature has examined the potential differences according to age in the development of CT skills. On this topic, previous studies revealed that there are low differences over the academic years (e.g., Giancarlo and Facione, 2001), or that there are no significant differences over the academic years (e.g., Profetto-McGrath, 2003). In addition, previous research showed non-significant differences in CT dispositions based on university students' academic year (Bakir, 2015; Akgun and Duruk, 2016; Turan, 2016). However, this question is still being discussed as other studies revealed that third/fourth year's higher education students had higher CT scores in contrast to their first-year peers (e.g., Roohr et al., 2019).

Likewise, when assessing the CT skills and dispositions of university students, some researchers have shed some light on analyses according to gender. Specifically, the vast majority of previous studies suggest that there are no significant differences between gender in CT skills (Bagheri and Ghanizadeh, 2016; Salahshoor and Rafiee, 2016), as well as in CT dispositions (Akgun and Duruk, 2016), or that the effect size of these differences are low for both in CT skills (Mahanal, 2012; Miftahul et al., 2017; Shubina and Kulaki, 2019), and in CT dispositions (Bakir, 2015; Turan, 2016). For instance, Shubina and Kulaki (2019) found significant

differences in favor of women in inference and deduction, but non-significant differences in recognition of assumptions, interpretation, and evaluation of arguments. Despite these differences, it should be emphasized, as indicated by Miftahul et al. (2017), that gender only contributes minimally to the development of critical thinking, and according to this author, it is essential to deepen into new methodologies and learning styles that allow enhancing all critical thinking skills, regardless of gender.

Since the 1980s, higher education institutions have increased their interest in assessing CT (Calle Álvarez, 2013). Some reasons why CT should be assessed include the effectiveness for diagnosing the initial level of students, the helpfulness of giving feedback and guide students on their progress, the value of motivating students to acquire critical thinking, or the utility for establishing a well-defined and adjusted curriculum plan and activities, to name but a few (Madariaga and Schaffernicht, 2013). However, due to the fact that CT has been defined in different ways, the assessment tools also tend to consist of multiple ways of assessing this competence (Liu et al., 2014).

Based on Ossa-Cornejo et al. (2017) systematic review, the most common CT assessment tests are those formed by multiple-choice questions with closed answers and open questions in which students need to develop their answers in writing (Madariaga and Schaffernicht, 2013), and those formed by multiple-choice, agree and disagree format or rating format. This last type of test is more objective and easier for assessing, but may have validity problems (Ennis, 1993). An adapted summary of the most common existing CT assessment tools is collected in Table 1.

The vast majority of instruments include dimensions related to inductive or deductive analysis (Ennis and Millman, 1985; Facione, 1990a; Halpern, 1998; Saiz and Rivas, 2008; Rivas and Saiz, 2012; Facione et al., 2016; Shaw et al., 2019); interpretation (Watson and Glaser, 1980; Facione, 1990a; Facione et al., 2016); explanation (Facione, 1990a; Facione et al., 2016); assumptions (Watson and Glaser, 1980; Ennis and Millman, 1985); inference (Watson and Glaser, 1980; Facione, 1990a; Facione et al., 2016); reasoning and argument justification (Halpern, 1998; Saiz and Rivas, 2008; Rivas and Saiz, 2012; Shaw et al., 2019; Hollis et al., 2020); evaluating information's and arguments' credibility (Watson and Glaser, 1980; Ennis and Millman, 1985; Facione, 1990a; Haynes et al., 2015; Facione et al., 2016; Shaw et al., 2019); decision making and problem-solving (Halpern, 1998; Saiz and Rivas, 2008; Rivas and Saiz, 2012; Haynes et al., 2015); and self-regulation (Facione, 1990a; Facione et al., 2016). As can be seen, despite the fact that the literature claims the relevance of dispositions when measuring CT, the vast majority of scales does not include any dimension related to dispositions.

Regardless of the instrument used to assess CT, as stated in Ossa-Cornejo et al. (2018), there is a need to continue developing models to properly assess and develop CT that may meet the requirements and challenges of university education due to the insecurities that educators show in this matter (Choy and Cheah, 2009; Aliakbari and Sadeghdaghighi, 2012; Stedman and Adams, 2012).

2. Purpose of the study

Bezanilla et al. (2018) made a new proposal for assessing CT skills and dispositions based on an inductive analysis carried out amongst university teachers on their conception of CT. This model was built in order to attempt to deal with some of the limitations that have been

TABLE 1 Analysis of common instruments to assess critical thinking.

Instrument	Year of implementation	Dimensions of test	Number of items	Type of test	Reliability (using Cronbach's alpha)
Watson-Glaser Critical Thinking (WGCTA)	Watson and Glaser (1980) First used in 1930	Inference, assumptions, deductions, interpretation, and evaluation	80 (shorter version of 40 items)	Multiple-choice questions from true to false	Original: 73–83 Reduced: 82
California Critical Thinking Skills (CCTST)	Facione (1990a) Specially for adults	Interpretation, analysis, inference, explanation, evaluation, and self-regulation (Facione and Facione, 2013)	34	Multiple-choice questions	78–0.80
California Critical Thinking Disposition Inventory (CCTDI)	Facione et al. (2016) For adults	Interpretation, analysis, inference, explanation, evaluation, and self-regulation (Facione et al., 1994)	75	Multiple-choice questions	90 overall 71–80 for seven internal scales (Facione et al., 1994)
Cornell Critical Thinking Test (CCTT)	Ennis and Millman (1985) First level is mainly for schools and the second level to identify gifted students and for university students	Induction, deduction, credibility, identification, and assumption. The second level adds semantics, definition, and production in planning	76	Multiple-choice questions (yes, no, maybe)	n/d
Halpern Critical Thinking Assessment using everyday situations (HCTA)	Halpern (1998)	Reasoning, argument analysis, thinking as hypothesis testing, likelihood and uncertainty, and decision and problem solving	25 closed questions 25 open questions	Open questions. Everyday problems or situations	88–77
Critical Thinking Salamanca (PENCRISAL)	Rivas and Saiz (2012) and Saiz and Rivas (2008) Adults and university students	Deductive, inductive and practical reasoning, decision making, and problem solving	35	Open questions. Everyday problems or situations (Rivas and Saiz, 2012)	65
Critical Thinking Assessment Test (CAT)	Instrument from Tennessee Technological University (TTU) with input from different faculty members and a wide range of disciplines (Haynes et al., 2015)	Core thinking skills: Evaluating information, creative thinking, learning and problem solving, and communication	15 (competed in 1 h)	Real word problem solving skills	According to their webpage the reliability of the test is >0.80
International Critical Thinking Essay Test (ICTET)	Hollis et al. (2020)	Reasoning in terms of clarity, accuracy, precision, relevance, depth, breadth, logicalness, significance, and fairness	Part 1: 8 judgments concerning student work (assigned reading) and in part 22 the grader grades holistically	Essay form: analysis of a writing prompt and assessment of a writing prompt (critical analysis)	The validity is due to the fact that it directly tests the student's ability to reason
HEIghten® critical thinking assessment	Educational Testing Service (ETS) and validated by Shaw et al. (2019)	Analytical skills (analyzing arguments, evaluating argument structure, evaluating evidence) and synthetic skills (developing arguments, understanding of the implications of argumentation by recognizing conclusions)	26 items	Dichotomic answers	80

Adapted and updated from Ossa-Cornejo et al. (2017, pp. 22–24).

found in the literature regarding the measurement of CT, such as the following:

1. The vast majority of instruments are focused on the skills required for an ideal critical thinker, leaving aside the disposition part of CT.
2. Some instruments present a high degree of complexity for their understanding. Therefore, there is a need for a solid training on the theoretical model behind that instrument, assuming the economic and functional resources this action could require.
3. In addition, a payment is sometimes required to use certain instruments. Hence, not all institutions can afford these expenses.

4. Finally, some instruments have low reliability indices. As previously mentioned, measuring critical thinking is not an easy task and there is a need to improve the reliability and validity of instruments.

The resultant model from the inductive analysis carried out by [Bezanilla et al. \(2018\)](#) was formed by six dimensions and is coherent with some of the most common dimensions found in the literature of CT assessment. The dimensions are explained below:

- **Analyzing/Organizing:** Understanding CT as a way of examining in detail something (a text, a reality), considering its parts in order to know its characteristics and draw conclusions. In some cases, it includes aspects related to the structuring and organization of information, but does not go beyond this.
- **Reasoning/Argumenting:** This category adds the relation and comparison of ideas and experiences on the basis of arguments, in order to draw conclusions and form a reasoned judgment. It involves expressing in words or in writing reasons for or against something, or to justify it as a reasonable action to convey content and promote understanding.
- **Questioning/Asking oneself:** Critical thinking is understood as the questioning of an issue that is controversial or commonly accepted by asking a series of questions. It means to question issues, to ask oneself questions about the reality in which one lives.
- **Evaluating:** It means to value, to ponder, to determine the value of something, to estimate the importance of a fact taking into account various elements or criteria. It is more than an argumentation (e.g., to deduce pros and cons of a reality) because it implies to determine the value of something based on certain criteria.
- **Taking a position/Making decisions:** It involves not only analyzing, reasoning, questioning, or evaluating, but also making a decision. It implies giving a solution or a definitive judgment on an issue in such a way that it includes adopting a position or proposing a solution.
- **Acting/Committing oneself.** CT is understood as a means of transforming reality through social commitment. It is to move to action, to act, to behave by performing voluntary and conscious acts in a determined and committed way. It implies the adoption of a certain attitude or position before a certain issue.

Based on this model, the purpose of this study has been the following one:

O1: Design and validate an instrument for the assessment of CT in university students based on the conception of CT that university teachers have. For this purpose, the model proposed by [Bezanilla et al. \(2018\)](#) was used.

O2: Analyze possible differences among the main dimensions of the questionnaire with regard to age.

O3: Analyze possible differences among the main dimensions of the questionnaire with regard to gender.

3. Materials and methods

3.1. Sample

Using non-probabilistic methods based on teachers' proximity, the sample of this study included 312 undergraduate university students

(Age = 20.42; SD = 1.34) from public and private universities of the Basque Country (Spain). The students took part in degrees related to different areas of Education and Sports Sciences. From the total number of participants, 105 were men and 207 were women; 255 came from the University of Deusto (private) and 57 came from the University of the Basque Country (public). Regarding their university degree, 32 were students in the Degree in Early Childhood Education, 139 were studying the Degree in Primary Education, 18 studied the Degree in Social Education/Work, 88 studied the double degree in Primary Education and Physical Activity and Sports Sciences, 23 studied the Degree in Physical Activity and Sports Sciences, and 12 studied other Degrees. The distribution by academic year was 42 students in the 1st year of their degree; 62 in the 2nd year of their bachelor's degree, 139 in their 3rd year of bachelor's degree; 58 in their 4th year degree, and 11 in their 5th year degree (for those in a Double Degree). A summary of the main characteristics of the sample is collected in [Table 2](#).

3.2. Instruments

In order to accomplish the objectives of this research a questionnaire was designed. After the review of different models and instruments to measure and assess critical thinking, a multiple-choice questionnaire, based on [Bezanilla et al. \(2021\)](#) model, was built. This model is coherent with other existing ones, since it includes elements related to analysis, evaluation, self-regulation, reasoning, argumentation, and decision making, among others ([Watson and Glaser, 1980](#); [Halpern, 1998](#); [Rivas and Saiz, 2012](#); [Facione and Facione, 2013](#); [Haynes et al., 2015](#); [Facione et al., 2016](#); [Shaw et al., 2019](#)), but adds some specificities derived from university teachers' concept of CT, such as questioning or acting/committing oneself, which add the contextualization of the scale in the field of higher education teaching and learning. The items from the questionnaire were fully developed by the authors of this research, based

TABLE 2 Descriptive statistics of the sample.

	f	%
Type of University		
Public	57	18.2
Private	255	81.8
Gender		
Male	105	33.6
Female	207	66.4
Degree		
Early childhood education	32	10.2
Primary education	139	44.5
Primary Education + Physical Activity and Sports Sciences	88	28.2
Physical activity and sports sciences	23	7.3
Other degrees	12	3.8
Academic Year		
1st course	42	13.4
2nd course	62	19.8
3rd course	139	44.5
4th course	58	18.5
5th course	11	3.5

on the dimensions of the theoretical model used. A summary of the item distribution is gathered in [Table 3](#) and the description of all the items is shown in [Supplementary Appendix S1](#).

The answers were proposed on a Likert scale ranging from never (1) to always (5), and the participants were asked to answer with the perception of their performance in the situations given in the items. In addition, some individual characteristics were asked, like university type, gender, age, degree and course.

3.3. Procedure

The procedure began with the elaboration of a group of items based on previous studies. At this point, 69 items were proposed after having gone through a pilot phase ($n=50$) carried out with university students. The deans and degree coordinators of the faculties gave their permission to collect data after understanding the aim and ethical procedures of the research. In this pilot phase, the students, through their voluntary participation and always respecting their anonymity and privacy, were asked to accept the terms of the study. Considering the results of the pilot phase, relevant changes were introduced to the instrument and the final questionnaire was completed by a larger sample group following the same previous procedure. At this stage, the initial sample for the pilot phase participated again with the last version of the instrument. It should be added that students were asked for their email in case they wanted to receive a report with the main results of the study. For both, pilot instrument and final instrument, an online survey was created. Students completed the questionnaire through *Google Forms* outside university classes.

3.4. Data analysis

In order to respond to Objective 1 of this study, the data analysis procedure started with a pilot phase carrying out an exploratory factor analysis (EFA), accompanied by a study of each dimension's reliability. Taking as a starting point the results of the pilot phase and the total sample, a model fit analysis was carried out through a confirmatory factor analysis (CFA) and its corresponding analysis of the X^2/df (*Chi-Square/degrees of freedom*), CFI (*Comparative Fit Index*), RMSEA (*Root Mean Square Error of Approximation*) and AIC (*Akaike Information Criterion*) indexes, factor loadings (λ), α_{ID} (*Cronbach's alpha if item is deleted*), and modification indexes (M. I.) in order to improve the theoretical model.

Finally, so as to give an answer to Objective 2 of this study, a series of regression analyses were performed to find out if age was a predictor of the different critical thinking skills. Likewise, to reply to Objective 3

of this study, an independent sample Student's t-test was performed to find out possible significant differences between genders. As significant differences were found, a multi-group analysis of factor invariance was performed so as to check whether the model was acceptable for males and females.

4. Results

With regard to objective 1 (**O1**), the design and validation of the instrument was done. First, an exploratory factor analysis (EFA) was conducted to determine the dimensionality of the instrument and the relevance of each item with its factor ([Supplementary Appendix S1](#)) using the preliminary instrument in a pilot phase ($n=50$). For the selection of the final items, those with factor loadings $\lambda < 0.40$ for its factor and/or improvement of alpha values if the item was deleted (α_{ID}), as collected in [Table 4](#), were eliminated from this preliminary phase ([Galindo-Domínguez, 2020](#)). From this procedure, the initial 69 items were reduced to 48 items.

Afterwards, the final phase began by studying the model fit. In this sense, the model fit was relatively good, although it could be improved ($X^2/df=2.03$; CFI=0.795; RMSEA=0.058; AIC=2489.14). In order to improve the model fit, those items with low factor loadings were eliminated. Thus, AN07 ($\lambda=0.370$), PO02 ($\lambda=0.411$), AC03 ($\lambda=0.394$), AC04 ($\lambda=0.409$) were eliminated. At this point, the model fit improved ($X^2/df=2.00$; CFI=0.823; RMSEA=0.057; AIC=2074.80), although the modification indexes had not been studied.

For this reason, an analysis of the Modification Index (M. I.) was carried out. Special attention was paid to those pairs of items with M.I. greater than 15, making decisions from higher to lower criticality ([Galindo-Domínguez, 2020](#)). After all the modifications and decisions were made, listed in [Table 5](#), the questionnaire was concluded by eliminating items EV03 and EV06.

The model fit of the final model was significantly better than that of the initial model ($X^2/df=1.86$; CFI=0.849; RMSEA=0.053; AIC=1778.56). It should be remembered that despite not reaching values in the incremental indexes (e.g., CFI) higher than 0.90, as stated by [Kenny \(2020\)](#), those theoretically more complex models are penalized in the model fit. After the CFA and the decisions made, the number of items of the final instrument was reduced to 42. The main results of the CFA are illustrated in [Figure 1](#).

Studying the reliability of the 6 dimensions, these were all acceptable for carrying out research [Analyzing/Organizing: $\alpha=0.747$; Reasoning/Argumenting: $\alpha=0.838$; Questioning/Asking oneself: $\alpha=0.732$; Evaluating: $\alpha=0.817$; Taking a position/Taking decisions: $\alpha=0.701$; Acting / Committing oneself: $\alpha=0.726$].

With regard to the second objective of the research (**O2**), it was verified whether age functioned as a predictor of the different dimensions of critical thinking. Results revealed non-significant differences for all dimensions (Analyzing/Organizing: $\beta=-0.014$; $p=0.446$; Reasoning/Argumenting: $\beta=-0.019$; $p=0.267$; Questioning/Asking oneself: $\beta=0.009$; $p=0.609$; Evaluating: $\beta=0.000$; $p=0.992$; Positioning/Taking Decisions: $\beta=-0.018$; $p=0.349$; Acting/Committing oneself: $\beta=-0.006$; $p=0.714$). These data showed that skills are inherent to individuals, regardless of higher education students' age, considering that our sample is formed mostly by students from 18 to 22 years old.

Finally, with regard to the third objective of the research (**O3**), possible significant differences according to gender were studied. This analysis, as seen in [Table 6](#), highlighted the significant differences found

TABLE 3 Distribution of the items per dimensions.

Dimensions	Items
Analyzing/Organizing	8 items: 11, 16, 21, 25, 29, 39, 40*, 42
Reasoning/Argumenting	9 items: 1, 4, 7, 12, 17, 22, 26, 30, 35
Questioning/Asking oneself	7 items: 5, 13, 18, 27, 31, 36, 46
Evaluating	9 items: 6, 8, 14*, 19, 23, 32*, 37, 41, 43
Taking a position/Taking Decisions	7 items: 2, 9, 15, 20, 28, 33, 48*
Acting/Committing oneself	8 items: 3, 10, 24*, 34*, 38, 44, 45, 47

* item eliminated after the CFA.

TABLE 4 Items removed after the exploratory factor analysis ($n=50$).

Dimension	Item	λ	α_{ID}
Analyzing/Organizing	1	0.417	0.630
	7	-0.115	
	13	0.245	
	49	0.002	
Reasoning/Argumenting	61	-0.088	0.794
	65	0.097	
Questioning/Asking oneself	3	0.344	0.657
	15	0.011	
	33	0.372	
	57	0.345	
	62	-0.058	
Evaluating	4	0.319	0.855
	40	0.276	
	66	0.006	
Taking a position/Taking Decisions	11	-0.425	0.700
	35	0.399	
	53	0.336	
Acting/Committing oneself	12	-0.220	0.697
	24	0.390	
	30	0.229	
	42	-0.235	
	59	0.426	

TABLE 5 Decisions taken for the study of the modification index (MI).

item1 (λ , α_{ID})	item2 (λ , α_{ID})	MI	Decision
AN04 (0.613; 0.719)	EV03 (0.618; 0.823)	56.95	Item EV03 is removed to avoid problems with other dimensions
EV06 (0.578; 0.832)	EV03 (0.618; 0.823)	33.22	Item EV03 is removed to avoid problems with other dimensions
AN04 (0.599; 0.696)	EV06 (0.578; 0.832)	30.16	Item EV06 is removed due to problems with other dimensions and to ensure the reliability of the Analyzing/Organizing factor
EV08 (0.650; 0.788)	EV09 (0.650; 0.784)	17.02	Covariance

in certain dimensions of the model. More specifically, statistically significant differences were found in the dimensions of Questioning/Asking oneself ($p=0.005$; $d=0.35$) and Acting/Committing oneself ($p=0.002$; $d=0.34$) in favor of women, with medium effect sizes. There was also a trend value in favor of men in the Positioning/Taking decisions dimension ($p=0.088$; $d=0.19$) with a small effect size.

Despite these differences in gender, the theoretical model ensured its factorial invariance as shown in Table 7, since changes of less than 0.01 were observed in the ΔCFI and $\Delta RMSEA$ coefficients (Cheung and Rensvold, 2002).

5. Discussion and conclusion

The main objective of this study has been to design and validate an instrument to evaluate critical thinking in university students. In view of the results obtained, the validation has been completed with the presentation of a valid and reliable instrument made up of 42 items to measure in students the six main dimensions of the original theoretical model: Analyzing/Organizing; Reasoning/Argumenting; Questioning/Asking oneself; Evaluating; Positioning/Taking decisions; and Acting/Committing oneself. In view of these results, it seems that the model based on 6 dimensions created from the inductive analysis of teachers' perceptions carried out in Bezanilla et al. (2018) gains validity to be used in future research.

In addition, another objective of this research was to analyze potential differences according to age. Findings revealed non-significant differences in CT dimensions in relation to age. These results are coherent with previous research that revealed small or non-significant differences in CT skills (e.g., Giancarlo and Facione, 2001; Profetto-McGrath, 2003), as well as in CT dispositions (e.g., Bakir, 2015; Akgun and Duruk, 2016; Turan, 2016) regarding age. Nevertheless, as stated in the theoretical review, this question is still being discussed as other studies revealed better scores in CT skills in third/fourth year's higher education students in contrast to their first-year peers (e.g., Roohr et al., 2019). Therefore, the debate would be if a real development of CT skills should reach significant differences over the university academic years. That is, the debate arises about the importance and the ways of developing CT to make a difference between the students' thinking processes when they start higher education studies and when they finish their training years. If the development of CT skills is important in higher education, some change should be expected when the application is planned and guaranteed.

Finally, the last objective of this research was to analyze potential differences according to gender. Findings revealed that while there were some minimum differences in questioning/asking oneself and acting/committing oneself in favor of females, there were small differences in positioning/taking decisions in favor of males. Non-significant differences were found in analyzing/organizing, reasoning/argumenting, and evaluating dimensions. These results are partially shared by previous research that found non-significant differences between genders in CT skills (Bagheri and Ghanizadeh, 2016; Salahshoor and Rafiee, 2016), as well as in CT dispositions (Akgun and Duruk, 2016), or that the effect size of these differences are low in CT skills (Mahanal, 2012; Miftahul et al., 2017; Shubina and Kulaki, 2019), as well as in CT dispositions (Bakir, 2015; Turan, 2016).

These results have important theoretical and practical implications for the teaching and learning of critical thinking in higher education. In relation to the theoretical implications, these results contribute by providing a new approach to the evaluation of critical thinking based on teachers' understanding of the concept of CT. The design and validation of the scale presented could be useful for future research to develop critical thinking conception and dimensions.

In regards to the practical implications, firstly, these results allow institutions to develop curricular plans that promote the development of the CT dimensions set out in this model. In fact, as stated by Liu et al. (2014), despite the fact that higher education institutions recognize the relevance of CT, not many offer specific training for fostering CT. Based on the validated model in this study, higher education institutions could use it as a reference for generating specific training for their teachers as well as for their students. The model

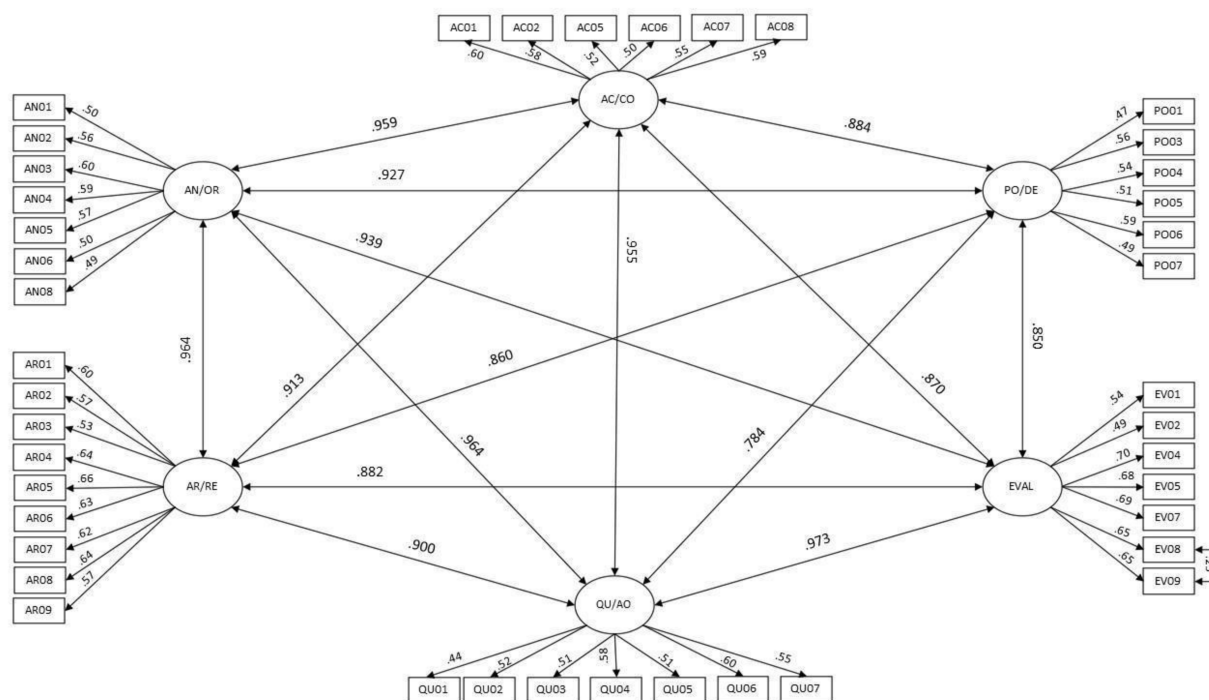


FIGURE 1

Confirmatory factor analysis. An/Or, analyzing/organizing; Ar/Re, reasoning/argumenting; Qu/Ao, questioning/asking oneself; Eval, evaluating; Po/De, positioning/taking decisions; Ac/Co, acting/committing oneself.

TABLE 6 Student's t test for independent samples based on gender.

	M (SD) Total n=312	M (SD) Men n=105	M (SD) Women n=207	p	d
Analyzing/ Organizing	3.15 (0.428)	3.10 (0.432)	3.17 (0.425)	0.143	–
Reasoning/ Argumenting	3.34 (0.403)	3.30 (0.366)	3.36 (0.421)	0.231	–
Questioning/ Asking oneself	3.29 (0.419)	3.19 (0.440)	3.34 (0.401)	0.005	0.35
Evaluating	3.24 (0.457)	3.20 (0.466)	3.26 (0.452)	0.343	–
Positioning/ Taking decisions	3.17 (0.444)	3.23 (0.460)	3.14 (0.440)	0.088	–0.19
Acting/ Committing oneself	3.35 (0.403)	3.26 (0.412)	3.40 (0.390)	0.002	0.34

A negative Cohen's d implies significant differences in the effect size in favor of males.

could also be used to measure longitudinal changes on CT skills and dispositions along the years.

In addition, these results allow teachers to make use of a solid instrument in order to know the effectiveness of a specific training program that involves the development of critical thinking competence among its learning objectives. Therefore, it can be used for diagnosis purposes.

Furthermore, these results give consistency to the original theoretical model of six dimensions for the development of CT (Bezanilla et al., 2018). This scheme based on six dimensions could permit teachers to elaborate guides and teaching plans in order to

develop each of the different CT dimensions throughout teaching units and materials. In this sense, a series of educational actions for each dimension can be carried out:

- To promote the Analyzing/Organizing dimension it is proposed to include in the classroom the use of observation, reading, handling and structuring information (Bezanilla et al., 2018; Alsaleh, 2020), marking up a text according to instructions provided or creating diagrams in which, based on the material supplied, students must produce or fill a diagram that analyzes or evaluates a certain material (Liu et al., 2014). Moreover, some authors like Williams and Moore (2021) revealed the utility of *thinking routines*, like *I see, I think, I wonder* thinking routine for promoting CT skills, such as analyzing/organizing skill.
- To promote the Reasoning/Argumenting dimension, classroom activities could involve relating, comparing and justifying (Bezanilla et al., 2018), like debates, short constructed-response (students must respond in their own words to a prompt based on text), statements' identification and selection from a list for the construction of certain ideas, or comparing for and against arguments (Liu et al., 2014).
- To promote the Questioning/Asking oneself dimension, it is proposed to make use of activities that involve asking, investigating, contrasting or debating. Alsaleh (2020) adds the relevance of teaching questioning techniques, like thinking routines (e.g., *I see, I think, I wonder*; 3–2–1 bridge...), used for example in Williams and Moore (2021), in order to develop this skill.
- To promote the Evaluating dimension, it is suggested the usage of activities that involve discriminating, weighting, evaluating or ranking ideas and information, like an essay where students are asked to evaluate an argument made for a particular conclusion, or an

TABLE 7 Analysis of factorial invariance as a function of gender.

	X2/gl	ΔX2/gl	CFI	ΔCFI	RMSEA	ΔRMSEA	AIC	ΔAIC
1	1.68	–	0.776	–	0.047	–	3272.66	–
2	1.67	–0.01	0.775	–0.001	0.047	0.000	3244.44	28.22
3	1.69	0.02	0.762	–0.013	0.047	0.000	3258.96	14.52
4	1.70	0.01	0.751	–0.009	0.048	0.001	3265.51	6.55

Model 1 (configural), model without restrictions; model 2 (metric), model 1 + equivalence in factorial coefficients; model 3 (scalar), model 2 + equivalence of the intercepts; model 4 (strict), model 3 + equivalence in variance and covariance of errors.

activity in which students are required to match evidence statements with their conclusion (Liu et al., 2014; Bezanilla et al., 2018).

- To promote the Positioning/Taking decisions dimension, it is proposed to make use of activities that involve discerning, making judgments and proposing solutions.
- To promote the Acting/Committing oneself dimension, it is suggested to make use of activities that encourage active participation, commitment and the involvement and transformation of reality, such as Service Learning or volunteer participation in NGOs, among others.

Previous evidence has shown that the type of methodology used in class affects the development of CT (Tiwari et al., 2006; Bezanilla et al., 2019, to name a few). For instance, Mahanal et al. (2019) revealed using the RICOSRE problem-based learning model that students' CT skills may be promoted more than conventional teaching methods. This model is divided into 6 different stages which require the use of different CT skills: (1) reading the case; (2) identifying the problem; (3) constructing the solution; (4) solving the problem; (5) reviewing the solution; (6) extending the solution. However, as commented in Cáceres et al. (2020), teachers consider that the development of CT skills may vary depending on each subject they are teaching, and hence, some skills may be more related to certain subjects than others.

Finally, results revealed small differences concerning gender. Despite the fact that it could be an aspect to consider when planning teachers' lessons based on their students' characteristics, as commented by Miftahul et al. (2017), gender may contribute minimally to the development of CT, and hence, it may be essential to deepen into new methodologies and learning styles that may allow enhancing all critical thinking skills, regardless of gender.

6. Limitations and prospective

This research is not exempted from limitations that should be taken into account when interpreting the results. First, the sample used in the study is based on students enrolled exclusively in universities in the Basque Country (Spain). In this sense, future research could try to replicate the present work by involving students from other national and international universities. Also, a diverse sample could enrich the data and implications of the instrument in terms of equity (Roksa et al., 2017).

Second, the instrument presented is an instrument based on perceptions of different facets of real-life situations and not a performance-based assessment, which is an approach that other authors of this field are working on (e.g., Shavelson et al., 2019). Therefore, it is necessary for future studies to elaborate and use other instruments that measure the "real" competence or performance, not just self-perception,

as well as the possible correlation between self-perception instruments and other performance-based assessment techniques.

Third, a solid instrument for assessment has been validated which does not have the possible problems that qualitative assessments can present (Rivas and Saiz, 2012; Verburgh et al., 2013). Nonetheless, it could be interesting to create a mix of qualitative and quantitative scales in order to contrast the validity and reliability of these new types of scales in comparison with just quantitative scales.

Fourth, unlike models based on a more philosophical point of view, the focus on education and, more specifically, the point of view of the teacher regarding CT has been considered in this case. However, future studies could attempt to analyze students' conception of CT and compare their views with the current model and scale based on teachers' conceptions, presented in this study.

Fifth, the scale presented in this study may be considered as a general domain scale as it has been created from an understanding of CT as a competence that could be developed transversely regardless of students' area of knowledge. Nevertheless, future research should shed some light on criteria validity of how CT as a general domain competence is associated with CT specific domains.

Finally, this research does not analyze the predictive validity of CT on certain variables. Hence, future research should be focused on analyzing the potential effects of CT skills and dispositions when predicting desirable outcomes (e.g., job or academic performance; Liu et al., 2014). An example of how this limitation is being addressed can be found in the study carried out by Shaw et al. (2019) where, after validating the HEIghten® critical thinking assessment scale, they showed how students that scored high in CT skills also had higher academic achievement (Pearson's *r* ranging from 0.18 to 0.37).

Despite all these limitations, we can conclude that this instrument, and the main conclusions drawn from the study, will be useful for the assessment of critical thinking areas through valid and reliable tools. Likewise, this validated instrument could lead to teaching plans, activities in the classroom and assessment of training programs that may have a significant impact in the development of CT skills.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Funding

The publication has been funded by eDucaR research team through the University of Deusto/Basque Government Contract-Programme.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations,

or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/feduc.2023.1127705/full#supplementary-material>

References

- Akgun, A., and Duruk, U. (2016). The investigation of pre-service science teachers' critical thinking dispositions in the context of personal and social factors. *Sci. Educ. Int.* 27, 3–15.
- Akramova, G. R. (2017). Modern approaches to development critical thinking of students. *East. Europ. Scient. J.* 5, 17–19. doi: 10.12851/EESJ201610C02ART03
- Aliakbari, M., and Sadeghdaghighi, A. (2012). Teachers' perception of the barriers to critical thinking. *Procedia* 70, 1–5. doi: 10.5897/err2015.2585
- Alsaleh, N. J. (2020). Teaching critical thinking skills: literature review. *Turk. Online J. Educ. Technol.* 19, 21–39.
- Bagheri, F., and Ghanizadeh, A. (2016). Critical thinking and gender differences in academic self-regulation in higher education. *J. Appl. Ling. Lang. Res.* 3, 133–145.
- Bakir, S. (2015). Critical thinking dispositions of pre-service teachers. *Educ. Res. Rev.* 10, 225–233.
- Bezanilla, M. J., Fernández-Nogueira, D., Poblete, M., and Galindo-Domínguez, H. (2019). Methodologies for teaching-learning critical thinking in higher education: the teachers' view. *Think. Skills Creat.* 33, 100584–100510. doi: 10.1016/j.tsc.2019.100584
- Bezanilla, M. J., Galindo-Domínguez, H., and Poblete, M. (2021). Importance of teaching critical thinking in higher education and existing difficulties according to Teacher's views. *Multidisc. J. Educ. Res.* 11, 20–48. doi: 10.17583/remie.0.6159
- Bezanilla, M. J., Poblete, M., Fernández-Nogueira, D., Arranz, S., and Campo, L. (2018). El pensamiento crítico desde la perspectiva de los docentes universitarios. *Estudios Pedagógicos* 44, 89–113. doi: 10.4067/S0718-07052018000100089
- Cáceres, M., Nussbaum, M., and Ortiz, J. (2020). Integrating critical thinking into the classroom: a teacher's perspective. *Think. Skills Creat.* 37:100674. doi: 10.1016/j.tsc.2020.100674
- Calle Álvarez, G. (2013). Construcción de argumentos durante la producción de textos digitales. *Revista Científica Guillermo de Ockham*. 11, 101–114. doi: 10.21500/22563202.613
- Cheung, G. W., and Rensvold, R. B. (2002). Evaluating goodness of fit indices for testing measurement invariance. *Struct. Equ. Model.* 9, 233–255. doi: 10.1207/S15328007SEM0902_5
- Choy, S. C., and Cheah, P. K. (2009). Teacher perceptions of critical thinking among students and its influence on higher education. *Int. J. Teach. Learn. High. Educ.* 20, 198–206.
- Cummings, R. D. (2019). Justice then and now: engaging students in critical thinking about justice and history. *Soc. Stud.* 110, 281–292. doi: 10.1080/00377996.2019.1652140
- Davies, M. (2013). Critical thinking and the disciplines reconsidered. *High. Educ. Res. Dev.* 32, 529–544. doi: 10.1080/07294360.2012.697878
- Ennis, R. (1993). Critical thinking assessment. *Theory Pract.* 32, 179–186. doi: 10.1080/00405849309543594
- Ennis, R. (1996). *Critical thinking*. Upper Saddle River, NJ: Prentice-Hall.
- Ennis, R. H., and Millman, J. (1985). *Cornell critical thinking test, level X*. Seaside, CA: Midwest Publications.
- Facione, P. A. (1990a). *The California critical thinking skills test, college level, technical report 1, experimental validation and content validity*. Available at: <https://files.eric.ed.gov/fulltext/ED327549.pdf>
- Facione, P. A. (1990b). *Critical thinking: A statement of expert consensus for purposes of educational assessment and instruction*. Millbrae, CA: The California Academic Press.
- Facione, P. A. (1991). *Using the California critical thinking skills test in research, evaluation, and assessment*. Millbrae, CA: California Academic Press.
- Facione, P. A., and Facione, N. C. (2013). Critical thinking for life: valuing, measuring, and training critical thinking in all its forms. *Inquiry* 28, 5–25. doi: 10.5840/inquiryct20132812
- Facione, N. C., Facione, P. A., and Giancarlo, C. A. (1994). The disposition toward critical thinking as a measure of competent clinical judgment: the development of the California thinking disposition inventory. *J. Nurs. Educ.* 33, 345–350. doi: 10.3928/0148-4834-19941001-05
- Facione, P. A., Gittens, C. A., and Facione, N. C. (2016). Cultivating a critical thinking mindset 1. *Insight Asses.* 1–9. <https://www.insightassessment.com/article/cultivating-a-criticalthinking-mindset-pdf>
- Facione, P. A., Sánchez, C. A., Facione, N. C., and Gainen, J. (1995). The disposition toward critical thinking. *J. Gen. Educ.* 44, 1–25.
- Fitriani, H., Asyari, M., Zubaidah, S., and Mahanal, S. (2018). Critical thinking disposition of prospective science teachers at IKIP Mataram, Indonesia. *J. Phys.* 1108:012091. doi: 10.1088/1742-6596/1108/1/012091
- Galindo-Domínguez, H. (2020). *Estadística para no estadísticos: una guía básica sobre la metodología cuantitativa de trabajos académicos* 3Ciencias. Alicante, Spain: 3Ciencias.
- Giancarlo, C. A., and Facione, P. A. (2001). A look across four years at the disposition toward critical thinking among undergraduate students. *J. Gen. Educ.* 50, 29–55. doi: 10.1353/jge.2001.0004
- Halpern, D. (1998). Teaching critical thinking for transfer across domains dispositions, skills, structure training, and metacognitive monitoring. *Am. Psychol.* 53, 449–455. doi: 10.1037/0003-066X.53.4.449
- Haynes, A., Lisc, E., Harris, K., Leming, K., Shanks, K., and Stein, B. (2015). Using the critical thinking assessment test (CAT) as a model for designing within-course assessments: changing how faculty assess student learning. *Inq. Crit. Think. Across Disc.* 30, 38–48. doi: 10.5840/inquiryct201530316
- Hollis, H., Rachiskiy, M., Leer, L.van der, and Elder, L. (2020). Validity and reliability testing of the international critical thinking essay test form a (ICTET-A). *Psychol. Rep.* Available at: https://discovery.ucl.ac.uk/id/eprint/10093714/1/Hollis_ICTETPrePrint.pdf
- Kenny, D. A. (2020). *Measuring model fit*. David Kenny. Available at: <http://www.davidakenny.net/cm/fit.htm>
- Lai, E. R. (2011). *Critical thinking: A literature review*. London, UK: Pearson's Research Reports. <http://images.pearsonassessments.com/images/tmrs/CriticalThinkingReviewFINAL.pdf>.
- Liu, O. L., Frankel, L., and Roohr, K. C. (2014). Assessing critical thinking in higher education: current state and directions for next-generation assessment. *ETS Res. Rep.* 2014, 1–23. doi: 10.1002/ets2.12009
- Lukitasari, M., Hasan, R., and Murtafiah, W. (2019). Using critical analysis to develop metacognitive ability and critical thinking skills in biology. *Jurnal Pendidikan Biologi Indonesia* 5, 151–158. doi: 10.22219/jpbi.%20v5i1.7262
- Madariaga, P., and Schaffernicht, M. (2013). Uso de objetos de aprendizaje para el desarrollo del pensamiento crítico. *Revista de Ciencias Sociales* 19, 472–484. Available at: <https://www.rsdalyc.org/articulo.oa?id=28028572010>. doi: 10.31876/rcs.v19i3.25637
- Mahanal, S. (2012). Strategi Pembelajaran Biologi, Gender dan Pengaruhnya Terhadap Kemampuan Berpikir Kritis. *Prosiding Seminar Nasional UNS* 9, 179–184.
- Mahanal, S., Zubaidah, S., Dewi, I., Maniarta, T., and Ismirawati, N. (2019). RICOSRE: a learning model to develop critical thinking skills for students with different academic abilities. *Int. J. Instr.* 12, 417–434. doi: 10.29333/iji.2019.12227a
- Miftahul, N., Zubaidah, S., Mahanal, S., and Suarsini, E. (2017). Improving junior high schools' critical thinking skills based on test three different models of learning. *Int. J. Instr.* 10, 101–116. doi: 10.12973/iji.2017.1017a
- Ossa-Cornejo, C., Palma-Luego, M., Lagos-San Martín, N., and Díaz-Larenas, C. (2017). Análisis de instrumentos de medición del pensamiento crítico. *Ciencias Psicológicas* 11, 19–28. doi: 10.22235/cp.v11i2.1343
- Ossa-Cornejo, C., Palma-Luego, M., Lagos-San Martín, N., and Díaz-Larenas, C. (2018). Evaluación del pensamiento crítico y científico en estudiantes de pedagogía de una universidad chilena. *Revista Electrónica Educare* 22, 1–18. doi: 10.15359/ree.22-2.12
- Peeler, D. (2016). The importance of critical thinking: a cost management and budget slant. *J. Am. Soc. Mil. Compt.* 61, 30–32.

- Pennell, S. (2018). *Critical thinking vs. social injustice in the classroom* Academic.Edu platform. https://www.academia.edu/download/57035206/Critical_Thinking_vs._Social_Injustice_in_the_Classroom.pdf.
- Profetto-McGrath, J. (2003). The relationship of critical thinking skills and critical thinking dispositions of baccalaureate nursing students. *J. Adv. Nurs.* 43, 569–577. doi: 10.1046/j.1365-2648.2003.02755.x
- Rivas, F. S., and Saiz, C. (2012). Validación y propiedades psicométricas de la prueba de pensamiento crítico PENCRIASAL. *Revista Electrónica de Metodología Aplicada (REMA)* 17, 18–34. doi: 10.17811/rem.17.1.2012.18-34
- Roksa, J., Trolan, T. L., Pascarella, E. T., Kilgo, C. A., Blaich, C., and Wise, K. S. (2017). Racial inequality in critical thinking skills: the role of academic and diversity experiences. *Res. High. Educ.* 58, 119–140. doi: 10.1007/s11162-016-9423-1
- Roohr, K., Olivera-Aguilar, M., Ling, G., and Rikoon, S. (2019). A multi-level modeling approach to investigating students' critical thinking at higher education institutions. *Assess. Eval. High. Educ.* 44, 946–960. doi: 10.1080/02602938.2018.1556776
- Saiz, C., and Rivas, S. (2008). Evaluación en pensamiento crítico: una propuesta para diferenciar formas de pensar. *Ergo Nueva Época* 22, 25–66.
- Salahshoor, N., and Rafiee, M. (2016). The relationship between critical thinking and gender: a case of Iranian EFL learners. *J. Appl. Ling. Lang. Res.* 3, 117–123.
- Saturno, S., Setiawan, A., Suhandi, A., Kaniawati, I., and Malik, A. (2019). The development and validation of critical thinking skills on photoelectric effect for pre-service physics teachers. *J. Phys. Conf. Ser.* 1157:32032
- Shavelson, R. J., Zlatkin-Troitschanskaia, O., Beck, K., Schmidt, S., and Marino, J. P. (2019). Assessment of university students' critical thinking: next generation performance assessment. *Int. J. Test.* 19, 337–362. doi: 10.1080/15305058.2018.1543309
- Shaw, A., Liu, O. L., Gu, L., et al. (2019). Thinking critically about critical thinking: validating the Russian HEIghTen[®] critical thinking assessment. *Stud. High. Educ.* 45, 1933–1948. doi: 10.1080/03075079.2019.1672640
- Shubina, I., and Kulaki, A. (2019). Critical thinking, creativity and gender differences for knowledge generation in education. *Lit. Inform. Comp. Educ. J.* 10, 3086–3093. doi: 10.20533/licej.2040.2589.2019.0405
- Stedman, N. L. P., and Adams, B. L. (2012). Identifying faculty's knowledge of critical thinking instruction in higher education. *NACTA* 56, 9–14.
- Tiwari, A., Lai, P., So, M., and Yuen, K. (2006). A comparison of the effects of problem-based learning and lecturing on the development of students' critical thinking. *Med. Educ.* 40, 547–554. doi: 10.1111/j.1365-2929.2006.02481.x
- Tremblay, K., Lalancette, D., and Roseveare, D. (2012). *Assessment of higher education learning outcomes. Design and Implementation*. Paris, France: OECD <http://www.oecd.org/education/skills-beyond-school/AHELOFSReportVolume1.pdf>.
- Turan, H. (2016). Comparison of critical thinking dispositions of prospective teachers. *Educ. Res. Rev.* 11, 867–876.
- Verburgh, A., François, S., Elen, J., and Janssen, R. (2013). *Educ. Res. Int.* 2013, 1–13. doi: 10.1155/2013/198920
- Watson, G., and Glaser, E. M. (1980). *Critical thinking appraisal, forms a and B*. Harcourt, Brace and World.
- Williams, N., and Moore, S. (2021). The role of a selected thinking routine in the development of critical thinking skills in preschool students. *Carib. J. Educ.* 43, 47–68. doi: 10.46425/c034302b9859
- World Economic Forum (2021). *These are the top 10 job skills of tomorrow – And how long it takes to learn them* World Economic Forum <https://www.weforum.org/agenda/2020/10/top-10-work-skills-of-tomorrow-how-long-it-takes-to-learn-them/>.



OPEN ACCESS

EDITED BY

David Alonso García,
Complutense University of Madrid, Spain

REVIEWED BY

Mohammad Najib Jaffar,
Islamic Science University of Malaysia, Malaysia
Remedios Bacus,
Cebu Normal University,
Philippines

*CORRESPONDENCE

Odete Palaré

✉ o.palare@belasartes.ulisboa.pt

[†]This article was produced as a part of the doctoral thesis being developed by first author

SPECIALTY SECTION

This article was submitted to
Higher Education,
a section of the journal
Frontiers in Education

RECEIVED 28 September 2022

ACCEPTED 19 January 2023

PUBLISHED 17 February 2023

CITATION

da Silva PR and Palaré O (2023) Drawing skills
at the beginning of higher education: Teachers'
perspectives, expectations, and realities.
Front. Educ. 8:1056518.
doi: 10.3389/feduc.2023.1056518

COPYRIGHT

© 2023 da Silva and Palaré. This is an open-access article distributed under the terms of the [Creative Commons Attribution License \(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

Drawing skills at the beginning of higher education: Teachers' perspectives, expectations, and realities

Pedro Ramalho da Silva[†] and Odete Palaré*

Universidade de Lisboa, Faculdade de Belas-Artes, Centro de Investigação e de Estudos em Belas-Artes (CIEBA), Largo da Academia Nacional de Belas-Artes, Lisbon, Portugal

For more than two decades, educational policies in Portugal have primarily focused on improving student outcomes, reducing school absenteeism, and preventing school abandonment. Another factor has been the overemphasis on literacy and numeracy, which has resulted in an unbalanced weighting of these school subjects on instructional time. As a result, instruction time for non-essential classes, such as music and visual arts, was reduced. What effect do these policies have on the drawing abilities and visual literacy of those who pursue visual arts studies in higher education? To date, there has been a plethora of studies on drawing in its didactic, neurological, and physiological components, with findings that strengthen and support the idea that drawing plays a central role in the development of conceptual thinking and abductive reasoning. These findings are significant when advocating for drawing as a learning tool in S.T.E.M., but also, for drawing to play a different role in education overall. To determine whether these policies impact the competencies, skills, and visual literacy of those who pursue visual arts studies, we surveyed higher education teachers regarding their perceptions of student drawing skills as they begin college degrees ranging from fine arts to design. Some survey findings point to weak areas, particularly in perspective drawing and preparatory drawings and sketches. The teachers suggested that the causes were mostly political. These findings should be investigated further, specifically through follow-up interviews and a survey of first- and second-year students enrolled in the courses taught at the educational institutions under analysis.

KEYWORDS

skills, learning, survey, drawing, visual literacy

1. Introduction

This research forms a component of a bigger research project as part of a doctoral degree program in fine arts. The study will be concentrating on how drawing is taught in primary, lower secondary, and upper secondary schools in Portugal.

The premise is that drawing is not just a skill (Simmons, 2019) or just a part of the visual arts, but it is one fundamental pillar of education and learning as important as literacy and numeracy (Mitchell, 2007). Stemming from the concepts of drawing to learn (Brew et al., 2012) and thinking through drawing (Kantrowitz et al., 2012), research was drawn to assess different aspects of this class subject in the Portuguese mandatory education curricula, mainly how it compares with other countries.

An examination of the Portuguese curricula between 1989 and 2021 reveals a decrease in the number of teaching hours in arts education, in general, while the number of teaching hours in Portuguese and mathematics increases. As a result of their lack of structural support, the arts is frequently the preferred victims of adjustments and budget cuts, according to Sullivan (2005), and

this reality is not unique to the Portuguese educational system. According to PORDATA data, state education spending over the last three decades has ranged from 3.7% of GDP in 1989 to 5% in 2000 and 3.9% in 2020. The trend in the 1990s was up until 2002, 5.1%; since then, although fluctuating, the trend has been down to a low of 3.5% of GDP in 2019 (PORDATA, 2022).

One aspect of the preliminary study was the reduction in art class instruction time over the last 20 years in favor of the Portuguese language and mathematics. As a result, in comparison to other European countries (OECD, 2014), Portuguese students benefit from the least amount of instruction time in arts education, which includes music, visual arts, and performing arts. What stands out when analyzing the Visual Education curriculums for the second and third cycles of basic education is that the loss of workload is not reflected in the curriculums, i.e., the same content must be taught in less time.

In the case of visual education in the third cycle, it resulted in the concentration of geometry contents in the seventh grade, some of which had previously been taught in the ninth grade, which raises the question of whether it was pedagogically correct because some contents did not fully fit the stage of development of students in the seventh grade. Perhaps this is why the National Assessment Test results show that average performance in visual education in eighth grade is lower than in fifth grade, which is lower than in third grade (IAVE, 2018; IAVE, 2019).

It is debatable whether structural subjects should be taught for less time. According to the European Commission's comparative documentation of educational systems, by the end of the ninth grade, Portuguese students had 1,660 h of mathematics lessons on average, compared to their Finnish counterparts who had 812 h (EACEA et al., 2015; European Commission/EACEA/Eurydice, 2017), while Estonian students had 945 h.

These times are not reflected in PISA results, and while Portugal has improved, it still lags behind countries such as Finland and Estonia, where the weight of mathematics and mother tongue teaching occupies less than 40% of the curriculum time up to the ninth grade, compared to more than 50% in Portugal (OECD, 2014). Although there has been an evolution in Portugal's PISA results (OECD, 2019), and the Finnish trend has been in the opposite direction, Finland's results remain higher than Portugal's. Moreover, when we look at Estonia, we find an upward trend in results.

We hypothesize that all of this is harming the academic performance of students who want to pursue higher education studies in creative fields, particularly those related to visual arts. To answer that, a survey was proposed to higher education docents who teach drawing to first-year students in fine arts schools at Lisbon and Porto universities. The goal is to understand if there is a noticeable decline in drawing abilities (Fava, 2020) in first-year students, not driven by a digital revolution, but as a result of policies.

2. Materials and methods

2.1. Participants

The survey was conducted between 20 June 2022 and 10 July 2022. The survey was answered by 7 participants, all of them faculty teachers, 3 men and 4 women, in two age groups, 5 between the ages of 41 and 55, and two over the age of 55, as shown in Figures 1, 2. All the participants had a degree in fine arts, five from Lisbon University and two from Porto University (see Figure 3), one had 6–10 years of teaching experience, five had 21–30 years of teaching experience, and one had more than 30 years

of teaching experience (see Figure 4). Figure 5 shows that all seven respondents teach fine arts courses, with three respondents also teaching architecture, design, and multimedia courses, respectively.

The limitation of this investigation is the small data pool (Quivy and Van Campenhoudt, 1998), there are only two fine art colleges in the country, and the drawing departments at both have a total of 24 faculty teachers.

Therefore, there is a small number of higher education teachers who meet the survey criteria, namely teaching drawing to first-year students in a fine arts college. According to the institutional information of both colleges, only three docents are teaching at the first-year level at Porto University Fine Arts College and five at Lisbon University Fine-Arts College. Thus, even though being a small sample, it comprises 87.5% of the population who fits the criteria.

Taking this into consideration, the Lisbon Fine-Arts College has 356 new students in six courses where drawing is taught as a first-year requirement. There were 136 new students in Porto. Overall, 492 students from the top performing visual arts students graduating from secondary school that year are reached by the study. All this is performed according to the publicly available information provided by the Ministry of Science, Technology, and Higher Education (DGES, 2022).

2.2. Survey

Due to a smaller pool, there will be a greater emphasis on qualitative analysis, rather than quantitative, and the investigation will be regarded as a closed interview survey, with questions that can be framed into four different categories:

- The first group of questions, from #1 to #6, is aimed to profile the enquired, ranging from gender group, age, experience, background, and geographic location.
- The second group of questions, from #7 to #8, aims to assess if there has been a visible decline in the ability to draw in younger generations that are starting their higher education.
- The third group of questions, which ranges from #9 to #10, peer into the observations made by teachers in their classrooms, their assessment of the students' practices and techniques to be evaluated on a Likert scale of 1 to 5 from total disagree to totally agree. In question #9, there are five sentences aimed at the assessment of the students' perceived skills, and in question #10, there are six sentences aimed at the perceived technical and theoretical knowledge.
- Finally, question #11 presents a group of four sentences with possible causes that could justify a decline in drawing skills or a lack of preparation of fine arts first-year college students, also on a Likert scale.

3. Results

3.1. A decline in students' drawing skills?

It was asked first if there is a visible decline in students' base skills in drawing with five possible answers: (a) Yes, since the pandemic; (b) Yes, for the last 5 years; (c) No; and (d) No, it has improved. Three of the respondents answered (b), "yes," and four answered (c), "no" (see Figure 6).

1. Age Group

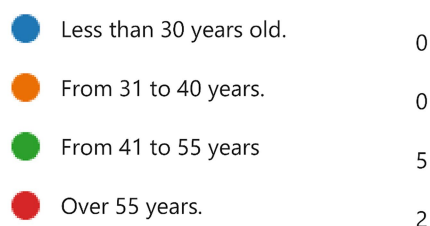


FIGURE 1
Age group.

2. Gender

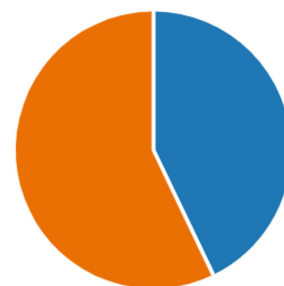
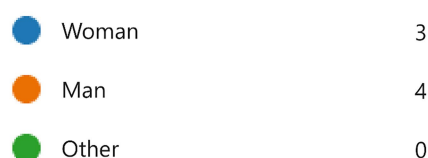


FIGURE 2
Gender.

There was no discernible age, gender, or geographic tendency in the responses; it was nearly a split, but the majority (57%), unlike the other 43%, do not perceive a decline in student abilities.

The second question was how the teachers classify their students' drawing skills at the start of the first year. Four answered "sufficient," two answered "good," and one answered "very weak," which is 57, 29, and 14%, respectively (see [Figure 7](#)). Has before, gender, age, and geography do not appear to influence the outcome of the questions, though the two teachers from Porto have opposite views in this regard.

An examination of the data derived from the national exams for the school subject "Desenho A" (Drawing), revealed a consistent trend of improvement, with grades rising from 57% in 2008 to 68.9% in 2021, having peaked in 2020 with a 73.5% average [this break in the data coincides with the pandemic mandatory confinement], and continuing a general upward trend in 2022 with a 70.5% average ([PORDATA, 2022](#)).

3.2. An observation-based assessment

In the third block, we delve into more specifics about each respondent's personal experience in the classroom. In the first sentence, we affirm that first-year students enter college with "bad habits" about drawing and a "lack of flexibility" to change them; six of the respondents, agreed with the sentence, an overwhelming majority of 86%, and one did not agree or disagreed with the sentence ([Figure 7](#)).

When we stated that the students lacked versatility in their use of various materials, one participant agreed completely (14%), two agreed (29%), three did not agree or disagreed (43%), and one partially disagreed (14%). There is a tie between those who do not have an opinion and the total of those who agree that students lack versatility.

Four participants agreed, and one completely agreed, or 71% total, that first-year students lack technical knowledge, while the other two did not agree or disagree with the sentence. In this question, all male participants answer the same way, which in the sum of all surveys does not appear to be relevant.

As for the difficulty, students have to use drawing as a tool for thinking and registering thoughts, two teachers, or 28%, did not agree, two agreed, other two totally agreed, which combined is 42% of positive answers, and finally, one participant did not agree or disagree with the sentence.

In the final sentence of this block, most participants, 72%, five in total, partially disagreed with the assertion that most students struggle to recognize their flaws and difficulties, one participant agreed, 14%, and another had no opinion, 14% (see [Figure 8](#)).

3.3. On students' overall knowledge

In the first sentence of the second part of the third bloc, we affirm that most new first-year students lack experience with various materials;

3. What is your area of academic training?



FIGURE 3
Academic training.

4. For how long have you been teaching?

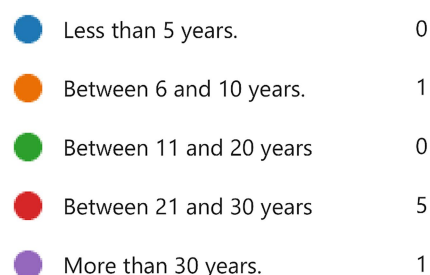


FIGURE 4
Teaching experience.

28% of participants partially disagree, 42% neither agree nor disagree, 14% agree, and another 14% completely agree.

When we affirm that new students use drawing materials insufficiently, one participant completely agrees, three others agree, and three partially disagree (see Figure 9).

Concerning observational drawing, three participants disagree that students have difficulty performing this type of registry, two neither agree nor disagree, and two completely agree.

When it comes to skills in perspective drawing, 71% of participants agree that students reveal difficulties in this type of drawing, with the exception of 29% of participants who have no opinion.

Four participants, or 57%, strongly agree with the assertion that most students do not dominate the terminology or understand the meaning of the design elements, 14% of participants agree, and another 14% partially disagree.

A total of 86% of the participants agree and one strongly agrees that students struggle with preparatory drawings and sketches.

3.4. Possible causes

For the final block, we look for possible causes of first-year students' difficulties and apparent lack of skills. We propose four motives that are

not mutually exclusive: (a) students lack preparation, (b) socioeconomic reasons limit access to media and materials, (c) the problem is outside the school, visual arts are socially undervalued, and (d) the problem is in education policies that undervalue visual arts.

Concerning the first sentence, one participant strongly agrees, two agree, and the remaining four participants, 57%, neither agree nor disagree.

Four participants partially disagree and three agree on social-economic factors, 57% vs. 43%.

The third sentence is more contentious; one participant completely disagrees and another partially disagrees that visual arts are socially undervalued; of the remaining participants, two, or 28%, agree and 43% neither agree nor disagree.

Figure 10 shows that six participants, 86% in total, agree that education policies tend to undervalue the visual arts, while the remaining participant had no opinion.

4. Discussion

In terms of observational drawing, participants are more positive about their student's abilities, in contrast to perspective drawing, where the majority agrees that students generally show some difficulty in this

5. In which area of general training do you teach Drawing?

Architecture	1
Fine Arts	7
Design	1
Multimedia	1
Others	0



FIGURE 5
Teaching field.

7. From your point of view, do you observe a decline in the core competencies of the students arriving from secondary school?

Yes, since the pandemic.	0
Yes, for over 5 years.	3
No.	4
No, they've even improved.	0



FIGURE 6
Students' competencies.

type of registry. Perspective and observational drawings, while similar, are very different. To create an effective perspective drawing, you must have a deep knowledge of geometry, light, focal points, and vanishing points, but in observational drawing, these aspects can be mostly ignored.

According to the responses of the participants, most first-year students also lack knowledge and comprehension of the elements and principles of design, which means they do not master the discipline's basic terminology and the essence of communicating visually; they lack visual literacy. Concerning preparatory drawing and sketching, all participants agree that students reveal difficulties in this type of registry. This type of free-flow reflexive drawing is less formal, but it requires capacities related to other subjects in the survey, such as perspective, observation, thinking through drawing, visual literacy, or media domain.

The overall assessment of the survey is that there are some issues, namely the students' tendency to show a lack of flexibility in changing old habits, which can be seen as an impediment to acquiring new techniques, skills, and knowledge. This difficulty in changing habits could be due to a lack of exposure to different materials and techniques, resulting in a lack of versatility in the use of different drawing materials and, as a result, a lack of technical skills.

We did not find any research on this theme in the context of Portuguese academia, but some research in other countries may help

create connections, establish comparisons, and provide some more scientific background, not only to contextualize but also to show the relevance of this kind of research in our national context. On a similar subject of research focused on architecture students in Poland, the researchers state that "there is no correlation between the results obtained in the entrance exam (the drawing stage) and the grades obtained by the students in the Drawing classes during their education in subsequent semesters of studies" (Gawlak et al., 2021). This means that we need further information about the student's performance during the two first semesters in college.

There is a great amount of research that links educational performance and social and economic background, where students with more resources tend to outperform those with fewer (Seabra, 2009). The social factor might play a role bigger than the majority of the participants in the survey believe, and it might be a path of research that will help frame some of the responses in the query. The participants tend to agree that students demonstrate an inadequate use of drawing materials and media, which may be evidence of no contact or little experience with an assortment of media. This might be a reflection of those social-economic differences, mainly because, even though the Portuguese educational system is tuition free from elementary school until the completion of secondary education, it is not free of frequency.

8. How do you classify your students' drawing skills level at of the beginning of higher education?

Very weak	1
Unsufficient	0
Sufficient	4
Good	2
Excellent	0

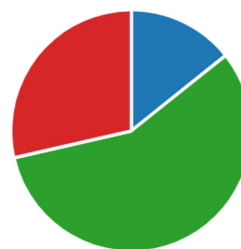


FIGURE 7
Students' skill level.

9. Considering your classroom experience, rank the following statements from 1 to 5, where 1 totally disagrees, 2 partially disagrees 3 without opinion, 4 agree and 5 completely agree.

1 2 3 4 5

First-year students have mannerisms, wrong drawing technics, and lack the flexibility to change.

New students' drawings reveal a lack of versatility in the use of different drawing media.

Students who start college reveal a lack of technical knowledge.

Students have difficulty using drawing as a tool or way of registering thought.

Most students have difficulty acknowledging their flaws/difficulties.

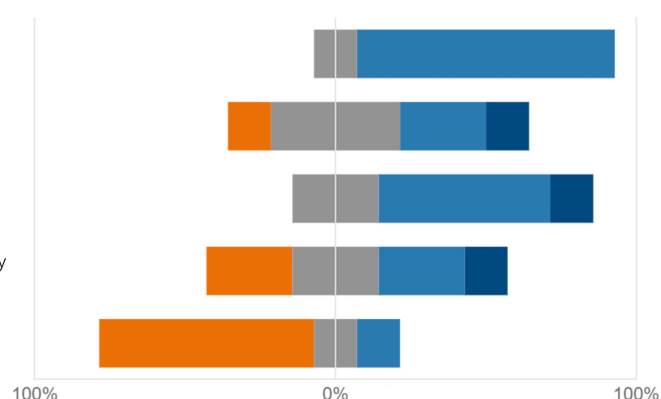


FIGURE 8
Students assessment.

Except for school books, most educational materials are the responsibility of the families; in light of this, teachers may attempt to reduce the social-economic impact of the drawing subject and other art-related topics, at the secondary education level, by limiting the number of materials requested. This will reduce financial strain while limiting the students' learning opportunities.

Another study "identified different patterns for arts participation and cultural engagement across society in the United Kingdom and found that these patterns are closely associated with demographic and socioeconomic characteristics" (Mak et al., 2020). In general, the Arts are a manifestation of culture, from music to dance, to theater, entertainment, visual arts, and multimedia, they drive industries, creating jobs and wealth; however, what happens when education in these fields is restricted? It results in a perpetuation of inequality. Portugal has the fifth lowest culture budget in the European Union and spends more on sports than on cultural services than the majority of E.U. countries (European Commission, 2022).

Educating in the arts is about more than just developing creators and artists; it is also about preserving culture and heritage, as well as incorporating creativity into the curriculum, as it is not limited to the arts (Kantrowitz et al., 2017), and plays an important role in learning other subjects such as sciences, technologies, engineering, and math (Tytler, 2016).

Educational policies are one of the major forces influencing the outcomes of visual arts teaching; thus, these policies are reflected in the weight and value that these disciplines have in school curricula, instruction time, and programs. However, social, economic, and cultural factors influence policymakers. The importance of the arts in society is reflected in the policies, and while the survey points to a link between teachers' perceptions of society's view of the arts as a negative factor in students' outcomes, it is unclear how this societal lack of awareness and undervaluing of the arts will affect policymakers and underpin educational policies.

As a result of this confluence, there has been a 20-year trend of decreasing instruction time in the lower levels of education, between the

10. With regard to the practices of your students, classify the following statements from 1 to 5, and 1 totally disagrees, 2 partially disagrees, 3 no opinion, 4 agrees and 5 totally agrees.

1 2 3 4 5

The majority of the new pupils show little experience with different drawing media.

In first-year classes, it is common to detect improper use of drawing materials.

Many students have a weak dominance in observational drawing.

Students, in general, demonstrate difficulties in perspective drawing.

Most students do not master the terminology or does not realize the meaning of the visual elements.

Many students show difficulties in preparatory drawing and drafting.

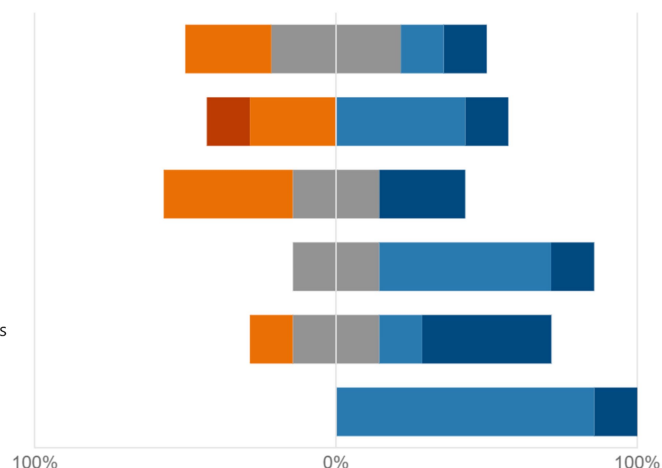


FIGURE 9
Students' practices.

11. From your point of view, what can be the causes of the difficulties and unpreparedness demonstrated by students in the 1st year of college, classify the following statements from 1 to 5, and 1 totally disagrees, 2 partially disagree, 3 no opinion, 4 agrees and 5 totally agrees.

1 2 3 4 5

Students have a poor preparation.

A lack of access to drawing materials due to socio-economic reasons condition learning and students'...

The problem is external to the school, by the visual arts being socially undervalued.

The problem lies in educational policies that devalue the visual arts.

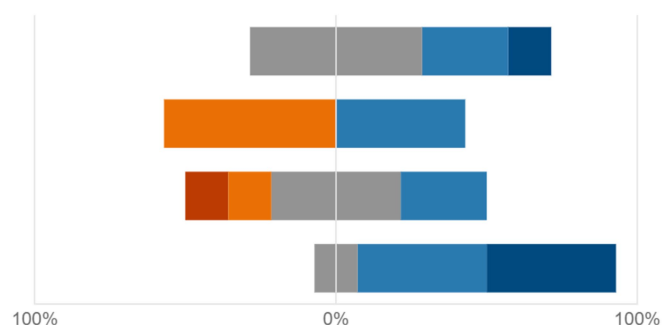


FIGURE 10
Possible causes.

first and ninth grades. As a result, students entering secondary school who wish to pursue a formal education in visual arts are already underprepared for the task ahead, and students in other fields will not benefit from visual literacy (Freedman and Stuhr, 2004).

5. Final considerations

The findings of the investigation appear to indicate a lack of consistency in the background formation of first-year fine arts students.

In some ways, the data confirmed a set of symptoms for us. The participants were asked to leave a final comment at the end of the inquiry, a brief reflection like the one that follows:

"Students, normally, demonstrate a lack of work habits, they do not understand the importance of repetition and do not have a good relationship with error. They are increasingly having difficulty concentrating on their tasks. All of these characteristics are required to draw, and they are obviously worked on throughout the year, but they should already be a part of the student's performance, i.e., they should

have been developed during secondary school. Then, regarding observational drawing, the large majority of the students have been in contact with this kind of representation, but nothing is explained or contextualized to them. That is, their observational drawing doesn't obey rules, and they get surprised that rules exist when they are explained and worked upon. At the end of the school year, all students claim to experience a radical change relative to knowing how to see."

This comment, the only one left by the participants, resumes the way teachers experience some of the difficulties shown by students. It also ratifies the hypothesis in the way that, even though there is not a decline in drawing abilities, there is something wrong with the skills of students that start their first year at fine arts colleges. So, the underlying issue of our conclusions is that there is a significant flaw in the skillset with which students should begin college. As assessing the problem is only half of the research, new questions arise, such as whether the problem exists in secondary schools. Is it the program, the curriculum, or something else? Or do secondary school teachers struggle with a lack of resources and student disengagement?

As students apply to college there is a limited number of vacancies in each course, and students with the best secondary school average, plus the best national examination results tend to occupy first the most desired courses. This means there are differences in the teacher's experience with said students. Which might explain some different points of view over the survey? We cannot affirm that there is a decline in students drawing skills in a general sense. Though some issues might reveal a lack of systematic practice of drawing, and that might be attributed to a varied number of factors.

The findings of the survey provided a clearer picture of the expectations that higher education teachers in the field of drawing have for their new students, and how those expectations may not be met exactly. Mostly, it shows that there is a lack of investigation on this subject, at least in the context of the Portuguese educational system. Because there is a noticeable gap, or miscommunication, between secondary and higher education as stated by Shifrin (2009):

"Some aspects of the scholarly debate are relevant to—and can therefore help to elucidate—the pedagogical assumptions, practices, and divergences at the primary and secondary school levels; and, as a result, that there is a degree of understanding to be gained by examining those practices and perceptions (initially at least) in the context of the larger debate, rather than as divorced and remote from it, as is often the case when secondary educational practices are considered in relation to those of higher education or of the academy in general."

Since 2008, the average examination grades have been rising, but this leads us to a first conclusion: the competencies and skills evaluated in the exam are not the same skills and competencies that higher education teachers expect of first-year students. Because, according to the teachers' responses, there are some key competencies, techniques, practices, and knowledge that the students lack, and this perception is exacerbated when we consider that the teachers who respond to the survey teach students with above-average exam results and secondary school conclusion grades. As a result, it appears that college and secondary curricula are not on the same page.

The investigation leads us to the conclusion that students struggle to abandon old habits and flawed techniques, which creates hurdles to their learning. In addition to these habits, students demonstrate a lack

of versatility in using different media, a lack of overall knowledge, and a lack of use of drawing as a tool. They appear to have a limited understanding of the discipline, as evidenced by the contrast between good observational drawing skills and a lack of perspective drawing skills, which relate to a broader set of competencies related to visual literacy.

That is notable in a lack of understanding of the elements and principles of art, as these are the foundations of visual communication; perhaps there is a rooted misconception of their learning in which ability or aptness are mistaken for actual knowledge.

Another aspect of the narrow view of drawing is the difficulties students exhibit in preparatory drawing and sketching, which exposes a lack of learning of how to see because they apparently do not go beyond observation to analyze and deconstruct reality reflexively, and looking not only with sight but with the mind's eye. This method is used to draw what one sees with his eyes as well as what one designs in the mind.

All of the various nuances asserted by participants, as obstacles or gaps in the student's preparation, are a result of various factors that shape their learning experience prior to beginning college degrees. Thus, it is important to survey the students, namely first and second-year students, because their points of view are important to seek answers to some of the questions raised by the teacher's survey, such as social and economic factors. Further research is needed.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study of participants in accordance with the local legislation and institutional requirements. Written informed consent from the participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Funding

This work was funded by national funds through FCT – Fundação para a Ciência e a Tecnologia, i.p., in the scope of the project «uidb/04042/2020».

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated

organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

- Brew, A., Fava, M., and Kantrowitz, A. (2012). Drawing Connections: New Directions in Drawing and Cognition Research. 2012 Drawing Research Network Conference, September, 77–90. Available at: <http://www.drawing-research-network.org/wp-content/uploads/DRN2012Proceedings-v4MediaLight.pdf>
- DGES (2022). Guia da Candidatura 2022 - Detalhe de Curso. Direção Geral do Ensino Superior. Available at: <https://www.dges.gov.pt/guias/detkursopi.asp?codc=9007&code=5402>
- European Education and Culture Executive Agency, Eurydice, Pejnovic, S., and Baidak, N. (2015). Recommended annual instruction time in full-time compulsory education in Europe: 2013/14, Education, Audiovisual.
- European Commission/EACEA/Eurydice (2017). Recommended Annual Instruction Time in Full-time Compulsory Education in Europe – 2016/17. Eurydice – Facts and Figures. Luxembourg: Publications Office.
- European Commission (2022). File: Total general government expenditure on recreation, culture and religion, 2020 (% of GDP).png – Statistics Explained. European Commission. Available at: [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Total_general_government_expenditure_on_recreation,_culture_and_religion,_2020_\(%_of_GDP\).png](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Total_general_government_expenditure_on_recreation,_culture_and_religion,_2020_(%_of_GDP).png)
- Fava, M. (2020). A decline in drawing ability? *Int. J. Art Design Educ.* 39, 319–332. doi: 10.1111/jade.12255
- Freedman, K., and Stuhr, P. (2004). "Curriculum change for the 21st century: visual culture in art education" in *Handbook of Research and Policy in Art Education*. eds. E. W. Eisner and M. D. Day (New York: Routledge)
- Gawlak, A., Pruszeicz-Sipińska, E., and Bonenberg, W. (2021). Drawing skills of candidates for architectural studies vs. learning outcomes of graduates. Comparative research based on the example of the Faculty of Architecture, Poznan University of Technology. *Educ. Sci* 11:339. doi: 10.3390/educsci11070339
- IAVE (2018). Relatório nacional 2016 e 2017: Provas de aferição. ISBN 978-989-99741-6-6 <http://www.iave.pt>
- IAVE (2019). Resultados Nacionais das Provas de Aferição, 2018. 1–8. https://iave.pt/wp-content/uploads/2021/03/Informacao_Resultados_PA2018_16jan.pdf
- Kantrowitz, A., Brew, A., Fava, M., Burton, J. M., Tversky, B., Farthing, S., et al. (2012). "Thinking Through Drawing: Practice Into Knowledge" in *Proceedings of an Interdisciplinary Symposium on Drawing, Cognition and Education*. eds. A. Kantrowitz, A. Brew and M. Fava (New York: Teachers College, Columbia University)
- Kantrowitz, A., Fava, M., and Brew, A. (2017). Drawing Together Research and Pedagogy. *Art Education* 70, 50–60. doi: 10.1080/00043125.2017.1286863
- Mak, H. W., Coulter, R., and Fancourt, D. (2020). Patterns of social inequality in arts and cultural participation: findings from a nationally representative sample of adults living in the United Kingdom of Great Britain and Northern Ireland. *Public Health Panor* 6, 55–68.
- Mitchell, W. J. T. (2007). Visual literacy or literary visualcy? In Elkins James (Ed.) *Visual Literacy*. New York: Routledge.
- OECD (2014). *Education at a Glance 2014: OECD Indicators Indicator D1 How Much Time Do Students Spend in the Classroom?*. OECD Publishing, Paris.
- OECD (2019). *PISA 2018 Results (Volume I): What Students Know and Can Do, PISA*. OECD Publishing, Paris.
- PORDATA (2022). Média global dos resultados nas provas de exame do ensino básico e secundário. PORDATA - Estatísticas, gráficos e indicadores de Municípios, Portugal e Europa. Available at: <https://www.pordata.pt/DB/Portugal/Ambiente+de+Consulta/Tabela>
- Quivy, R., and Van Campenhoudt, L. (1998). *Manual de investigação em ciências sociais*. Gradiva – Publicações, Lda. Lisboa, Portugal. 2.ª edição, janeiro de 1998.
- Seabra, T. (2009). Desigualdades escolares e desigualdades sociais. *Sociologia Problemas e Práticas* 59, 75–106.
- Shifrin, S. (2009). "Visual literacy in North American secondary schools: arts-centered learning, the classroom, and visual literacy" in *Visual Literacy*. ed. J. Elkins (New York: Routledge), 113–136.
- Simmons, S. (2019). Drawing in the Digital Age: Observations and Implications for Education. *Arts* 8:33. MDPI AG. doi: 10.3390/arts8010033
- Sullivan, G. (2005). Art practice as research: inquiry in the visual arts. *Choice Reviews Online* 42: 42-5662-42-5662. doi: 10.5860/CHOICE.42-5662
- Tytler, R. (2016). Drawing to learn in STEM. Available at: http://science.sciencemag.org/content/333/6046/1096.short%0Ahttps://search.proquest.com/docview/1823922547?accountid=13828%0Ahttp://find.shef.ac.uk/openurl/44SFD/44SFD_services_page?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:book&genre=conferenc



OPEN ACCESS

EDITED BY

Ana Luísa Rodrigues,
University of Lisbon, Portugal

REVIEWED BY

Xiaodong Zhang,
Beijing Foreign Studies University, China
Amr Abdullatif Yassin,
Ibb University, Yemen

*CORRESPONDENCE

Maha Atout
✉ m.atout@philadelphia.edu.jo

SPECIALTY SECTION

This article was submitted to
Higher Education,
a section of the journal
Frontiers in Education

RECEIVED 08 October 2022

ACCEPTED 15 February 2023

PUBLISHED 09 March 2023

CITATION

Atout M and Nalubega S (2023) Views and
experiences of using advanced technologies in
higher education of healthcare professionals: A
systematic mixed-method review.
Front. Educ. 8:1064697.
doi: 10.3389/feduc.2023.1064697

COPYRIGHT

© 2023 Atout and Nalubega. This is an
open-access article distributed under the terms
of the [Creative Commons Attribution License](#)
(CC BY). The use, distribution or reproduction
in other forums is permitted, provided the
original author(s) and the copyright owner(s)
are credited and that the original publication in
this journal is cited, in accordance with
accepted academic practice. No use,
distribution or reproduction is permitted which
does not comply with these terms.

Views and experiences of using advanced technologies in higher education of healthcare professionals: A systematic mixed-method review

Maha Atout^{1*} and Sylvia Nalubega²

¹Nursing School, Philadelphia University, Amman, Jordan, ²Department of Nursing, School of Health Sciences, Soroti University, Soroti, Uganda

Introduction: While it is highly recommended to adopt technology in higher education of healthcare professionals, user experiences have not been widely studied. This review investigates the experience of using technology within healthcare higher education, in an attempt to gather useful insights into how use of such technologies can be improved.

Methods: Both quantitative and qualitative data was used for this mixed-method review.

Results: The findings revealed many benefits associated with technology use, which included; improved clinical competency, improved overall quality of education and improved peer networking. However, there were numerous factors which hindered the widespread adoption of advanced technology. These factors included; the high costs involved, a lack of adequate equipment and a lack of understanding in such technology.

Discussion: While the use of advanced technology for the training of healthcare professionals is generally embraced, it is not without problems. It is necessary for institutions to offer relevant and accessible support to both students and teachers, in order to improve the use of such technology in teaching and learning practice.

KEYWORDS

advanced technology, healthcare training, experiences, barriers, facilitators

Background

The 21st century generation, referred to as “millennials”, has adopted technology-based activities that affect the way by which these individuals aim to learn (Chiou et al., 2017; Au-Yong-Oliveira et al., 2018; Martins et al., 2018). Current and modern teaching is becoming increasingly inclined to the use of advanced technologies owing to their vast advantages in easing the completion of day-to-day activities, such as information access, communication, shopping, socialization and media access (Kämpfen and Maurer, 2018; Martins et al., 2018). Technology-based gadgets, such as computers, smartphones, tablets, facilitate teaching and learning (Guze, 2015; Johnson et al., 2016) given their vast functions and advantages, such as portability, user-friendliness, customizability and accessibility (Mohammed et al., 2017; Moreira et al., 2017). Given these characteristics, technology has taken shape in the teaching and learning sector, with a variety of gadgets and equipment being adopted, ranging from simple devices to complex and advanced ones.

In healthcare education, drivers of technology advancement emerge from healthcare needs, which are becoming increasingly demanding for a range of interventions, many of which are based on technology (Risling, 2017). Individuals engaged in the education of

healthcare professionals are therefore expected to ensure that practitioners are prepared for their future role by introducing relevant technologies to their learning (Guze, 2015; Risling, 2017). Curriculum developers in healthcare education are likewise being encouraged to embrace technology and incorporate its components, such as eHealth, electronic records and wearable technologies, in their courses to meet the demands of healthcare practice (Risling, 2017). Recent healthcare trends such as the COVID-19 outbreak has seen a bigger rise in the use of advanced technology, through virtual platforms in training healthcare professionals worldwide (Hosen et al., 2022; Jeffries et al., 2022).

The use of sophisticated technology in healthcare training settings has been successful on account of the value and experience it adds to both the teaching and learning processes and its widespread use within healthcare practice. Forums such as Moodle, Doodle and online news feeds are commonly used in teaching healthcare professions due to their functionalities, which enable easy viewing of teaching content and make teaching and learning increasingly accessible and transparent (Au-Yong-Oliveira et al., 2018; Sklar, 2019; Linderman et al., 2020) and these have seen an increased use during the COVID-19 pandemic (Hosen et al., 2022; Jeffries et al., 2022). These approaches are certainly suitable for the training of healthcare professionals, who undertake off-campus training regularly during clinical and community placements and thus require considerable training flexibility (Johnston et al., 2018). In addition, technology-based approaches are highly engaging, with some being capable of mimicking real-life situations. For example, robots and mannequins mimic real-life situations and are very essential in the training of healthcare students; as the tools enable them to learn health conditions before they interact with actual patients (Archibald and Barnard, 2018), thereby demonstrating a person-centered care approach that minimizes harm to patients (Ireland, 2017).

The adoption of technology in healthcare training has also been influenced by the changing healthcare environment, which now demands increasing independence and involvement of clients in their care. However, one of the critical ethical issues regards safety and confidentiality of its use (Guze, 2015), which has been reported to affect the quality of healthcare services provided (Mohammed et al., 2017).

User experiences of technology use in higher education

The experience of using advanced technology has been relatively studied in various populations and has indicated positive acceptability and uptake. Despite some reported barriers, majority of users concede that technology is an indispensable educational tool whose use has numerous associated benefits. In healthcare education for example, technology has been commended for changing teachers' and students' experiences of teaching and learning, respectively. Johnston et al. (2018), who assessed how millennial nurses use YouTube to support their learning, stated that certain students believed that technology enabled them to easily understand a rather difficult course in bioscience. The video tools used in this study were perceived to further enhance

revision, as the students would review the learnt content on an ongoing basis, thereby increasing students' retention and enhancing lifelong learning.

Many studies have evaluated the application of technology models in higher education and found these successful. A study on the success of an educational management information system (EMIS) in higher education (Martins et al., 2018) established that the use of the EMIS was accepted by students and reportedly increased their satisfaction with the learning process. A related study by Hamidi and Chavoshi (2018), which assessed the factors associated with the adoption of mobile learning in higher education, revealed that mobile learning is a highly acceptable and successful approach that has numerous advantages associated with its adoption, such as ease of use, perceived usefulness and trustworthiness. Another study evaluated the acceptance of mobile technology use among practicing nurses in Germany and found high acceptance and considerable use of mobile technology among the nurses, with factors such as ease of use and perceived usefulness as the main motivating factors for its acceptance (Schmeer et al., 2016). It can therefore be asserted that technology use in higher education could enhance educational efficiency and result in positive learning outcomes.

A systematic review that aimed to assess the effectiveness of using human patient mannequin simulators in teaching undergraduate nursing students in Australia revealed that these technologies highly increased students' satisfaction with learning and were important in teaching particular skills, such as psychomotor skills (Lapkin et al., 2010). These findings indicate that advanced technology not only benefits acquisition of technical skills during the learning situation but can enable students to achieve transferable skills during the simulation experience.

Barriers associated with technology use in higher education

Despite its usefulness, technology use is associated with numerous barriers and challenges that may hinder the use of technology use in education. Concerns include those about increased costs (Mohammed et al., 2017), having to adopt new curriculums and learning new technologies and teaching techniques (Johnson et al., 2016).

In their review, Lapkin et al. (2010), explained that despite the potential usefulness of high-technology mannequins in the teaching of nursing students, there is a lack of evidence regarding how the use of such tools will facilitate the acquisition of clinical reasoning skills and about whether the skills used will be helpful in the future practice of students. Hence, some authors have suggested that while we need to adopt technology in the higher education of healthcare professionals, its usefulness and the need to integrate it with conventional, non-technological teaching approaches must be reconsidered (Goodchild, 2018). Moreover, as this intervention is relatively new, additional research should be undertaken to evaluate its usefulness and impact on the teaching of healthcare professionals and their future practice (Laschinger et al., 2008). River et al. (2016) also recommended the conduct of added research

on the barriers to the use of technology and the impact of technology on student learning outcomes.

We performed an initial search on three databases, namely, JBI Database of Systematic Reviews and Implementation Reports, Cochrane Database of Systematic Reviews and PubMed, to identify any existing review on our study topic and found four related works. However, none of these reviews could adequately address our review aim. For example, the review by Webb et al. (2017) assessed the utility and impact of information communication technology on enhancing student performance and the learning environment of nursing students. The review by Watts (2018) only assessed the use of social media among radiological students. The review by Jelec et al. (2016) evaluated the application of modern technology in nursing and how it affects the nursing profession, and the review by Lapkin et al. (2010) assessed the effectiveness of using human patient mannequin simulators in teaching undergraduate nursing students in Australia. While these reviews are informative and highlight important aspects of using technology in the higher education of healthcare professionals, they cover limited contexts and scope, as the majority focuses on the nursing profession. By contrast, the current review expands the understanding of the adoption of advanced technologies within higher-education institutions that teach various healthcare-related professions.

Methods

Inclusion criteria

This review included studies that targeted current and/or former students (within the past 5 years) and educators who have been teaching for at least 6 months. Healthcare-related courses, such as nursing, medicine (MBChB), dentistry, medical laboratory science/technology and pharmacy, were targeted. Studies conducted across all healthcare institutions of higher learning in the world were included. We covered students undertaking undergraduate degrees. Hence, studies that included students at diploma, master and PhD levels were not considered. The decision to include only undergraduate students was due to the specific and clearly aligned nature of undergraduate programs compared with the diploma and PhD programs.

The qualitative component of this review sought to establish the experiences, views, perceptions, beliefs, understandings, practices and opinions regarding the use of advanced technologies. Aspects that were assessed included facilitators, barriers and challenges related to the use of advanced technologies in healthcare training. The quantitative component of this review focused on studies that assessed/compared various advanced technologies. Works that aimed to establish the impact of various technologies on learning outcomes were of particular interest.

For the qualitative component we considered studies that focused on various qualitative designs, such as phenomenology, ethnography, grounded theory and action research, in assessing views and experiences with the use of advanced technologies. On the other hand, the quantitative component considered all quantitative designs, such as randomized controlled trials, non-randomized controlled trials, analytical observational studies

TABLE 1 Search strategy.

Key words	Synonyms/related words/
Experience*	Experience* OR view* OR perception* OR belief* OR understanding* OR practice* OR opinion*
Challenge*	Challenge* OR Barrier* OR obstacle* OR problem* OR hinderance*
Facilitator*	Facilitator* OR Motivation* OR benefit*
Advanced technolog*	Advanced technolog* OR Technolog* OR e?learning OR ICT
Higher education	Higher education OR University OR college* OR institution* OR school
Health?care professional*	Health?care professional* OR Health?worker* OR nurse* OR doctor* OR medic* OR dentist*

(such as prospective and retrospective cohort studies), case-control studies, analytical cross-sectional studies and descriptive observational studies (such as case series), that investigated views and experiences with the use of advanced technologies. Articles based on systematic reviews, gray literature, case reports and editorials were not included. Only articles that were written in the English language and achieved 25% in Mixed Methods Appraisal Tool (MMAT) were included in our review (Pluye et al., 2009; Pluye, 2011).

Search strategy and quality assessment

The search strategy aimed to identify both published and unpublished papers. A three-step search strategy was executed for each component in this review. A limited initial search on MEDLINE and CINAHL was undertaken, followed by an analysis of the text contained in the titles and abstracts and of the index terms used to describe the identified articles. A second search was performed using all identified keywords and index terms across all the included databases. A third phase involved a search of the reference lists of all the identified reports and articles to find any additional studies. Various databases were searched to identify papers, including CINAHL, Embase, Scopus, MEDLINE, ProQuest, PsycINFO, ScienceDirect, and Web of Science. A search strategy (Table 1) was used to search for eligible studies. The keywords identified were used alone or combined with others through the Boolean system.

The papers selected for retrieval were assessed by two independent reviewers for methodological validity before being included in the review. This was done using MMAT version 2011 (Pluye et al., 2009; Pluye, 2011) (Appendix 1). MMAT is a valid tool for assessing the quality of mixed-method studies (Pace et al., 2012); hence, we adopted it for the quality assessment of the studies included in this review. MMAT scores the quality of papers from 0 to 100% on the basis of its criteria. This review considered grades of 25% or lower to be indicative of poor quality, and papers with such scores should be excluded. However, no study was removed in accordance with this criterion. No disagreements occurred between the reviewers regarding the quality assessment outcomes.

Data extraction and synthesis

Data was extracted using a modified JBI data extraction tool that extracts both quantitative and qualitative data. The data extracted included the phenomena of interest, populations, study methods, contexts and outcomes of significance to the review questions and specific objectives. Data extraction also involved summarizing the key findings of the included studies. For enhanced reporting of the review findings, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist and flowchart were used (Moher et al., 2009). Then, one reviewer extracted the data and discussed this with the co-reviewers.

Qualitative and quantitative data was synthesized using a thematic analysis approach, which is suitable for analyzing literature reviews involving quantitative and qualitative data due to its ability to capture themes from various study designs (Dahan-Oliel et al., 2012). This approach allowed the synthesis to be performed in an inductive manner, where themes were generated from the data according to their meanings. This process was implemented by extracting the findings from all the included studies in a Microsoft Word document, followed by a manual coding process, where the findings extracted from the primary studies were categorized. Generated categories were then discussed by the reviewers, organized and consolidated into meaningful condensed themes (Dahan-Oliel et al., 2012). The final themes expressed the patterns of qualitative and quantitative evidence of the experiences of using technology in the higher education of healthcare professionals.

Results

Upon a comprehensive literature search of eight databases (CINAHL, Embase, Scopus, MEDLINE, ProQuest, PsycINFO, ScienceDirect, and Web of Science, 2,070 articles were identified. Eighty-nine (89) duplicates were removed, leaving 1,981 articles to be assessed. Then, 1,749 articles were excluded after a review of titles, and 205 were removed after a review of abstracts, leaving 27 articles for full text review. Of these, 18 were excluded for not meeting the inclusion criteria, leaving 9 studies eligible for inclusion in the review. Through a reading of the reference lists of these eligible studies, 5 additional eligible papers were identified. Overall, 14 eligible papers were assessed for quality, and they were all included in the review. Figure 1 presents details about the search results and the screening of the eligible papers.

Characteristics of included studies

In total, 14 papers were included in the review, namely, seven quantitative (Little, 2013; Wilkinson et al., 2013; Arzu et al., 2014; Van Schyndel, 2015; Heden and Ahlstrom, 2016; Hincapie et al., 2016; Dyer et al., 2018), five mixed-method (Long et al., 2016; Vogt and Schaffner, 2016; Feldacker et al., 2017; George et al., 2017; Johnston et al., 2018) and two qualitative studies (Todhunter, 2015; Mackay et al., 2017). Ten of these studies focused on the experiences of nurses, one on the experiences of medical doctors, one on the experiences of pharmacy students and two on the

experiences of mixtures of nurses and paramedical students. Two of the included papers were academic theses; the first was at PhD level (Van Schyndel, 2015), and the other was at master's level (Little, 2013). The included studies were conducted from diverse contexts; five works were from the United States (US), three were from the United Kingdom (UK), one was from Turkey, one was from both the US and the Middle East, one was from New Zealand, one was from Sweden, one was from Sub-Saharan Africa (SSA) (from various countries, including Kenya, Namibia, Nigeria, Zambia, Cameroon, Ethiopia and Botswana) and one was from 60 countries (with Australia, the US, India, the UK and Canada being the top five in terms of survey response). Details about the included studies are presented in Appendix 2.

Quality appraisal findings

All papers appraised for quality passed the 25% cut-off MMAT score for inclusion. Hence, all appraised papers were included in the review. Nevertheless, a few limitations were noted in the included papers that could have affected the overall quality of the current review. For example, reflexivity was not appropriately indicated in the two qualitative papers (Todhunter, 2015; Mackay et al., 2017); some studies included small samples (Little, 2013; Vogt and Schaffner, 2016); some mixed-method papers (Long et al., 2016; Vogt and Schaffner, 2016) did not adequately describe the qualitative methodologies used.

Our review generated three categories, which were synthesized into the following themes: (i) facilitators of using advanced technology and (ii) challenges of using advanced technology.

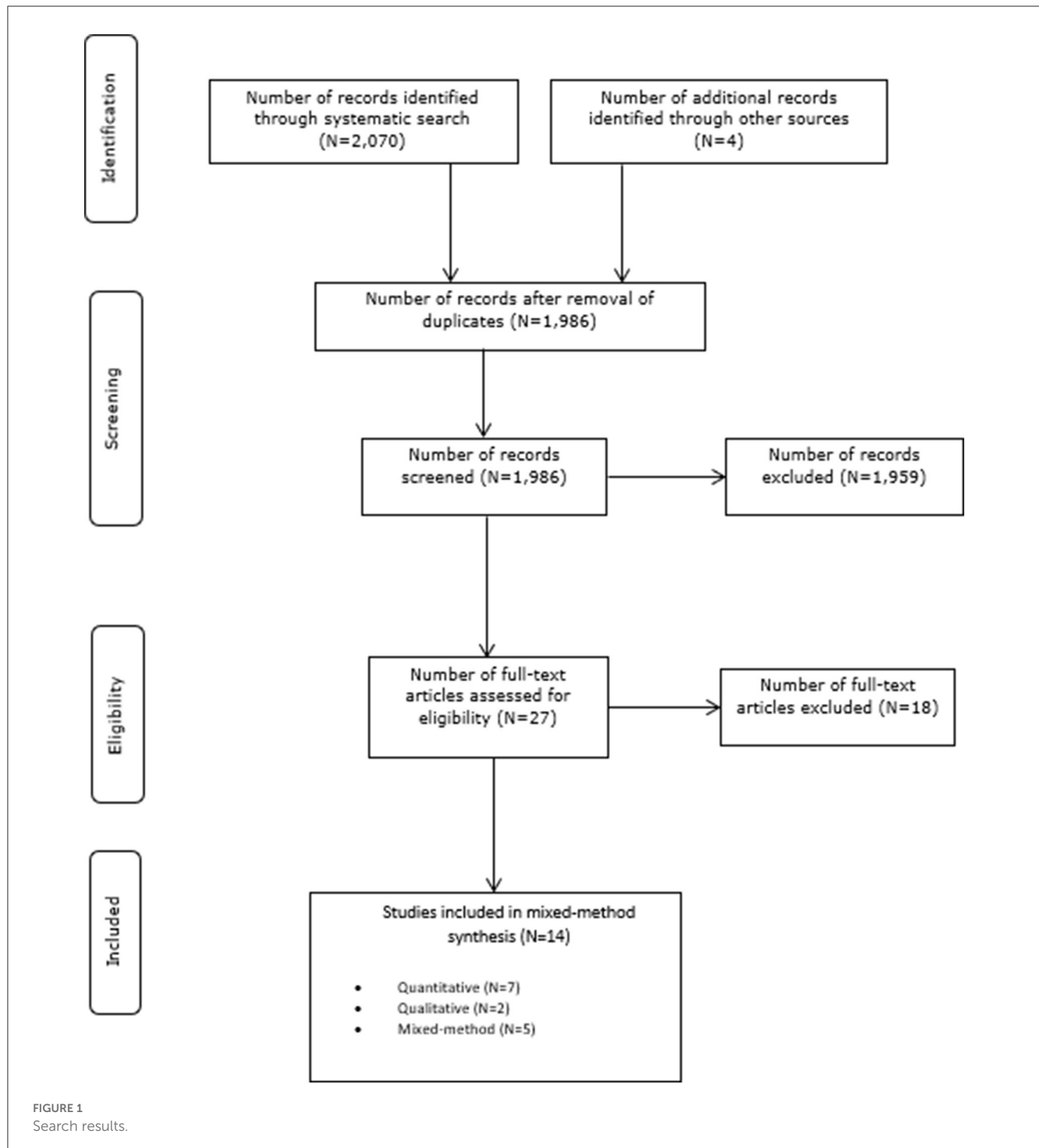
Facilitators of using advanced technology

Technology is an indispensable tool in healthcare education. The review findings revealed that the facilitators of using advanced technology include its benefits and other factors that can enhance its utilization. Two categories represented this finding, namely, benefits of using advanced technology and enablers of using advanced technology.

Benefits of using advanced technology

Many benefits associated with the use of advanced technology were expressed. These included the ability of advanced technology to improve the clinical competency of healthcare professionals during practice; increased student engagement during the learning process, which improves the overall quality of education; improved patient care, safety and outcomes; improved research and evidence-based practice skills; improved peer networking, co-working and collaboration; improved learning experience and outputs; and an enhanced understanding of self-directed learning.

The usability of advanced technology is an important factor for learners to appreciate its adoption in their learning. Factors that enhanced the usability of advanced technology included its fast speed, ease of use and accessibility (e.g., easily accessible smartphones), as illustrated in the quote below.



"I think they are very helpful and a great advancement in nursing", "very quick and easy to use as a resource" and "they are very useful and meaningful, being that my peers and I are dependent on technology and smartphones" (George et al., 2017).

Certain students expressed that using technology is essential for follow-up learning and revision, as taught information can easily be retrieved whenever needed.

"The YouTube clips are a life saver and I've often referred back to them for further understanding" (Johnston et al., 2018).

The use of advanced technology, such as mannequins, in clinical learning can greatly reduce the risks associated with inexperienced student practitioners, as these technologies can be used to portray real-life situations. Consequently, patients are protected from injury caused by the limited experience of students.

“The training is doing a good job in improving patient safety and quality care delivery. This is a plus for the advancement of healthcare services in the developing countries” (Feldacker et al., 2017).

Enablers of using advanced technology

The results of this review indicated that a number of factors should be addressed in order to fully utilize advanced technologies in the higher education of healthcare professionals. These factors included the need to provide adequate resources, such as good Internet connection and appropriate equipment; reduction of costs associated with technology use; recognition and appreciation of individuals who exert effort to learn technologies, especially courses that are outside the primary curriculum; and provision of access to technical support and mentorship on technology use, as many users will require expertise knowledge.

“Courses should have lower cost or be free and an expanded time frame (5%) to complete the course content would help with both time and technology constraints” (Feldacker et al., 2017).

Challenges of using advanced technology

Numerous factors that hinder the widespread adoption of advanced technology in healthcare education were identified. These factors included the high costs involved, a lack of relevant or adequate equipment, a lack of knowledge or understanding of such technology, a dearth of technical support, failure of technology, heavy workloads combined with time constraints, negative user attitude toward technology use and generalized user aversion to change. These barriers were found to be of much importance within low-income settings, where facilities for advanced technologies are not well-established, as illustrated in the following quote.

“The idea is very good, but it can only work in the urban areas where there is light and internet services. I would prefer to take the course in person. Because there is poor internet access especially in my area” (Feldacker et al., 2017).

Some students felt that certain technologies were time consuming and difficult to incorporate within their already busy schedules. In these cases, students preferred to study without the technology.

“How can I look at YouTube as well as all the other course resources?” (Johnston et al., 2018).

Discussion

The use of technology in higher education has been accepted in healthcare training owing to its numerous advantages in both healthcare education and practice (Guze, 2015; Ireland, 2017; Archibald and Barnard, 2018). The current review indicates that

technology is an essential tool in healthcare education; it is associated with numerous benefits, such as improved clinical competency; improved overall quality of education; improved patient care and outcomes; improved research and evidence-based practice skills; improved peer networking, co-working and collaboration; and improved learning experience and outputs for learners. These findings are consistent with those in previous studies. For example, the use of technology in the training of healthcare professionals has been reported to be advantageous in various aspects, such as demonstrating real-life situations (e.g., robots and mannequins) (Archibald and Barnard, 2018), improving psychomotor skills (Lapkin et al., 2010) and contributing to patient-centered care (Ireland, 2017). Therefore, incorporating technology in healthcare education can contribute to the care of patients and improve their outcomes. This evidence suggests that the training of healthcare professionals should embrace the use of advanced technologies in a manner that targets their use in healthcare practice. The current review findings also indicate that when technology is incorporated in the training of healthcare professionals, it is likely to improve future patient care. However, additional research should be performed to ascertain the effects of integrating technology in the training of healthcare professionals on patient outcomes. As our review shows, the use of technology in healthcare education has been driven by the need to incorporate these technologies in patient care. In modern healthcare practice, technology use is highly accepted, and the need for professionals to be adequately prepared for this task is fundamental (Risling, 2017).

Numerous factors that hinder the widespread adoption of advanced technology in healthcare education were identified. These factors included the high costs involved, a lack of relevant or adequate equipment, a lack of knowledge or understanding of such technology, a dearth of technical support, failure of technology, heavy workloads combined with time constraints, negative user attitude toward technology use and generalized user aversion to change. Previous studies reported related concerns, such as increased costs (Mohammed et al., 2017), having to adopt new curriculums and learning new technologies and teaching techniques (Johnson et al., 2016), as barriers to using technology in training. In particular, our findings indicate that low-income settings are affected by specific barriers, such as Internet accessibility and related costs (Feldacker et al., 2017). Thus, special interventions should be designed to address the challenges encountered in low-income settings.

The results of our review further reveal that several factors need to be addressed to fully use advanced technologies in healthcare training. For example, the provision of adequate resources, reduction of the high costs associated with technology use, recognition of the effort of learners and provision of technical support and mentorship are needed in order to successfully implement technology in the education of healthcare professionals in higher institutions of learning. These findings highlight the need to continuously improve this new educational paradigm to strengthen its adoption in the higher education of healthcare professionals. Our review sets precedence for the need to avail incentives to both learners and educators

for adequate adoption of technology in higher education of healthcare professionals.

Study limitations and directions for future studies

We included papers globally yet technological advances stand at different levels in different countries. It is necessary that future research assesses how technology is applied in healthcare professional training and if variations exist in different geographical settings. In addition, our study was limited to exploring the views and experiences of using advanced technology. Future research should also seek to understand the influence of advanced technology on the education and training of professionals within the healthcare sector. Furthermore, studies are needed to ascertain the effects of incorporating technology in the training of healthcare professionals on patient outcomes.

Conclusion and implications

Emerging trends including pandemics such as COVID-19 have warranted the need to incorporate advanced technology in the training of healthcare professionals. Our study has indicated that advanced technology is generally accepted by both healthcare teachers and students as it may improve the teaching and learning experience and is likely to result into lifelong learning. While this trend is generally accepted, it does have certain challenges that require to be addressed for its success. Our study identifies the need for institutional support of both learners and educators in terms of training and aligning teaching with modern technology, and to ensure widespread availability of the technology to all required users.

References

- Archibald, M. M., and Barnard, A. (2018). Futurism in nursing: technology, robotics and the fundamentals of care. *J. Clin. Nurs.* 27, 2473–2480. doi: 10.1111/jocn.14081
- Arzu, A., Firdevs, E., and Mustafa, A. T. (2014). Psychometric properties and reliability of the turkish version of the technology attitudes survey and nursing students' attitudes toward technology. *Int. J. Caring Sci.* 7, 415–425.
- Au-Yong-Oliveira, M., Gonçalves, R., Martins, J., and Branco, F. (2018). The social impact of technology on millennials and consequences for higher education and leadership. *Telemat. Inform.* 35, 954–963. doi: 10.1016/j.tele.2017.10.007
- Chiou, S. F., Su, H. C., and Huang, E. W. (2017). The application of information and communication technology (ICT) in nursing education. *Hu Li Za Zhi* 64, 5–11. doi: 10.6224/JN.000077
- Dahan-Oliel, N., Shikako-Thomas, K., and Majnemer, A. (2012). Quality of life and leisure participation in children with neurodevelopmental disabilities: a thematic analysis of the literature. *Qual. Life Res.* 21, 427–439. doi: 10.1007/s11136-011-0063-9
- Dyer, E., Swartzlander, B. J., and Gugliucci, M. R. (2018). Using virtual reality in medical education to teach empathy. *J. Med. Library Assoc.* 106, 498–500. doi: 10.5195/jmla.2018.518
- Feldacker, C., Jacob, S., Chung, M. H., Nartker, A., and Kim, H. N. (2017). Experiences and perceptions of online continuing professional development among clinicians in sub-Saharan Africa. *Hum. Resour. Health* 15, 1–8. doi: 10.1186/s12960-017-0266-4
- George, T. P., DeCristofaro, C., Murphy, P. F., and Sims, A. (2017). Student perceptions and acceptance of mobile technology in an undergraduate nursing program. *Healthcare* 5, 35. doi: 10.3390/healthcare5030035
- Goodchild, T. (2018). Does technology really enhance nurse education? *Nurse Educ. Today* 66, 69–72. doi: 10.1016/j.nedt.2018.04.005
- Guze, P. A. (2015). Using technology to meet the challenges of medical education. *Trans. Am. Clin. Climatol. Assoc.* 126, 260–270.
- Hamidi, H., and Chavoshi, A. (2018). Analysis of the essential factors for the adoption of mobile learning in higher education: a case study of students of the University of Technology. *Telemat. Inform.* 35, 1053–1070. doi: 10.1016/j.tele.2017.09.016
- Heden, L., and Ahlstrom, L. (2016). Individual response technology to promote active learning within the caring sciences: an experimental research study. *Nurse Educ. Today* 36, 202–206. doi: 10.1016/j.nedt.2015.10.010
- Hincapie, A. L., Cutler, T. W., and Fingado, A. R. (2016). Incorporating health information technology and pharmacy informatics in a pharmacy professional didactic curriculum -with a team-based learning approach. *Am. J. Pharm. Educ.* 80, 107. doi: 10.5688/ajpe806107
- Hosen, M., Uddin, M. N., Hossain, S., Islam, M. A., and Ahmad, A. (2022). The impact of COVID-19 on tertiary educational institutions and students in Bangladesh. *Heliyon* 8, e08806. doi: 10.1016/j.heliyon.2022.e08806
- Ireland, A. V. (2017). Simulated human patients and patient-centredness: the uncanny hybridity of nursing education, technology, and learning to care. *Nurs. Philos.* 18, e12157. doi: 10.1111/nup.12157
- Jeffries, P. R., Bushardt, R. L., DuBose-Morris, R., Hood, C., Kardong-Edgren, S., Pintz, C., et al. (2022). The role of technology in health professions

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

MA conducted the review. MA and SN designed, drafted, and revised the manuscript for intellectual content. Both authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/feduc.2023.1064697/full#supplementary-material>

- education during the COVID-19 pandemic. *Acad. Med.* 97, S104–S109. doi: 10.1097/ACM.00000000000004523
- Jelec, K., Sukalic, S., and Friganović, A. (2016). Nursing and implementation of modern technology. *Signa Vitae* 12, 23–27. doi: 10.22514/SV121.102016.3
- Johnson, A. M., Jacovina, M. E., Russell, D. E., and Soto, C. M. (2016). *Challenges and Solutions When Using Technologies in the Classroom*. New York: Taylor & Francis.
- Johnston, A. N., Barton, M. J., Williams-Pritchard, G. A., and Todorovic, M. (2018). Youtube for millennial nursing students; using internet technology to support student engagement with bioscience. *Nurse Educ. Pract.* 31, 151–155. doi: 10.1016/j.nepr.2018.06.002
- Kämpfen, F., and Maurer, J. (2018). Does education help “old dogs” learn “new tricks”? The lasting impact of early-life education on technology use among older adults. *Res. Policy* 47, 1125–1132. doi: 10.1016/j.respol.2018.03.017
- Lapkin, S., Fernandez, R., Levett-Jones, T., and Bellchambers, H. (2010). The effectiveness of using human patient simulation manikins in the teaching of clinical reasoning skills to undergraduate nursing students: a systematic review. *JBI Database Syst. Rev. Implement. Rep.* 8, 661–694. doi: 10.11124/01938924-201008160-00001
- Laschinger, S., Medves, J., Pulling, C., McGraw, R., Waytuck, B., Harrison, M. B., et al. (2008). Effectiveness of simulation on health profession students' knowledge, skills, confidence and satisfaction. *JBI Database Syst. Rev. Implement. Rep.* 6, 265–309. doi: 10.11124/01938924-200806070-00001
- Linderman, S. W., Appukutty, A. J., Russo, M. V., Shah, A. P., and Javaherian, K. (2020). Advancing healthcare technology education and innovation in academia. *Nat. Biotechnol.* 38, 1213–1217. doi: 10.1038/s41587-020-0689-7
- Little, G. N. (2013). *The Effect of a Simulation Experience on Student Perception of Self Confidence (Publication Number 68)*, Gardner-Webb University.
- Long, J. D., Gannaway, P., Ford, C., Doumit, R., Zeeni, N., Sukkarieh-Haraty, O., et al. (2016). Effectiveness of a technology-based intervention to teach evidence-based practice: the EBR tool. *Worldviews Evid. Based Nurs.* 13, 59–65. doi: 10.1111/wvn.12132
- Mackay, B. J., Anderson, J., and Harding, T. (2017). Mobile technology in clinical teaching. *Nurse Educ. Pract.* 22, 1–6. doi: 10.1016/j.nepr.2016.11.001
- Martins, J., Branco, F., Gonçalves, R., Au-Yong-Oliveira, M., Oliveira, T., Naranjo-Zolotov, M., et al. (2018). Assessing the success behind the use of education management information systems in higher education. *Telemat. Inform.* 38, 182–193. doi: 10.1016/j.tele.2018.10.001
- Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., and The, PRISMA, Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Ann. Intern. Med.* 151, 264–269. doi: 10.7326/0003-4819-151-4-200908180-00135
- Mohammed, R. G. A., Mohammed, H. M., and El-sol, A. E. (2017). New technology in nursing education and practice. *J. Nurs. Health Sci.* 6, 2320–1940.
- Moreira, F., Ferreira, M. J., Santos, C. P., and Durão, N. (2017). Evolution and use of mobile devices in higher education: a case study in Portuguese Higher Education Institutions between 2009/2010 and 2014/2015. *Telemat. Inform.* 34, 838–852. doi: 10.1016/j.tele.2016.08.010
- Pace, R., Pluye, P., Bartlett, G., Macaulay, A. C., Salsberg, J., Jagosh, J., et al. (2012). Testing the reliability and efficiency of the pilot Mixed Methods Appraisal Tool (MMAT) for systematic mixed studies review. *Int. J. Nurs. Stud.* 49, 47–53. doi: 10.1016/j.ijnurstu.2011.07.002
- Pluye, P. (2011). *Collaborative Development of a Mixed Methods Appraisal Tool: A Public WIKI Workspace*. Available online at: <http://mixedmethodsappraisaltoolpublic.pbworks.com/w/page/24607821/FrontPage> (accessed December 1, 2022).
- Pluye, P., Gagnon, M. P., Griffiths, F., and Johnson-Lafleur, J. (2009). A scoring system for appraising mixed methods research, and concomitantly appraising qualitative, quantitative and mixed methods primary studies in Mixed Studies Reviews. *Int. J. Nurs. Stud.* 46, 529–546. doi: 10.1016/j.ijnurstu.2009.01.009
- Risling, T. (2017). Educating the nurses of 2025: technology trends of the next decade. *Nurse Educ. Pract.* 22, 89–92. doi: 10.1016/j.nepr.2016.12.007
- River, J., Currie, J., Crawford, T., Betihavas, V., and Randall, S. (2016). A systematic review examining the effectiveness of blending technology with team-based learning. *Nurse Educ. Today* 45, 185–192. doi: 10.1016/j.nedt.2016.08.012
- Schmeer, R., Behrends, M., Kupka, T., Meyenburg-Altward, I., and Marschollek, M. (2016). Use and acceptance of mobile technology by hospital nurses in Germany. *Stud. Health Technol. Inform.* 225, 944–945.
- Sklar, D. P. (2019). The influence of technology on health professions education and health care delivery: new opportunities and responsibilities for health professions educators. *Acad. Med.* 94, 607–609. doi: 10.1097/ACM.0000000000002652
- Todhunter, F. (2015). Using concurrent think-aloud and protocol analysis to explore student nurses' social learning information communication technology knowledge and skill development. *Nurse Educ. Today* 35, 815–822. doi: 10.1016/j.nedt.2015.01.010
- Van Schyndel, J. L. (2015). *Nursing Students' Perceptions of Presence in Online Courses*, Indiana University.
- Vogt, M. A., and Schaffner, B. H. (2016). Evaluating interactive technology for an evolving case study on learning and satisfaction of graduate nursing students. *Nurse Educ. Pract.* 19, 79–83. doi: 10.1016/j.nepr.2016.05.006
- Watts, L. K. (2018). Social media considerations in higher education: recommendations for radiologic sciences education. *Radiol. Sci. Educ.* 23, 17–24.
- Webb, L., Clough, J., O'Reilly, D., Wilmott, D., and Witham, G. (2017). The utility and impact of information communication technology (ICT) for pre-registration nurse education: a narrative synthesis systematic review. *Nurse Educ. Today* 48, 160–171. doi: 10.1016/j.nedt.2016.10.007
- Wilkinson, A., Roberts, J., and While, A. (2013). Nursing students' use of technology enhanced learning: a longitudinal study. *J. Nurs. Educ. Pract.* 3, 102. doi: 10.5430/jnep.v3n5p102



OPEN ACCESS

EDITED BY

Ana Luisa Rodrigues,
University of Lisbon,
Portugal

REVIEWED BY

Zhe Li,
Osaka University,
Japan
Ingrid Isenhardt,
RWTH Aachen University,
Germany

*CORRESPONDENCE

Walton Wider
✉ walton.wider@newinti.edu.my

SPECIALTY SECTION

This article was submitted to
Higher Education,
a section of the journal
Frontiers in Education

RECEIVED 11 January 2023

ACCEPTED 20 February 2023

PUBLISHED 22 March 2023

CITATION

Zakaria H, Kamarudin D, Fauzi MA and
Wider W (2023) Mapping the helix model of
innovation influence on education: A
bibliometric review.
Front. Educ. 8:1142502.
doi: 10.3389/feduc.2023.1142502

COPYRIGHT

© 2023 Zakaria, Kamarudin, Fauzi and Wider.
This is an open-access article distributed under
the terms of the [Creative Commons Attribution
License \(CC BY\)](#). The use, distribution or
reproduction in other forums is permitted,
provided the original author(s) and the
copyright owner(s) are credited and that the
original publication in this journal is cited, in
accordance with accepted academic practice.
No use, distribution or reproduction is
permitted which does not comply with these
terms.

Mapping the helix model of innovation influence on education: A bibliometric review

Haziman Zakaria¹, Diyana Kamarudin², Muhammad Ashraf Fauzi¹
and Walton Wider^{2*}

¹Faculty of Industrial Management, Universiti Malaysia Pahang, Gambang, Malaysia, ²Faculty of Business and Communications, INTI International University, Nilai, Malaysia

As a direct result of the increased significance of knowledge in the various endeavours attempting to implement the triple helix model, higher education institutions have assumed a more prominent position in the processes involved in regional innovation and development. Expanding study on the helix model is currently examining the underlying causes and consequences of the evolution of the helix model in education. This research examines the relationship between the triple helix model and education by using bibliometric analysis on 227 articles subjected to peer review between 1970 and 2022. This investigation concentrated on three aspects of analysis: (1) document citation via the use of co-citation analysis that produce 4 clusters; (2) document cited reference through the utilisation of bibliographic coupling that generates 5 clusters; and (3) document keyword through the utilisation of co-word analysis with 4 clusters. These results are essential for academics, practitioners, and other interested parties working to improve the helix model for policymakers by putting it into an education strategy.

KEYWORDS

triple helix model, quadruple helix model, quintuple helix model, education, entrepreneurship education, bibliometric analysis

1. Introduction

The helix models of innovation (triple, quadruple and quintuple) turn over contribution to the innovation study area, emphasising the university's expanded role in the middle of a knowledge-based society (Cai and Lattu, 2022). This emphasis is distinct from previous innovation strategies, which emphasised interactions between firms or between firms and governments (Carayannis et al., 2021). The university ranks first due to its increased importance in technology transfer (TT), company formation, and regional revitalisation inside the knowledge society. In contrast, in an industrial society, it ranks second (Cai and Etzkowitz, 2020). The Helix model of innovation and major innovation theory acknowledges the importance of three main components and their interplay (universities, industry, and government) that nurse innovation and cultivate entrepreneurship (Afzal et al., 2018). However, most innovation theories and models emphasise that industry or company are the main factors influencing innovation (Cai and Amaral, 2021).

Previous helix of innovation models literature views this universities, industry, and government (UIC) as a “block” object that exists without delving deeper into each actor in a globular-object connection. Viewing the connection in sphere-specific actors will open a new perspective that conceals exemplary character, objective, aim, responsibility and challenge. This

new view also will reveal how they affect the interplay dynamics between the actors (Shinn, 2002; Etzkowitz, 2003b; Galvao et al., 2019). One of the university's significant contributions is extending TT. TT will expand and derive university capabilities to produce graduates with entrepreneurial mindsets and skills that will play a significant regional economic role by creating jobs and initiating new businesses (Etzkowitz, 2016). Universities throughout the world now offer a variety of entrepreneurship education programmes to help students cultivate entrepreneurship mindset skills, gain practical and theoretical business development knowledge, inspire new learning paradigms, and cultivate an entrepreneurial mindset as a valuable asset when pursuing careers (Meyer, 2003; Bienkowska and Klofsten, 2012; Boldureanu et al., 2020).

Additionally, academic entrepreneurship is another innovation that will impact the local, regional, and national economies. To boost the entrepreneurial activities and TT within academics, university faculty can maintain the establishment and student participation in research by increasing educational and entrepreneurial research funding. This action will lead to the cooperation of nearby businesses, and entrepreneurs and academics can have an opportunity to test their knowledge outside the university's walls (Shane, 2004; Davey et al., 2016; Hayter, 2016; Sansone et al., 2021).

Therefore, this study aims:

1. To investigate past themes of the helix model on education.
2. To determine the current knowledge structure of the helix model on education.
3. To forecast and predict research trends of the helix model on education.

As far as the author is aware, there is no systematic review based on a bibliometric analysis that captures knowledge structure by mapping and visualising the specific context of the economic contexts of the helix model on education. This study is the first to undertake a quantitative review of the literature on the scope of the helix model and education using the Web of Science database (WOS) to conduct a bibliometric analysis. Such an approach will help researchers explore this area, gain deeper insights and predict future trends in the knowledge economy in higher education. This review also provides an idea of what previous studies have dealt with over the past 22 years and how meaningful clusters and university functional themes in helix models may be significant in the future. Our study explores the helix model in education by looking at universities as one of the main actors in this model and how they function. This study also presents a roadmap for a well-informed research agenda, advocating the use and advancement of helix models to open up new areas of inquiry and theoretical development within helix models on education. This discovery will clarify and direct the helix model's future research on education.

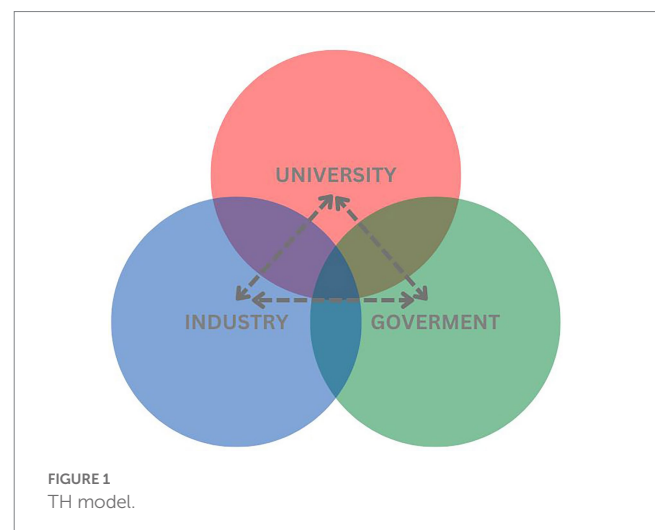
This study is arranged as the following. The helix model and the purpose of the study are introduced in Section 1 of the text. The history of the helix model and its connection to education are discussed in Section 2 of the literature review. In Section 3, the methodology based on bibliometric analysis is described. Results of all studies and comments based on clusters and included themes are provided in Section 4. The theoretical and practical ramifications are covered in part 5. Section 6 discusses the study's limitations, future work and conclusion.

2. Literature review

The Triple Helix (TH) Model was developed in 1995 to describe the fundamental trends in knowledge-based economies (Etzkowitz, 2003b). This strategy highlights the contributions that top universities make to society and the dissemination of knowledge (Ranga and Garzik, 2015). The TH model emphasises regional social development due to its characteristics, which include a strong interplay between three critical social systems: industry, universities, and governments (Cai and Lattu, 2022). It is impossible to overstate the significance of these three direct social systems of interaction and cooperation and their mutual benefits. Academics must analyse social networking as a “neo-intuitive structure” because the interconnection of networks in universities, businesses, and governments is essential (Carayannis and Campbell, 2009; Galvao et al., 2019). The TH model is the basis for the quadruple and quintuple helix models, which include an additional environment helix. Five-helix model is another name for the quintuple-helix model (Carayannis et al., 2012, 2021).

Through the application of knowledge and innovation, interactions between UICs have created a three-dimensional flow of materials and information (Ivanova and Leydesdorff, 2014). The TH model intentionally modifies the knowledge transfer process. Thus, the main objective of universities has shifted from the transmission of knowledge to the production of new ideas and innovations, and this shift is currently taking place in many countries (Ranga and Etzkowitz, 2013). The university is indispensable for innovation development, especially in business development, research, teaching and training for social engagement. In addition to its role as an investor, the institution engages in business activities such as TT and artistic ventures. The TH model is a tool for assessing the economic balance between knowing “when to intervene” and “when not to intervene” in innovation development (Carayannis and Campbell, 2010; Cunningham et al., 2018). Figure 1 represents the interaction of UIC in the TH model.

Participation in technology transfer by universities has also enhanced their capacity to train and develop graduates' entrepreneurial skills (Bercovitz and Feldman, 2005). These graduates have the potential to stimulate economic growth by launching new businesses and filling vacancies. Significant gains have also been observed at the local level, where economic gains from university start-ups, such as



job creation and tax revenue, are combined with social and cultural gains, such as favourable social perception of entrepreneurs, stronger ties between the university and the community, and a heightened appeal of the university and the region to talent and investors from across the nation and the globe (Siegel et al., 2003a; Fromhold-Eisebith and Werker, 2013; del Giudice et al., 2017; Cunningham et al., 2018; Paoloni et al., 2019). Obtaining the designation of “entrepreneurial university” is crucial for many cities worldwide because it provides access to highly skilled workers, entrepreneurs with rapid growth, and venture capital investment (Boldureanu et al., 2020). This frequently results in the region becoming an entrepreneurial ecosystem of the highest calibre (Ranga and Etzkowitz, 2013). Through entrepreneurship, incubator programmes, and brand-new training modules, universities are expanding their educational capabilities beyond educating individuals to educate organisations (Skute, 2019).

2.1. Bibliometric approach

A bibliometric analysis is a technique utilised to map the structure and development of a specific scientific field. It applies a quantitative methodology to scientific mapping. In order to analyse and evaluate scientific literature, bibliometric tools will enhance qualitative structured literature reviews and meta-analyses by visualising the scientific knowledge in network mapping. The network visualisation uses the bibliometric database to build, analyse, and visualise the scientometric study (van Eck and Waltman, 2014). Bibliometric analysis studies and reports on numerous aspects of the scientific community, including research topics, methodology, notable scholars, organisations, and publications. It helps investigate the impact of research (Serenko et al., 2010), patterns of collaboration, and the conceptual framework of journals (Serenko, 2013; Ramy et al., 2018). According to (Mingers and Leydesdorff, 2015), bibliometrics is transitioning to altmetrics or Scientometrics 2.0, where social networking metrics such as likes, downloads, views, and reads are replacing journal citations. Thus to achieve this study’s three objectives, this paper will take up three scientometric analyses: (i) co-citation analysis, (ii) bibliographic coupling, and (iii) co-word analysis.

Co-citation analysis is a method for locating pairs of papers cited in the same source articles (Boyack and Klavans, 2010). When multiple authors simultaneously co-cite the same pair of papers, the seeds of a research cluster are planted. Most of these cited papers have something in common, such as making predictions about a popular topic (Boyack and Klavans, 2010). Bibliographic coupling is the process of linking documents with the same reference of cited documents is referred to as “bibliographic coupling.” This method determines how similar two citing articles are (Maseda et al., 2022). This approach is the most forward-thinking of the citation-based methods and is appropriate for analysing current research trends in the field (Boyack and Klavans, 2010). Bibliographic coupling was done by counting the words in the title, abstract and authors, and keywords. The clusters are formed by the inductive interpretation of the authors based on the word connections among them. Co-word analysis: The extraction of keywords from a publication’s title, abstract, and keywords is the first step in the co-word analysis (van Eck and Waltman, 2014). It investigates the relationship between various concepts that appear in the keywords simultaneously.

Co-word analysis is a content analysis method that uses quantitative descriptions to map the relationship between information items in textual data and to analyse the content of scientific or other types of articles. A co-word analysis can reveal the significance of a field’s structure, which can then be used to forecast future trends (Fauzi, 2017). Co-word analysis is the only bibliometric method that performs a similarity analysis based on the primary text (Zupic and Čater, 2014).

2.2. Data collection

The most dependable, trustworthy, and high-quality article database from WOS was utilised to collect data for this study (Mongeon and Paul-Hus, 2016). Numerous scholars have utilised the WOS database for scientometrics and bibliometric research (Mejia et al., 2021; Craiut et al., 2022; López-Rubio et al., 2022). VOSviewer (V1.6.18) is an analytical tool to map the collected data. VOSviewer is the optimal application for constructing a network of research papers using a quantitative database technique, as it can display and navigate scientific maps based on retrieved databases (Flamini et al., 2022). Table 1 lists the search string terms used in this investigation. The expanded list of keywords and concepts in the TH model covers all practical queries in the TH model’s current field. Then, to locate all relevant data related to the research objective, education and its associated keywords and concepts act as second keyword strings. The search returned 557 publications published between 2000 to 2022, including journal articles, conference proceedings, periodicals, novels, books, and book chapters. The search was only limited to relevant citation topic meso, which are (1) Management ($N=473$), (2) education and education research ($N=49$), (3) bibliometrics, scientometrics and research integrity ($N=21$), and (4) economics (14). There were 4,507 citing articles, of which 4,264 were not self-citations. A total of 5,695 articles are time cited, and 5,204 are without self-citation. The database h-index is 33, and the average number of citations per article was 10.22.

3. Result and analysis

The concept of the TH model and other helix models for education topics is of intense interest to academicians worldwide, as seen in Figure 2. The first published topic related to study keywords was in 2000; since then, it has grown significantly. The publication and citation trend shows that interest in the topic continues growing as more people become interested in studying the helix model for education and its effect on education and socio-economic development in the region.

TABLE 1 Study keyword search string.

No	Keywords	Explanation
1	“Helix model* of innovation” OR “Triple helix” OR “Quadruple helix” OR “Quintuple helix”	To identify literature related to the triple helix model of innovation
2	“Education*” OR “Montessori” OR “Learning*”	To identify literature related the education

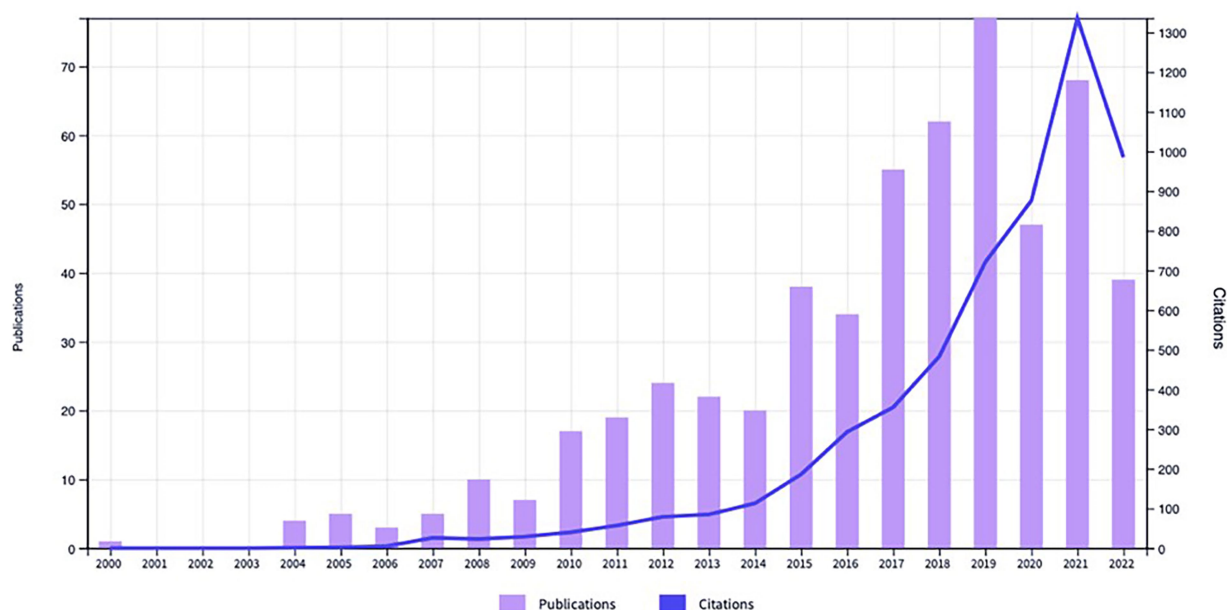


FIGURE 2
Search analysis summary on helix model and education in WOS.

3.1. Co-citation analysis

The analysis threshold value was set for the articles with 20 or above cited references. Table 2 show a summary of the highest cited document where Etzkowitz et al. (2000) (295 times), Etzkowitz (2003b) (112 times), and Etzkowitz et al. (80 times) are the top 3 in 48 cited reference from the total 22,605 cited reference.

The co-citation network of the helix models and education has been envisioned using VOSviewer software in Figure 3. Table 3 presents the helix model and education summary based on the co-citation analysis consisting of the cluster number and colour, cluster labels, number of articles and representative articles.

Based on the co-citation network of the helix model and education result, the authors managed to interpret the cluster shown in Table 3.

- Cluster 1 (red): With 17 articles, cluster 1 represents “Triple helix development.”

This cluster explains the expansion of the helix model of innovation as one of the fundamental theories for the knowledge-sharing economy, starting from establishing the TH. Etzkowitz and Leydesdorff (2000) proposed the use of a more dynamic model named the TH of the university-industry-government relationship compared to a non-linear model of innovation like the national innovation system and mode 2. The TH model consists of three actors (UIC). When three selection actors (industry wealth generation, university product novelty and government control) in the TH are involved, more complex dynamics resulting from interplay requiring “bi” or “tri” lateral relations can be expected (Leydesdorff and Meyer, 2006). The evolution of the TH model grew toward the introduction of ‘mode 3’ and ‘quadruple helix’ by Carayannis and Campbell (2009). This extension adds another helix (cultured-based public) into the model to evaluate how media and public reality influence the national innovation system. In 2010, a proposed framework of the quintuple helix by Carayannis and Campbell added another actor into the

model: the environment. This model broadens out to weigh the factor of sustainability and the opportunity for the model to be used in the transdisciplinary area to understand more about knowledge and innovation development (Carayannis and Campbell, 2010). Ranga and Etzkowitz (2013) explain the TH frameworks, boundaries and distinction between the components and institution as the relationship between the institution and the system’s function. Leydesdorff (2012) recommends a complete justification for those who like to evolve the model more than the main three actors. The justification includes relevant data, further development and relevant operationalisation and specification indicators.

- Cluster 2 (green): With 22 articles, cluster 2 represents an “entrepreneurial university.”

The entrepreneurial university concept was preliminarily discussed as entrepreneurial activities related to the formation of a new business company by a university academic or joint venture with a private company to commercialise their research (Etzkowitz, 1983). The endless transaction of the TH model brings the future of the university’s role in knowledge innovation (Etzkowitz and Leydesdorff, 2000). University intuitional transformation opens a broad new interpretation of university entrepreneurship activity that can be developed within the TH model. The evolution of universities from conserving knowledge to entrepreneurial and innovative activities will not stop the main function of universities in teaching and conducting research (Etzkowitz, 2003b). Entrepreneurial universities play an essential role in improving the university’s financial performance, region, and national economy through academic knowledge creation (e.g., company spin-off). Rothaermel et al. (2007) simplify the dynamic process of university entrepreneurship into four central themes, which are (1) entrepreneurial research university, (2) productivity of technology transfer offices (TTOs), (3) new firm creation, and (4) environmental context including networks of innovation. Guerrero and Urbano (2012) identified academic and

TABLE 2 Top 15 from 48 publication with the highest cited reference.

No	Authors	Publication	Citation	Total link strength
1.	Etzkowitz and Leydesdorff (2000)	Res Policy, v29, p109	295	1,030
2.	Etzkowitz (2003b)	Soc Sci Inform, v42, p293	112	509
3.	Etzkowitz et al. (2000)	Res Policy, v29, p313	80	472
4.	Perkmann et al. (2013)	Res Policy, v42, p423	59	331
5.	Leydesdorff and Etzkowitz (1996a)	EASST Review, v15	58	253
6.	Carayannis and Campbell (2009)	Int J Tech Manag, v46, p201	55	225
7.	Ranga and Etzkowitz (2013)	Ind Higher Educ, v27, p237	54	258
8.	Gibbons et al. (1994)	Sage Publication Inc.	54	220
9.	Etzkowitz (2008)	Routledge, New York	53	260
10.	D'Este and Patel (2007)	Res Policy, v36, p1295	45	242
11.	Etzkowitz and Leydesdorff (1998)	Minerva, v36, p203	45	174
12.	Lundvall (1992)	Anthem Press, p85	42	209
13.	Etzkowitz (2003b)	Res Policy, v32, p109	41	277
14.	Etzkowitz (1998)	Res Policy, v27, p823	40	279
15.	Etzkowitz and Klofsten (2005)	R&D Manag, v35, p243	40	210

student mindsets toward entrepreneurship as a critical factor in entrepreneurial university development. Among the factor in the development of academic and student entrepreneurship mindset are (1) entrepreneurship education, (2) teaching methodologies, (3) role models and (4) reward systems. While the entrepreneurial university was established in response to the need for TT and knowledge-based businesses, its role in the entrepreneurial society has evolved to encompass cultivating entrepreneurial behaviour and boosting entrepreneurship capital ([Audretsch, 2014](#)).

- Cluster 3 (blue): with 11 articles and cluster 3, known as “knowledge-based economy.”

Knowledge transfer is the fundamental knowledge-based economy in the TH model that shows how knowledge is utilised and transferred into wealth. Common knowledge and TT happen through research joint ventures, licensing agreements, intellectual properties, start-ups and spin-offs governed by university TTOs ([Siegel et al.,](#)

[2003a,b](#)). Siegel also identified some barriers that affect the knowledge transfer process: (1) bureaucratic inflexibility, (2) ineffective management of university TTOs, (3) poorly designed reward systems and culture clashes. In the same year, [Siegel et al. \(2003b\)](#) identify that TTOs compensation practices, cultural barriers between universities and industry and faculty reward systems are crucial organisational factors in evaluating TTOs’ productivity and performance. [Bercovitz and Feldman \(2005\)](#) proposed a framework to develop a deeper understanding of university-industry relationships and their function within knowledge-based innovation systems. These influences include (1) sponsoring research, (2) hiring of students, (3) spin-off firms, (4) license and (5) serendipity (economic, social, and political factors) that influence universities’ ability to generate new knowledge and deploy that knowledge for economic gain. [Perkmann and Walsh \(2007\)](#) identified that in university-industry relationships, most firms want to learn motives and capacity-building (research partnerships, contract research and consulting) in the innovation cycles rather than tangible outcomes such as product and innovation. [Perkmann et al. \(2013\)](#) proposed that growing both the quantity and quality of university-industry contacts would seem possible with the help of fostering individual engagement abilities.

- Cluster 4 (yellow): with eight articles and cluster 4, known as “Mode 2- academic capitalism and society.”

This cluster discusses the dynamic relationship between the knowledge economy in academic capitalism and society. [Helga et al. \(2001\)](#) describe the university’s role in knowledge production as a scientific and social institution that does not neglect its social roles under the mode-2 condition. The future university will become more open in the sense of their socio-economic, cultural, and scientific roles and remove the internal and external boundaries (de-institutionalisation). [Etzkowitz \(2002\)](#) share how the Massachusetts Institute of Technology (MIT) university’s role in entrepreneurial science changed the landscape of American academic institution and their impact not only on the generation of intellectual and social but also on human capital until it became a core institution in society. [Slaughter and Rhoades \(2004\)](#) discuss the concept of social entrepreneurship, in which profit/non-profit blends bring innovation and opportunity, as well as unforeseen change and risk. This type of business can put universities at the forefront of hybridisation.

3.2. Bibliographic coupling analysis

From 557 documents, 149 met the 30 thresholds in the bibliographic coupling analysis. The top 10 highest publication based on the cited document is shown in [Table 4](#). [D'Este and Patel \(2007\)](#) (801 citations), [Ankrah and AL-Tabbaa \(2015\)](#) (338 citations) and, [Martinelli et al. \(2008\)](#) (156 citations) is the top cited article. The remaining top 10 cited articles for study bibliographic coupling analysis are represented in [Table 4](#).

[Figure 4](#) visualises the bibliographic coupling network of the helix models and education. [Table 5](#) presents the helix model and education summary based on the bibliographic coupling analysis consisting of the cluster number and colour, cluster labels, number of articles and representative articles.

Based on the bibliographic coupling network of the helix model and education result, the authors managed to interpret the cluster shown in [Table 5](#).

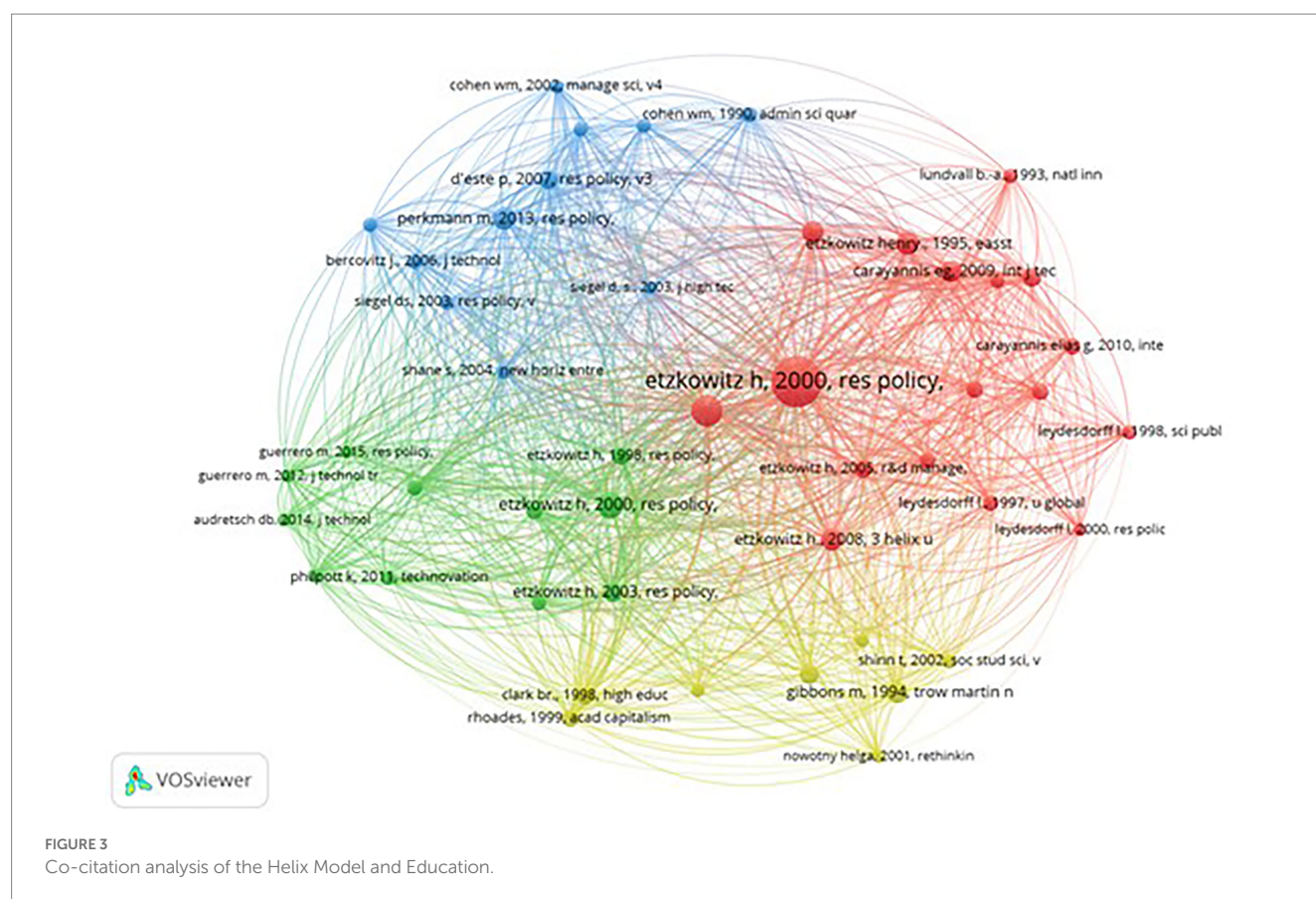


TABLE 3 Co-citation cluster on helix model and education.

Cluster 1 (Red) – Triple helix development, <i>N</i> =17	Cluster 2 (Green) – Entrepreneurial university concept, <i>N</i> =11	Cluster 3 (Blue) – knowledge-based economy, <i>N</i> =11	Cluster 4 (yellow) – Mode 2 – Academic capitalism and society, <i>N</i> =8
Carayannis and Campbell (2009)	Audretsch (2014)	Bercovitz and Feldman (2005)	Clark (1998)
Carayannis and Campbell (2010)	Etzkowitz (1983)	Bruneel et al. (2010)	Etzkowitz and Leydesdorff (1998)
Etzkowitz & Leydesdorff (2000a)	Etzkowitz (1998)	Cohen and Levinthal (1990)	Etzkowitz (2002)
Etzkowitz (2003b)	Etzkowitz et al. (2000)	Cohen et al. (2002)	Gibbons et al. (1994)
Etzkowitz and Klofsten (2005)	Etzkowitz (2003a)	D'Este and Patel (2007)	Helga et al. (2001)
Etzkowitz (2008)	Etzkowitz (2004)	D'Este and Perkmann (2011)	Slaughter and Leslie (1999)
Leydesdorff and Etzkowitz (1996a)	Guerrero and Urbano (2012)	Perkmann and Walsh (2007)	Shinn (2002)
Etzkowitz and Leydesdorff (2000b)	Guerrero et al. (2015)	Perkmann et al. (2013)	Slaughter and Rhoades (2004)
Leydesdorff and Meyer (2006)	Jacob et al. (2003)	Shane (2004)	
Leydesdorff (2012)	Philpott et al. (2011)	Siegel et al. (2003a)	
Leydesdorff and Etzkowitz (1996b)	Rothaermel et al. (2007)	Siegel et al. (2003b)	
Etzkowitz and Leydesdorff (1993)			
Leydesdorff and Etzkowitz (1998)			
Lundvall (1992)			
Lundvall and Edquist (1993)			
Nelson (1993)			
Ranga and Etzkowitz (2013)			

• Cluster 1 (red): With 16 articles, cluster 1 represents “Third mission: Entrepreneurial university co-creation in triple helix.”

This cluster explains the function of actors in the TH innovation model for developing an entrepreneurial university. Crespo et al. (2006) identified that the success factor for academic commercialisation

and intellectual properties in universities mainly depends on support from the public and government funding. The third objective has typically emphasised commercial interaction, especially licencing and spin-off operations, intending to foster entrepreneurship within universities (Nelles and Vorley, 2011). Trencher et al. (2014) comment that the growth of the entrepreneurial university and the use of the term “third mission” should therefore be viewed as an expansion or amplification of earlier expectations. Universities management believes that fostering an entrepreneurial culture will result in more new employment and enterprises, and students will require entrepreneurship training to start their businesses or compete in the labour market (Sam and van der Sijde, 2014). In addition to incubators, innovation centres, TTOs, scientific parks, and venture capital operations, entrepreneurship education can

be an integral part of any business venture support system that aspires to create jobs. An academic entrepreneurial shift results from the collision between the internal growth of higher education institutions and external impacts on academic structures associated with the advent of “knowledge-based” innovation (Etzkowitz, 2016). Globally, organisations have created policies, processes, and innovations to convert knowledge into economic activity and address societal problems (Lo et al., 2009). Although all parties (UIC) involved appear to agree that graduate employability is of the utmost importance, there is still a considerable lot of difference in how each party views graduate job readiness, such as how the most recent global trend will affect skills such as entrepreneurship (Winterton and Turner, 2019).

- Cluster 2 (green): With 15 articles, cluster 2 represents “knowledge transfer and commercialisation.”

Universities’ TTOs are crucial in determining how effectively their institutions perform in TT. Previous research overlooked the roles of intellectual capital (IC) in universities to promote the TTP and the function of TTOs as a moderator. Feng et al. (2011) stress the importance of IC roles in universities to promote TT performance, and the function of TTOs as a moderator was overlooked. TTOs at universities require various skills to commercialise research products (Weckowska, 2015). While other TTOs are predominately relations-focused, some TTOs combine commercialisation transactions-focused practise and relations-focused practise styles. Galan-Muros and Davey (2017) develop frameworks to increase the bilateral cooperation between universities and industry that contribute to TTOs policymakers. The main component for the frameworks is (1) inputs, (2) activities, (3) outcomes, (4) outputs, (5) impacts, (6) supporting mechanisms, (7) circumstances and (8) context. Universities may use improved education and human capital to

TABLE 4 Top 10 bibliographic coupling cited articles.

Articles	Citation	Total link strength
Ranga and Etzkowitz (2013)	287	156
Trencher et al. (2014)	210	90
Carayannis and Campbell (2011)	130	153
Sedlacek (2013)	128	48
Sam and van der Sijde (2014)	127	154
Inzelt (2004)	122	14
Carayannis and Campbell (2012)	102	166
Weckowska (2015)	95	99
Martin (2012)	84	167
Leydesdorff and Meyer (2010)	78	96

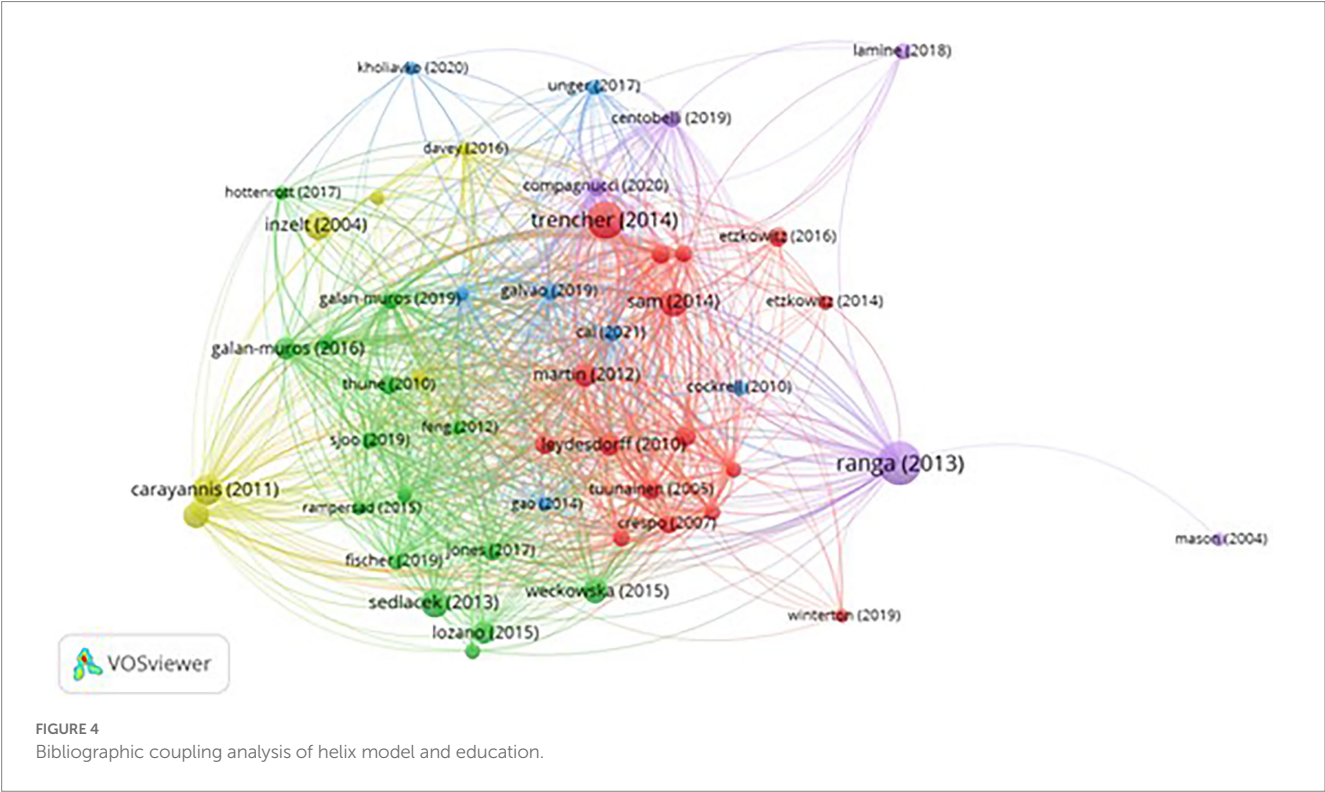


TABLE 5 Bibliographic coupling clusters on helix model and education.

Cluster 1 (Red) – Entrepreneurial university co-creation in triple helix, N=16	Cluster 2 (Green) – knowledge transfer and commercialisation, N=15	Cluster 3 (Blue) University Adaptability in innovation strategy–, N=7	Cluster 4 (yellow)- University capabilities in technology transfer, N=6	Cluster 5 (purple)- The role of universities in entrepreneurship, N=5
Bentley et al. (2015)	Beck et al. (2020)	Cai and Etzkowitz (2020)	Bano and Taylor (2014)	Centobelli et al. (2019)
Bernasconi (2005)	de Zubielqui et al. (2015)	Cameron Cockrell and Stone (2010)	Carayannis and Campbell (2011)	Compagnucci and Spigarelli (2020)
Bienkowska and Klofsten (2012)	Feng et al. (2011)	Galvao et al. (2019)	Carayannis and Campbell (2012)	Lamine et al. (2018)
Crespo et al. (2006)	Fischer et al. (2019)	Gao et al. (2014)	Davey et al. (2016)	Mason et al. (2004)
Etzkowitz (2014)	Galán-Muros and Plewa (2016)	Kholiavko et al. (2020)	Inzelt (2004)	Ranga and Etzkowitz (2013)
Etzkowitz (2016)	Galan-Muros and Davey (2017)	Unger and Polt (2017)	Petersen et al. (2016)	
Hemlin and Rasmussen (2016)	Hottenrott and Lawson (2017)	Zhang et al. (2019)		
Huggins (2009)	Jones and Corral de Zubielqui (2017)			
Leydesdorff and Meyer (2010)	Lozano et al. (2015)			
Martin (2012)	Rampersad (2015)			
Nelles and Vorley (2011)	Sedlacek (2013)			
Sam and van der Sijde (2014)	Sjöö and Hellström (2019)			
Tuunainen (2005)	Sugimoto et al. (2011)			
Trencher et al. (2014)	Thune (2010)			
Watermeyer (2014)	Weckowska (2015)			
Winterton and Turner (2019)				

be more receptive to TT programs to transfer researcher knowledge to industry. For example, in Brazil, research-focused universities have taken a more active role in technological upgrading initiatives, building relationships with the business sector and responding to the call for coordinated national efforts to close the gap within 20 years since 1999 (Fischer et al., 2019).

- Cluster 3 (blue): with seven articles and cluster 3, known as “University Adaptability in innovation strategy.”

According to a study done for the Chinese Academy of Sciences (CAS), interactions between research institutions and universities have a greater positive impact on the scientific performance of those institutions than connections with industry (Zhang et al., 2019). This proves that university adaptability is important in the need for industries to innovate. Galvao et al. (2019) point out that a key component of relationships between universities and industries is sharing knowledge through technology and scientific communities. The unique characteristics of an established practice of cooperation and financial accomplishment in a particular business may be an important element in the accomplishment of university partnerships with industry. In the case of China, in the last 20 years, China’s information and communications technology (ICT) industry has shown a low level of university-industry collaborations (Gao et al., 2014). The need for collaborations should be further emphasised, and more universities and research institutes should be encouraged to participate in university-industry collaborations to support businesses in enhancing their innovative capabilities. This showed that the university needs to adapt more aggressively to the fast-moving technology evolution to catch up with industry innovation needs, especially in the ICT sector. Besides that, to strengthen the

adaptability of universities within the basic mechanism of Triple Helix, they must also adapt to various forms of fungible capital, including cultural, human, economic and social capital (Cai and Etzkowitz, 2020).

- Cluster 4 (yellow): with six articles and cluster 4, known as “University capabilities in technology transfer.”

It is important for a university as a body of knowledge because it demonstrates an inventive capacity by producing knowledge that results in superior (knowledge-based) economic performance (Carayannis and Campbell, 2011). Thus, Universities are under pressure to play a bigger part in improving the competitiveness of the national economy on the global stage. One of the main items that can improve university capability in TT is the commercialisation of research that is transferred to regional stakeholders in the form of licences or patents and or through the creation of university-industry spin-out companies (Davey et al., 2016). As internalisation can become one interplay in UIC interaction, the university should look forward toward the firm from other countries that could change and shift sectoral innovation patterns, such as firms from China and South Korea, since these firms develop more substantial capabilities in research and innovation (Carayannis and Campbell, 2012).

- Cluster 5 (purple): with five articles and cluster 4, known as “the role of universities in entrepreneurship.”

The university’s “third mission,” which entails commercialising research and participating in socio-economic development, has several facets, including forms, stakeholders, drivers, impediments, advantages, and impact, as well as university TT. This cluster will focus on the university’s role in entrepreneurship development. The involvement of universities in TT has also enhanced their capacity to

create graduates with entrepreneurial education and aptitude who can contribute to economic growth by launching enterprises and creating jobs. Most universities nowadays offer various entrepreneurship education to stimulate the acquisition of an entrepreneurial mindset, new learning methods and the development of entrepreneurial skills as a valued career asset (Ranga and Etzkowitz, 2013). University-based business incubators can act as platforms and engines for local entrepreneurial ecosystems (Lamine et al., 2018). Supporting regional growth, accelerating start-ups in the university, and bridging the gap between entrepreneurship education, practical experience, and regional development are just a few of the crucial responsibilities played by university business incubators. In their evolutionary journey toward the entrepreneurial model, universities must strike a balance between exploitation and exploration, while it may not be necessary to invest in both processes simultaneously. Centobelli et al. (2019) proposed a systemic conceptual framework to evaluate entrepreneurial universities with these six constructs: university exploitation, university exploration, internal environment, external environment, university ambidexterity and entrepreneurial university performance. In conclusion, the integration of lifelong learning and entrepreneurship as a talent that can be taught, inspired, and promoted is strengthened through entrepreneurship education in higher education (Compagnucci and Spigarelli, 2020).

3.3. Co-word analysis

The analysis threshold value was set that the articles should have 13 or above keyword occurrences. Table 6 show a summary of the highest 15 keywords out of 54 keyword occurrence, with “triple-helix” (374 occurrences) innovation” (229 occurrences) and “knowledge” (83 occurrences) as the highest occurrence keyword for the total 2,089 keywords.

Figure 5 visualises the co-word network of the helix models and education. Table 7 presents the helix model and education summary based on the co-word analysis consisting of the cluster number and colour, cluster labels, number of articles and representative articles.

Based on the co-word network of the helix model and education result, the authors managed to interpret the cluster shown in Table 7.

- Cluster 1 (red): With 17 keywords, cluster 1 represents “quadruple helix innovation: sustainable development.”

TH co-creation has been increased into quadruple and quintuple co-creation (Galvao et al., 2019). Quartey and Oguntoye (2021) explain how the TH might promote African nations’ social, economic, and environmental well-being through industrialisation and innovation. Understanding and fostering industrial sustainability is vital for sustainable development. The sustainable development route of a high-tech company in China shows that information technology, resource allocation, and platform operation and management are vital to science-tech intermediaries’ long-term success (Yu et al., 2020). The higher education subsystem is uniquely positioned within the Quintuple Helix Model (Kholiavko et al., 2020). Universities produce qualified workers and create a green consciousness among young people through extracurricular activities, which is vital for continuing economic growth. Universities investigate cutting-edge, eco-friendly, regenerative technologies. Universities create knowledge for innovation in renewable energy development (Lerman et al., 2021).

TABLE 6 Top 15 Helix model and education keywords analysis.

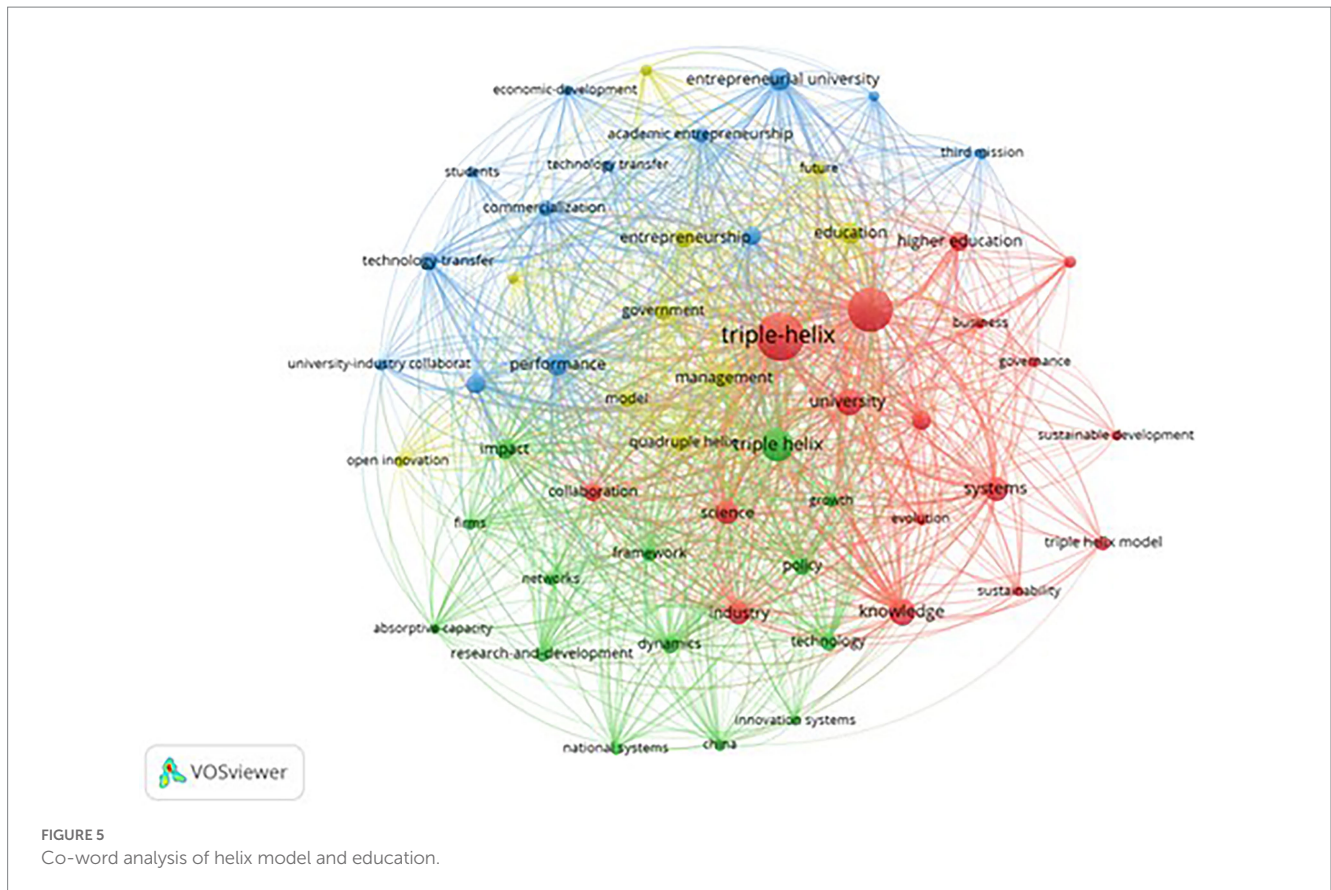
Rank	Keyword	Occurrences	Total link strength
1.	Triple helix	374	1,076
2.	Innovation	229	914
3.	Knowledge	83	398
4.	University	82	368
5.	System	70	312
6.	Science	61	298
7.	Industry	59	310
8.	Entrepreneurial University	59	272
9.	Education	56	302
10.	Performance	55	319
11.	Impact	46	241
12.	Entrepreneurship	46	225
13.	Higher education	44	163
14.	Management	43	219
15.	Knowledge transfer	41	223

- Cluster 2 (green): With 14 keywords, cluster 2 represents an “Absorptive capacity in the helix model collaboration.”

Absorptive capacity is the capacity of an organisation to utilise extrinsic knowledge. Companies with robust absorptive capacity have a higher chance of obtaining external knowledge, exploiting it, synthesising it and assimilating it (Ryan et al., 2018). The assimilation of external benefits derived from UIC relationships is typically contingent on the company’s capacity to exploit university knowledge. In these UIC relationships, a company’s absorptive capacity determines the company’s learning capacity (Ryan et al., 2018). Innovative small and medium-sized enterprises (SMEs) embedded in the regional setup that do not have strong interactions between universities and businesses are distinguished by their adequate and structured absorptive capacity. To utilise the UICs interaction, policy interventions should encourage the formation of a research and development (R&D) office, which could grow the absorption capacity of SMEs (Apa et al., 2021). Businesses with a larger R&D workforce are more likely to have a knowledge structure in which employees have overlapping information from their long-term collaboration and non-overlapping knowledge from their diverse backgrounds, enhancing an organisation’s capacity for absorption (Tang et al., 2019). The absorptive capacity, which considers the variables of higher education, R&D extramural activities, and R&D intramural activities, had a positive and significant effect on the demand for benefits from the EU’s public financial support (Moura et al., 2019). External regional absorptive capacity demonstrates that external technical differences cannot aid the spatial separation between businesses and universities in capturing more innovation performance (Yu and Yuizono, 2021).

- Cluster 3 (blue): with 13 articles and cluster 3, known as “The performance of the entrepreneurial university.”

Entrepreneurial colleges should be considered transformative forces that can inspire entrepreneurship, promote ecosystem change, and catalyse natural or financial resource utilisation in a particular location (Nicholls-Nixon et al., 2021). Entrepreneurial universities



are flexible, adaptable organisations that successfully carry out their third mission by modifying their objectives and action plans, seizing new opportunities, and taking calculated risks to integrate themselves into contemporary, competitive, and dynamic knowledge societies (Forliano et al., 2021). Entrepreneurial universities act in answer to this paradigm shift by establishing TTOs that support graduate entrepreneurship, student business plan competitions, university-based accelerators, incubators, and science parks, to name a few. Regional high-tech entrepreneurship is profoundly affected by a policy-driven transformation of universities toward an entrepreneurial paradigm (Nicholls-Nixon et al., 2021). As universities transform into entrepreneurial universities, there are an increasing number of high-tech start-ups in the area. Cerver Romero et al. (2021) focus on the entrepreneurial university concept of literary contribution from the researcher's perspective. The result shows that the connection between entrepreneurship activities and original academic intention is more toward the entrepreneurial university concept that its practicability,

- Cluster 4 (yellow): with six articles and cluster 4, known as "Entrepreneurship education."

According to the objectives of university assistance methods, terms such as "educating," "stimulating," and "incubating" are used to differentiate entrepreneurship education. Included in the categories of "stimulating" and "incubating" are activities such as providing pitching opportunities, office space, and even seed funding. The goals and methods of entrepreneurship education vary. As a result, the practical work methods employed by various colleges may vary considerably depending on the objectives of the programme, course,

or support mechanisms (Zaring et al., 2021). According to a study of engineering students' entrepreneurship classes, they emphasised the importance of knowledge and skill development. The reflections highlighted the theoretical foundations of design thinking as a method and the creation of knowledge regarding technology commercialisation. In addition, a substantial portion of the learning was divergent and therefore focused on acquiring generic skills such as teamwork, interpersonal communication, networking, empathy, perspective-shifting, and becoming more comfortable with ambiguity (Lynch et al., 2021). Due to the diverse structure of learning experiences in higher education, research evaluating the influence of entrepreneurship education on students' entrepreneurial mindsets in China reveals that entrepreneurship education influences vary. Student entrepreneurial mindset is positively affected by extracurricular activities but negatively affected by class attendance. Further demonstrating the mediating role of entrepreneurial inspiration, entrepreneurship education influences entrepreneurial motivation, which improves students' entrepreneurial mindset. Thirdly, participation in extracurricular activities has a more significant positive impact on students' emotional intelligence (entrepreneurial mindset) than classroom attendance, highlighting the significance of learning experiences in entrepreneurship education - entrepreneurial mindset connection (Cui et al., 2021). Igwe et al. (2021) demonstrate that the entrepreneurship education and management education mechanism is comprised of a variety of factors, including knowledge and cognitive learning, innovation in teaching pedagogy, a shift in teachers' and students' attitudes, and a shift in their behaviour that will lead to knowledge exchange,

TABLE 7 Co-word clusters on helix model and education.

Cluster no and colour	Cluster label	Number of keywords	Representative keywords
1 (red)	Quadruple helix innovation: sustainable development.	17	“business,” “collaboration,” “evolution,” “governance,” “higher education,” “industry,” “industry-government,” “innovation,” “knowledge,” “science,” “sustainability,” “sustainability development,” “system,” “triple helix model,” “triple helix,” “universities,” “university”
2 (green)	Absorptive capacity in the helix model collaboration	14	“absorptive-capacity,” “China,” “dynamics,” “firms,” “framework,” “growth,” “impact,” “innovation system,” “national system,” “networks,” “policy,” “research-and-development,” “technology,” “triple helix”
3 (blue)	The performance of the entrepreneurial university	13	“academic entrepreneurship,” “commercialisation,” “economic-development,” “entrepreneurial university,” “entrepreneurial universities,” “higher-education,” “knowledge transfer,” “performance,” “students,” “technology transfer,” “technology-transfer,” “third mission,” “university-industry collaboration”
4 (yellow)	Entrepreneurship education	10	“education,” “entrepreneurship,” “entrepreneurship education,” “future,” “government,” “management,” “model,” “open innovation,” “quadruple helix,” “strategy”

responsible education, a decline in unemployment, and the preparation of the future workforce.

4. Implications

4.1. Theoretical implications

Despite increased interest in the topic over the past few years, spurred by a variety of specific issues and calls for papers, the subject matter of TH and education publications remain dispersed. The use of TH in educational settings is a field that necessitates systematisation efforts such as the one proposed in this study; in the future, more of these efforts should be supported (Siegel and Wright, 2015; Secundo et al., 2019). Participation in TH operations and collaborative research and development initiatives can assist universities in achieving their third objective of social effectiveness while also satisfying the industry participation requirements of finance programmes. Additionally, they should be aware of their innovation-related actions and capabilities (Etzkowitz, 2003a). Entrepreneurial universities received a great deal of attention in primarily technological journal publications. As part of managing relationships between universities, industries, and governments, one topic to consider is expanding knowledge of the performance measurement practises currently used by university authorities in entrepreneurial endeavours. Additionally, the study enhanced our empirical comprehension of the issues surrounding evaluating the success of entrepreneurial institutions’ initiatives.

The development of TH is primarily influenced by the regional adoption of novel products, goods, services and technologies with a strong need for the capacity to absorb foreign knowledge spillovers (Lehmann et al., 2022). Consequently, industries maintain their technological innovation leadership. The commercial sector should aggressively pursue the acquisition of high-tech radiation, including research results and the expertise of government and academic institutions. The endogenous growth model can be utilised to calculate absorptive capacity, which can then be applied to the problem of knowledge filtering (Grossman and Helpman, 1994; Galvao et al., 2019). Entrepreneurship alone cannot bridge the gap between the production of new knowledge and increased output. The two

components of “absorptive capacity” are cognitive capacity and technical capacity. Technical and critical thinking skills, as well as an entrepreneurial spirit, are potential indicators of the eventual breach of the knowledge filter.

4.2. Practical implications

The TH maximises universities’ contributions to intellectual and technological innovation while extending the benefits of these contributions to other areas of innovation (Etzkowitz, 2003b). TH actors (UIC) must abandon the old ivory tower advancement paradigm. These actors need to focus more on application novelty and technological creation and ultimately transform toward an entrepreneurial university. Building a comprehensive TH innovation chain and promoting science and technology professionalisation and connection to intermediate service organisations should be the objective of all regional innovation participants (Ankrah and AL-Tabbaa, 2015). The TH relationship is not as strong as it should be because the networks and diverse organisations created by the interaction of the three central bodies have yet to be fully developed and utilised (Kim and Lee, 2016). The type of interaction includes TTOs, business incubators and venture capital firms. The government must actively support the complete change and industrialisation of R&D achievements, bolster the commercialisation of R&D spin-off firms, permit professionals to do what they do best, and establish a vital connection between the university and the industry.

Zhang et al. (2019) say that tools for developing higher education policy that helps universities become entrepreneurial are suitable for both the universities and the communities where they are located. These policy instruments must offer enough institutional autonomy to help universities realise an entrepreneurial university paradigm while adjusting to regional realities. Institutions should support “economic and social coherence” (Kitagawa et al., 2004). Teaching, studying, and sharing new technologies are the institution’s main influences on local high-tech start-ups. Academics must explore how university design encourages individual career advancement, independent of gender, ethnicity, or professional stage.

TABLE 8 Suggestion for future research agenda.

Cluster/theme	Suggestions for future research
<i>Co-citation analysis</i>	
Cluster 1: "Triple helix development"	It needs to be investigated whether the university would benefit more if it continued to be involved in the creation of spin-off companies (financial gains and survival rate)
	The impact of academic engagement in the process of UIC needs to be addressed.
	There is a need to explore the extent to which UIC can be used to enhance the competitive advantages of participating companies.
	There is a need for longitudinal studies to broaden our understanding of UIC.
Cluster 2: "Entrepreneurial university"	Examine the university's position in entrepreneurial society in terms of entrepreneurial capital.
	There is a need to examine the role of the university in promoting entrepreneurial thinking, leadership and action in an evolving entrepreneurial society.
	Should operational knowledge be considered in entrepreneurial universities?
	Most research focuses on science and engineering courses and faculties; other areas need to be investigated.
Cluster 3: "knowledge-based economy"	A outlook toward in-depth analysis of a TTO's skillful communication with both stakeholder groups in TH, focusing on effectively crossing boundaries.
	There is possible extensions of the econometric analysis include the addition of additional environmental and institutional factors as explanatory variables in the inefficiency equation, such as measures of the rigour of state and university technology transfer policies, local venture capital activities, and more specific data on regional R&D.
	There is a need to examine the effect of obstacles on the outcomes of collaborations between Helix model actors and the effect of perceived barriers on subsequent collaborations.
	Should academics become entrepreneurs?
	How might the various incentive systems for academic researchers and industrial colleagues be aligned to create mutually beneficial results?
Cluster 4: "Mode 2-academic capitalism and society"	Are university scholars becoming more reflective in the sense that they are aware of the potential societal consequences of their study and consider this when conducting research?
	Do new criteria connected to the societal relevance of research outcomes now play a significant role in all types of scientific quality control, including not only the awarding of funds, but also the retrospective evaluation of persons, organisations or programmes?
	To confront global challenges to existing global and national hierarchies, is it possible to develop alternative forms of education organisation?
<i>Bibliographic coupling analysis</i>	
Cluster 1: "Third mission: Entrepreneurial university co-creation in triple helix."	There is a need to explore and explain similarities and differences in stakeholder perspectives to promote a shared understanding of entrepreneurial university co-creation in the Triple Helix.
	Do entrepreneurial university policies influence individual norms for implementing the third mission?
	To what extent is the culture of the third mission perceived by university staff and different organisational levels?
	There is a need to assess academic accountability to improve university performance and practise, and also to advance disciplinary support for innovation and entrepreneurship.
Cluster 2: "Knowledge transfer and commercialization"	Does access to knowledge <i>via</i> the transfer of human resources and human capital only have a significant positive impact on innovative capacity?
	Is the rate of improvement and linkages with international value chains the same as for domestic knowledge transfer activities?
	The differences between sectors in terms of interaction with universities deserve attention, as sectoral characteristics are pervasive in terms of technological progress.
	The determinants of the integration of universities into productive structures need to be assessed not only from the perspective of the universities, but also from the perspective of the companies.
Cluster 3: "University adaptability in innovation strategy"	There is a need to include the factor of industry cultures as a potential influencing factor for useless knowledge exchange.
	There is a need to explore whether greater stakeholder involvement in the design of entrepreneurial ecosystems in areas of low population density is appropriate.
	There is a need to explore the role of allocating consumer goods in creating start-up models to meet organisational and trans-regional needs
	The impact of linking macro- and micro-level mechanisms in innovation strategy needs to be explored.

(Continued)

TABLE 8 (Continued)

Cluster/theme	Suggestions for future research
Cluster 4: “University capabilities in technology transfer”	Evaluate TT policies and mechanisms and help build trust between Triple Helix actors
	In a private or public context, evaluate and assess the capabilities of universities in creating innovation networks that trigger invention, catalyse innovation and foster creativity.
	Determine the entrepreneurial actors at the university.
	Do universities need more autonomy and less bureaucracy to succeed in TT?
	What is the role of universities in central planning and accountability in the TT process?
Cluster 5: “The role of universities in entrepreneurship”	Is the development of counter-cyclical finance and creative leadership important in the development of entrepreneurship?
	It is necessary to look at the development of incubators in universities based on the nature of the incubator, its objectives, mechanism, context and green technology.
	A study needs to be done on the relationship between regional development, entrepreneurial education and experiential knowledge.
	The importance of universities’ ability to diversify their relationships with industry to access a range of expertise and funding from other industries needs to be explored in the future.
<i>Co-word analysis</i>	
Cluster 1: “Quadruple helix innovation: sustainable development.”	A future study can assess the impact of another dimension, globalisation, and position it at the centre of the Triple Helix framework.
	There is a need to explore new forms, mutual interests and possibilities of collaboration between the university and its stakeholders, in terms of the social, economic and environmental links that universities can foster and activate at different levels.
	The concept of ‘living laboratories’ that share opportunities and common interests to bridge the gap between the university and society at large can receive attention.
	There is a need to cultivate the strategic orientation of TH toward co-developing approaches and solutions to forecast and address sustainability challenges in the context of developed and developing countries.
Cluster 2: “Absorptive capacity in the helix model collaboration”	There is a need to advance research on TH by collecting more indicators and data through surveys or statistics to explore TH interactions from different research perspectives and assess the absorptive capacity of actors on TH.
	The role of TTOs could be explored in the light of current environmental, economic, technological and societal challenges to measure the absorptive capacity of universities.
	New forms and channels need to be developed to disseminate scientific results to non-academic audiences to enhance collaboration.
	Does the social capital of an organisation have a major impact on its absorptive capacity toward TH stakeholders?
Cluster 3: “The performance of the entrepreneurial university”	It is necessary to consider the impact of both internal and external organisational factors on the processes of exploitation and exploration in university entrepreneurship.
	Ambidexterity in entrepreneurial universities, how is university ambidexterity achieved over time?
	Is there a relationship between the exploitation or exploration process and the performance of the entrepreneurial university in achieving the university’s goals in outreach, research and teaching?
	Entrepreneurial universities should not only focus on commercialisation of knowledge, but also on spin-off creation and patenting.
	The study should not only focus on strong leaders, but also on the micro-practises in evaluating entrepreneurial universities.
Cluster 4: “Entrepreneurship education”	Developing and testing new entrepreneurship education programmes based on interdisciplinary and operational approaches and involving university staff, students and external stakeholders is something to consider.
	Entrepreneurship education should be assessed according to the characteristics and specialisations of each university and the specific socio-economic environment in which the institution operates.
	The development of university entrepreneurship education and its research should also include information on social engagement, entrepreneurship education and training, and the different dimensions of innovation, and not be limited to the technological dimension.

5. Conclusion, limitation and future work

The examination of the bibliometric literature in this study has yielded several important findings and has also highlighted some areas that require further research. The inductive interpretation of the authors makes it difficult to classify the subject of the study. Depending on the context of the study, this interpretation could lead to several different themes. When examining the TH and its impact on education, the authors were able to extract the most important aspects

of this research topic thanks to a precise search query. By reviewing the 22 periods of data collection, the result leads to the discovery of current and future research agendas, such as potentially groundbreaking research on the “triple helix” and “universities,” which may offer new perspectives. Additional time can be used to achieve this. A future research agenda capable of the further scope of bibliometric analysis through the use of topic modelling and other unsupervised machine learning algorithms. The list of possible research topics on environmentally conscious education and business practices is by no means exhaustive. The data source for this study is

based on the large database of the Web of Science. Many previous studies have used this database over the past decades (Ramy et al., 2018; Flamini et al., 2022; Maseda et al., 2022). It should be noted that recent studies such as Mohammadi and Karami (2020) and Schröder et al. (2015) have adopted a new approach, text mining, to investigate the scope and structure of big data across disciplines. Schröder et al. (2015) noted that text mining or clustering algorithms could be used as a benchmark for research clusters. Future research should incorporate this new approach in the study of TH.

Nevertheless, the results of the bibliometric analysis of this study make it abundantly clear that we need significantly more scientific efforts on sustainability in business education to improve our knowledge base. The increasing acceptance of scholarly work in this area by the leading university journals on business, entrepreneurship and management should encourage scholars to explore these topics further, as mentioned earlier. Table 8 illustrates some areas we believe future helix model development should consider answering all research objectives.

In conclusion, this study aimed to examine the current state of TH development in education and suggest new avenues of inquiry. This research aims to: (1) provide an overview of significant publications in the field of the TH model in education using the co-citation method; (2) present the current framework of the field network using the bibliographic coupling method; and (3) predict the outlook research agenda in the development of the field through co-word analysis. We analysed 557 documents from the WoS database on the development and implementation of the helix model. After conducting an in-depth analysis of the material, this report proposes a comprehensive research agenda for emerging trends that are anticipated to impact academics and policymakers significantly. The research will assist in evaluating and contributing to even more astounding advancements in economic, technological, and social fields, especially collegiate entrepreneurship.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

References

- Afzal, M. N. I., Sulong, R. S., Dutta, S., Mansur, D. K., and Bin, H. J. M. (2018). An investigation on triple helix model and national innovation systems: the case of Malaysia. *J. Entrep. Educ.* 21, 299–313.
- Ankrah, S., and AL-Tabbaa, O. (2015). Universities–industry collaboration: a systematic review. *Scand. J. Manag.* 31, 387–408. doi: 10.1016/j.scaman.2015.02.003
- Apa, R., de Marchi, V., Grandinetti, R., and Sedita, S. R. (2021). University-SME collaboration and innovation performance: the role of informal relationships and absorptive capacity. *J. Technol. Transfer.* 46, 961–988. doi: 10.1007/s10961-020-09802-9
- Audretsch, D. B. (2014). From the entrepreneurial university to the university for the entrepreneurial society. *J. Technol. Transfer.* 39, 313–321. doi: 10.1007/S10961-012-9288-1/FIGURES/1
- Bano, S., and Taylor, J. (2014). Universities and the knowledge-based economy: perceptions from a developing country. *High. Educat. Res. Develop.* 34, 242–255. doi: 10.1080/07294360.2014.956696
- Beck, S., Bergenholtz, C., Bogers, M., Brasseur, T. M., Conradsen, M. L., di Marco, D., et al. (2020). The open innovation in science research field: a collaborative conceptualisation approach. *Ind. Innov.* 29, 136–185. doi: 10.1080/13662716.2020.1792274
- Bentley, P. J., Gulbrandsen, M., and Kyvik, S. (2015). The relationship between basic and applied research in universities. *High. Educ.* 70, 689–709. doi: 10.1007/S10734-015-9861-2/TABLES/6
- Bercovitz, J., and Feldman, M. (2005). Entrepreneurial universities and technology transfer: a conceptual framework for understanding knowledge-based economic development. *J. Technol. Transf.* 31, 175–188. doi: 10.1007/S10961-005-5029-Z
- Bernasconi, A. (2005). University entrepreneurship in a developing country: The case of the P. Universidad Católica de Chile, 1985–2000. *High. Educ.* 50, 247–274. doi: 10.1007/S10734-004-6353-1
- Bienkowska, D., and Klofsten, M. (2012). Creating entrepreneurial networks: academic entrepreneurship, mobility and collaboration during PhD education. *High. Educ.* 64, 207–222. doi: 10.1007/S10734-011-9488-X/TABLES/5
- Boldureanu, G., Ionescu, A. M., Bercu, A. M., Bedrule-Grigoriuță, M. V., and Boldureanu, D. (2020). Entrepreneurship education through successful entrepreneurial models in higher education institutions. *Sustainability* 12, 1–33. doi: 10.3390/su12031267
- Boyack, K. W., and Klavans, R. (2010). Co-citation analysis, bibliographic coupling, and direct citation: which citation approach represents the research front most accurately? *J. Am. Soc. Inf. Sci. Technol.* 61, 2389–2404. doi: 10.1002/ASI.21419
- Bruneel, J., D'Este, P., and Salter, A. (2010). Investigating the factors that diminish the barriers to university–industry collaboration. *Res. Policy* 39, 858–868. doi: 10.1016/j.respol.2010.03.006

Author contributions

HZ and DK contributed to the design of the study. HZ organised the database and wrote the first draft of the manuscript. HZ and MF performed the statistical analysis. HZ and WW performed the theme development. All authors contributed to the manuscript's revision and read and approved the submitted version.

Funding

This study was supported by University Malaysia Pahang Research grant no. RDU 210322 (Quintuple Innovative Model for SME Innovation) and PGRS2003162 (Determinant of Malaysia SME Innovation Action Based on the Triple Helix Model).

Acknowledgments

The authors thank the INTI International University and University Malaysia Pahang for providing the funds and facilities to make this research possible.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

- Cai, Y., and Amaral, M. (2021). The triple helix model and the future of innovation: a reflection on the triple helix research agenda. *Triple Helix* 8, 217–229. doi: 10.1163/21971927-12340004
- Cai, Y., and Etzkowitz, H. (2020). Theorising the triple helix model: past, present, and future. *Triple Helix* 7, 1–38. doi: 10.1163/21971927-BJA10003
- Cai, Y., and Lattu, A. (2022). Triple helix or quadruple helix: which model of innovation to choose for empirical studies? *Minerva* 60, 257–280. doi: 10.1007/S11024-021-09453-6/TABLES/4
- Cameron Cockrell, R., and Stone, D. N. (2010). Industry culture influences pseudo-knowledge sharing: a multiple mediation analysis. *J. Knowl. Manag.* 14, 841–857. doi: 10.1108/13673271011084899/FULL/PDF
- Carayannis, E. G., Barth, T. D., and Campbell, D. F. (2012). The quintuple helix innovation model: global warming as a challenge and driver for innovation. *J. Innov. Entrep.* 1:2. doi: 10.1186/2192-5372-1-2
- Carayannis, E. G., and Campbell, D. F. J. (2009). “Mode 3” and “quadruple helix”: toward a 21st century fractal innovation ecosystem. *Int. J. Technol. Manag.* 46:201. doi: 10.1504/IJTM.2009.023374
- Carayannis, E. G., and Campbell, D. F. J. (2010). Triple helix, quadruple helix and quintuple helix and how do knowledge, innovation and the environment relate to each other? *Int. J. Soc. Ecol. Sustain. Develop.* 1, 41–69. doi: 10.4018/jesed.2010010105
- Carayannis, E. G., and Campbell, D. F. J. (2011). Open innovation diplomacy and a 21st century fractal research, education and innovation (FREIE) ecosystem: building on the quadruple and quintuple helix innovation concepts and the “mode 3” knowledge production system. *J. Knowl. Econ.* 2, 327–372. doi: 10.1007/S13132-011-0058-3
- Carayannis, E. G., and Campbell, D. F. J. (2012). *Mode 3 Knowledge Production in Quadruple Helix Innovation Systems*. New York, NY: Springer
- Carayannis, E. G., Campbell, D. F. J., and Grigoroudis, E. (2021). Helix trilogy: the triple, quadruple, and quintuple innovation helices from a theory, policy, and practice set of perspectives. *J. Knowl. Econ.* 13, 2272–2301. doi: 10.1007/s13132-021-00813-x
- Centobelli, P., Cerchione, R., Esposito, E., and Shashi, (2019). Exploration and exploitation in the development of more entrepreneurial universities: a twisting learning path model of ambidexterity. *Technol. Forecast Soc. Change* 141, 172–194. doi: 10.1016/J.TECHFORE.2018.10.014
- Cerver Romero, E., Ferreira, J. J. M., and Fernandes, C. I. (2021). The multiple faces of the entrepreneurial university: a review of the prevailing theoretical approaches. *J. Technol. Transfer* 46, 1173–1195. doi: 10.1007/s10961-020-09815-4
- Clark, B. R. (1998). *Creating Entrepreneurial Universities: Organisational Pathways of Transformation*. Guildford IAU Press by Pergamon Press.
- Cohen, W. M., and Levinthal, D. A. (1990). Absorptive capacity: a new perspective on learning and innovation. *Adm. Sci. Q.* 35:128. doi: 10.2307/2393553
- Cohen, W. M., Nelson, R. R., and Walsh, J. P. (2002). Links and impacts: the influence of public research on industrial R&D. *Manage. Sci.* 48, 1–23. doi: 10.1287/mnsc.48.1.1.14273
- Compagnucci, L., and Spigarelli, F. (2020). The third Mission of the university: a systematic literature review on potentials and constraints. *Technol. Forecast. Soc. Change* 161:120284. doi: 10.1016/J.TECHFORE.2020.120284
- Craiu, L., Bungau, C., Negru, P. A., Bungau, T., and Radu, A. F. (2022). Technology transfer in the context of sustainable development – A bibliometric analysis of publications in the field. *Sustainability* 14:11973. doi: 10.3390/SU141911973
- Crespo, M., Dridi, A. H., Crespo, M., and Dridi, H. (2006). Intensification of university–industry relationships and its impact on academic research. *High. Educ.* 54, 61–84. doi: 10.1007/S10734-006-9046-0
- Cui, J., Sun, J., and Bell, R. (2021). The impact of entrepreneurship education on the entrepreneurial mindset of college students in China: the mediating role of inspiration and the role of educational attributes. *Int. J. Manag. Educat.* 19:100296. doi: 10.1016/j.ijme.2019.04.001
- Cunningham, J. A., Cunningham, J. A., and O'Reilly, P. (2018). Macro, meso and micro perspectives of technology transfer. *J. Technol. Transfer* 43, 545–557. doi: 10.1007/S10961-018-9658-4
- Cunningham, J. A., Menter, M., and O'Kane, C. (2018). Value creation in the quadruple helix: a micro level conceptual model of principal investigators as value creators. *R&D Manag.* 48, 136–147. doi: 10.1111/RADM.12310
- D'Este, P., and Patel, P. (2007). University–industry linkages in the UK: what are the factors underlying the variety of interactions with industry? *Res. Policy* 36, 1295–1313. doi: 10.1016/j.respol.2007.05.002
- D'Este, P., and Perkmann, M. (2011). Why do academics engage with industry? The entrepreneurial university and individual motivations. *J. Technol. Transf.* 36, 316–339. doi: 10.1007/s10961-010-9153-z
- Davey, T., Hannon, P., and Penaluna, A. (2016). Entrepreneurship education and the role of universities in entrepreneurship. *Ind. High. Educ.* 30, 171–182. doi: 10.1177/0950422216656699
- de Zubielqui, G. C., Jones, J., Seet, P. S., and Lindsay, N. (2015). Knowledge transfer between actors in the innovation system: a study of higher education institutions (HEIS) and SMES. *J. Bus. Industr. Market.* 30, 436–458. doi: 10.1108/JBIM-07-2013-0152/FULL/PDF
- del Giudice, M., Carayannis, E. G., and Maggioni, V. (2017). Global knowledge intensive enterprises and international technology transfer: emerging perspectives from a quadruple helix environment. *J. Technol. Transf.* 42, 229–235. doi: 10.1007/s10961-016-9496-1
- Etzkowitz, H. (1983). Entrepreneurial scientists and entrepreneurial universities in American academic science. *Minerva* 21, 198–233. doi: 10.1007/BF01097964
- Etzkowitz, H. (1998). The norms of entrepreneurial science: cognitive effects of the new university–industry linkages. *Res. Policy* 27, 823–833. doi: 10.1016/S0048-7333(98)00093-6
- Etzkowitz, H. (2002). *MIT and the Rise of Entrepreneurial Science*. London Routledge
- Etzkowitz, H. (2003a). Innovation in innovation: the triple helix of university–industry–government relations. *Soc. Sci. Inf.* 42, 293–337. doi: 10.1177/05390184030423002
- Etzkowitz, H. (2003b). Research groups as 'quasi-firms': the invention of the entrepreneurial university. *Res. Policy* 32, 109–121. doi: 10.1016/S0048-7333(02)00009-4
- Etzkowitz, H. (2004). The evolution of the entrepreneurial university. *Int. J. Technol. Glob.* 1:64. doi: 10.1504/IJTG.2004.004551
- Etzkowitz, H. (2008). *The Triple Helix: Industry, University, and Government in Innovation*. New York Routledge
- Etzkowitz, H. (2014). The entrepreneurial university wave. *Ind. High. Educ.* 28, 223–232. doi: 10.5367/IHE.2014.0211
- Etzkowitz, H. (2016). The entrepreneurial university: vision and metrics. *Ind. High. Educ.* 30, 83–97. doi: 10.5367/IHE.2016.0303
- Etzkowitz, H., and Klofsten, M. (2005). The innovating region: toward a theory of knowledge-based regional development. *R&D Manag.* 35, 243–255. doi: 10.1111/j.1467-9310.2005.00387.x
- Etzkowitz, H., and Leydesdorff, L. (1993). Technology transfer in Europe: public and private networks. *Futures* 25, 819–820. doi: 10.1016/0016-3287(93)90029-S
- Etzkowitz, H., and Leydesdorff, L. (1998). The endless transition: a “triple helix” of university–industry–government relations: introduction. *Minerva* 36, 203–208.
- Etzkowitz, H., and Leydesdorff, L. (2000). The dynamics of innovation: from National Systems and “Mode 2” to a Triple Helix of university–industry–government relations. *Res. Policy* 29, 109–123. doi: 10.1016/S0048-7333(99)00055-4
- Etzkowitz, H., Webster, A., Gebhardt, C., and Terra, B. R. C. (2000). The future of the university and the university of the future: evolution of ivory tower to entrepreneurial paradigm. *Res. Policy* 29, 313–330. doi: 10.1016/S0048-7333(99)00069-4
- Fauzi, M. A. (2017). E-learning in higher education institutions during COVID-19 pandemic: current and future trends through bibliometric analysis. *Heliyon* 8:e09433. doi: 10.1016/j.heliyon.2022.e09433
- Feng, H. I., Chen, C. S., Wang, C. H., and Chiang, H. C. (2011). The role of intellectual capital and university technology transfer offices in university-based technology transfer. *Serv. Ind. J.* 32, 899–917. doi: 10.1080/02642069.2010.545883
- Fischer, B. B., Schaeffer, P. R., and Vonortas, N. S. (2019). Evolution of university–industry collaboration in Brazil from a technology upgrading perspective. *Technol. Forecast. Soc. Change* 145, 330–340. doi: 10.1016/J.TECHFORE.2018.05.001
- Flamini, G., Pellegrini, M. M., Fakhar Manesh, M., and Caputo, A. (2022). Entrepreneurial approach for open innovation: opening new opportunities, mapping knowledge and highlighting gaps. *Int. J. Entrepreneurial Behav. Res.* 28, 1347–1368. doi: 10.1108/IJEBR-01-2021-0079/FULL/PDF
- Forlano, C., de Bernardi, P., and Yahiaoui, D. (2021). Entrepreneurial universities: a bibliometric analysis within the business and management domains. *Technol. Forecast. Soc. Change* 165:120522. doi: 10.1016/j.techfore.2020.120522
- Fromhold-Eisebith, M., and Werker, C. (2013). Universities' functions in knowledge transfer: a geographical perspective. *Ann. Reg. Sci.* 51, 621–643. doi: 10.1007/s00168-013-0559-z
- Galan-Muros, V., and Davey, T. (2017). The UBC ecosystem: putting together a comprehensive framework for university–business cooperation. *J. Technol. Transf.* 44, 1311–1346. doi: 10.1007/S10961-017-9562-3
- Galán-Muros, V., and Plewa, C. (2016). What drives and inhibits university–business cooperation in Europe? A comprehensive assessment. *R&D Manag.* 46, 369–382. doi: 10.1111/RADM.12180
- Galvão, A., Mascarenhas, C., Marques, C., Ferreira, J., and Ratten, V. (2019). Triple helix and its evolution: a systematic literature review. *J. Sci. Technol. Policy Manag.* 10, 812–833. doi: 10.1108/JSTPM-10-2018-0103/FULL/XML
- Gao, X., Guo, X., and Guan, J. (2014). An analysis of the patenting activities and collaboration among industry–university–research institutes in the Chinese ICT sector. *Scientometrics* 98, 247–263. doi: 10.1007/S11192-013-1048-Y/TABLES/7
- Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., and Trow, M. (1994). *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*. London Sage Publications, Inc
- Grossman, G. M., and Helpman, E. (1994). Endogenous innovation in the theory of growth. *J. Econ. Perspect.* 8, 23–44. doi: 10.1257/jep.8.1.23

- Guerrero, M., Cunningham, J. A., and Urbano, D. (2015). Economic impact of entrepreneurial universities' activities: an exploratory study of the United Kingdom. *Res. Policy* 44, 748–764. doi: 10.1016/j.respol.2014.10.008
- Guerrero, M., and Urbano, D. (2012). The development of an entrepreneurial university. *J. Technol. Transfer* 37, 43–74. doi: 10.1007/S10961-010-9171-X/TABLES/11
- Hayter, C. S. (2016). Constraining entrepreneurial development: a knowledge-based view of social networks among academic entrepreneurs. *Res. Policy* 45, 475–490. doi: 10.1016/J.RESPOL.2015.11.003
- Helga, N., Scott, P., and Gibbons, M. (2001). Re-thinking science: knowledge and the public in an age of uncertainty. Available at: <https://www.wiley.com/en-us/Re+Thinking+Science%3A+Knowledge+and+the+Public+in+an+Age+of+Uncertainty-p-9780745626079> (Accessed October 7, 2022).
- Hemlin, S., and Rasmussen, S. B. (2016). The shift in academic quality control. *Sci. Technol. Human Values* 31, 173–198. doi: 10.1177/0162243905283639
- Hottenrott, H., and Lawson, C. (2017). Fishing for complementarities: research grants and research productivity. *Int. J. Ind. Organ.* 51, 1–38. doi: 10.1016/J.IJINDORG.2016.12.004
- Huggins, R. (2009). Universities and knowledge-based venturing: finance, management and networks in London. *Entrep. Reg. Develop.* 20, 185–206. doi: 10.1080/08985620701748342
- Igwe, P. A., Okolie, U. C., and Nwokoro, C. V. (2021). Towards a responsible entrepreneurship education and the future of the workforce. *Int. J. Manag. Educat.* 19:100300. doi: 10.1016/j.ijme.2019.05.001
- Inzelt, A. (2004). The evolution of university–industry–government relationships during transition. *Res. Policy* 33, 975–995. doi: 10.1016/J.RESPOL.2004.03.002
- Ivanova, I. A., and Leydesdorff, L. (2014). Rotational symmetry and the transformation of innovation systems in a Triple Helix of university–industry–government relations. *Technol. Forecast. Soc. Change* 86, 143–156. doi: 10.1016/j.techfore.2013.08.022
- Jacob, M., Lundqvist, M., and Hellsmark, H. (2003). Entrepreneurial transformations in the Swedish University system: the case of Chalmers University of Technology. *Res. Policy* 32, 1555–1568. doi: 10.1016/S0048-7333(03)00024-6
- Jones, J., and Corral de Zubielqui, G. (2017). Doing well by doing good: a study of university–industry interactions, innovativeness and firm performance in sustainability-oriented Australian SMEs. *Technol. Forecast. Soc. Change* 123, 262–270. doi: 10.1016/J.TECHFORE.2016.07.036
- Kholiavko, N., Djakona, A., Dubyna, M., Zhavoronok, A., and Lavrov, R. (2020). The higher education adaptability to the digital economy. *Bull. Natl. Acad. Sci. Repub. Kazakh.* 4, 294–306. doi: 10.32014/2020.2518-1467.130
- Kim, J. Y., and Lee, M. J. (2016). Living with casinos: the triple-helix approach, innovative solutions, and big data. *Technol. Forecast. Soc. Change* 110, 33–41. doi: 10.1016/J.TECHFORE.2016.04.024
- Kitagawa, A., Horii, R., and Futagami, K. (2004). Who benefits from a better education environment? *SSRN Electron. J.* 4–15. doi: 10.2139/SSRN.572029
- Lamine, W., Mian, S., Fayolle, A., Wright, M., Klofsten, M., and Etzkowitz, H. (2018). Technology business incubation mechanisms and sustainable regional development. *J. Technol. Transfer* 43, 1121–1141. doi: 10.1007/S10961-016-9537-9/TABLES/1
- Lehmann, E. E., Menter, M., and Wirsching, K. (2022). University spillovers, absorptive capacities, and firm performance. *Eurasian Bus. Rev.* 12, 125–150. doi: 10.1007/S40821-021-00199-5/TABLES/5
- Lerman, L. V., Gerstlberger, W., Ferreira Lima, M., and Frank, A. G. (2021). How governments, universities, and companies contribute to renewable energy development? A municipal innovation policy perspective of the triple helix. *Energy Res. Soc. Sci.* 71:101854. doi: 10.1016/j.erss.2020.101854
- Leydesdorff, L. (2012). The triple helix, quadruple helix, ..., and an N-tuple of helices: explanatory models for analysing the knowledge-based economy? *J. Knowl. Econ.* 3, 25–35. doi: 10.1007/S13132-011-0049-4/FIGURES/2
- Leydesdorff, L., and Etzkowitz, H. (1996a). Emergence of a Triple Helix of university–industry–government relations. *Sci. Public Policy* 23, 279–286. doi: 10.1093/spp/23.5.279
- Leydesdorff, L., and Etzkowitz, H. (1996b). The future location of research: a triple helix of university–industry–government. *EASST Rev.* 15, 20–25.
- Leydesdorff, L., and Etzkowitz, H. (1998). The Triple Helix as a model for innovation studies. *Sci. Public Policy* 25, 195–203. doi: 10.1093/SPP/25.3.195
- Leydesdorff, L., and Meyer, M. (2006). Triple Helix indicators of knowledge-based innovation systems. *Res. Policy* 35, 1441–1449. doi: 10.1016/j.respol.2006.09.016
- Leydesdorff, L., and Meyer, M. (2010). The decline of university patenting and the end of the Bayh-Dole effect. *Scientometrics* 83, 355–362. doi: 10.1007/S11192-009-0001-6/FIGURES/4
- Lo, M.-C., Ramayah, T., and Min, H. W. (2009). Leadership styles and Organisational commitment: a test on Malaysia manufacturing industry. *Afr. J. Market. Manag.* 1, 133–139. doi: 10.5897/AJMM.9000052
- López-Rubio, P., Roig-Tierno, N., and Mas-Verdú, F. (2022). Context matters: a global bibliometric review of regional innovation systems. *Int. J. Technol. Pol. Manag.* 22, 247–270. doi: 10.1504/IJTPM.2022.125257
- Lozano, R., Ceulemans, K., and Scarff Seatter, C. (2015). Teaching organisational change management for sustainability: designing and delivering a course at the University of Leeds to better prepare future sustainability change agents. *J. Clean. Prod.* 106, 205–215. doi: 10.1016/J.JCLEPRO.2014.03.031
- Lundvall, B.-Å. (1992). “National systems of innovation: towards a theory of innovation and interactive learning” in *The Learning Economy and the Economics of Hope*. Pinter Publishers, 85–106.
- Lundvall, B.-Å., and Edquist, C. (1993). “Comparing the Danish and Swedish Systems of Innovation” in *National Innovation Systems*. ed. R. Nelson (Oxford: Oxford University Press)
- Lynch, M., Kamovich, U., Longva, K. K., and Steinert, M. (2021). Combining technology and entrepreneurial education through design thinking: Students' reflections on the learning process. *Technol. Forecast. Soc. Change* 164:119689. doi: 10.1016/j.techfore.2019.06.015
- Martin, B. R. (2012). Are universities and university research under threat? Towards an evolutionary model of university speciation. *Cambridge J. Econ.* 36, 543–565. doi: 10.1093/CJE/BES006
- Martinelli, A., Meyer, M., and von Tunzelmann, N. (2008). Becoming an entrepreneurial university? A case study of knowledge exchange relationships and faculty attitudes in a medium-sized, research-oriented university. *J. Technol. Transf.* 33, 259–283. doi: 10.1007/s10961-007-9031-5
- Maseda, A., Iturralde, T., Cooper, S., and Aparicio, G. (2022). Mapping women's involvement in family firms: a review based on bibliographic coupling analysis. *Int. J. Manag. Rev.* 24, 279–305. doi: 10.1111/IJMR.12278
- Mason, G., Beltramo, J. P., and Paul, J. J. (2004). External knowledge sourcing in different national settings: a comparison of electronics establishments in Britain and France. *Res. Policy* 33, 53–72. doi: 10.1016/S0048-7333(03)00106-9
- Mejia, C., Wu, M., Zhang, Y., and Kajikawa, Y. (2021). Exploring topics in bibliometric research through citation networks and semantic analysis. *Front. Res. Metr. Anal.* 6, 1–16. doi: 10.3389/FRMA.2021.742311
- Meyer, M. (2003). Academic entrepreneurs or entrepreneurial academics? Research-based ventures and public support mechanisms. *R&D Manag.* 33, 107–115. doi: 10.1111/1467-9310.00286
- Mingers, J., and Leydesdorff, L. (2015). A review of theory and practice in scientometrics. *Eur. J. Oper. Res.* 246, 1–19. doi: 10.1016/J.EJOR.2015.04.002
- Mohammadi, E., and Karami, A. (2020). Exploring research trends in big data across disciplines: a text mining analysis. *J. Inf. Sci.* 48, 44–56. doi: 10.1177/0165551520932855
- Mongeon, P., and Paul-Hus, A. (2016). The journal coverage of web of science and Scopus: a comparative analysis. *Scientometrics* 106, 213–228. doi: 10.1007/S11192-015-1765-5
- Moura, D. C., Madeira, M. J., Duarte, F. A. P., Carvalho, J., and Kahilana, O. (2019). Absorptive capacity and cooperation evidence in innovation from public policies for innovation. *Int. J. Innovat. Sci.* 11, 2–19. doi: 10.1108/IJIS-05-2017-0051
- Nelles, J., and Vorley, T. (2011). Entrepreneurial architecture: a blueprint for entrepreneurial universities. *Can. J. Administr. Sci.* 28, 341–353. doi: 10.1002/CJAS.186
- Nelson, R. R. (1993). *National innovation systems: a comparative analysis*. Oxford University Press.
- Nicholls-Nixon, C. L., Valliere, D., Gedeon, S. A., and Wise, S. (2021). Entrepreneurial ecosystems and the lifecycle of university business incubators: an integrative case study. *Int. Entrep. Manag. J.* 17, 809–837. doi: 10.1007/s11365-019-00622-4
- Paoloni, P., Cesaroni, F. M., and Demartini, P. (2019). Relational capital and knowledge transfer in universities. *Bus. Process. Manag. J.* 25, 185–201. doi: 10.1108/BPMJ-06-2017-0155
- Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D'Este, P., et al. (2013). Academic engagement and commercialisation: a review of the literature on university–industry relations. *Res. Policy* 42, 423–442. doi: 10.1016/j.respol.2012.09.007
- Perkmann, M., and Walsh, K. (2007). University–industry relationships and open innovation: towards a research agenda. *Int. J. Manag. Rev.* 9, 259–280. doi: 10.1111/J.1468-2370.2007.00225.X
- Petersen, A. M., Rotolo, D., and Leydesdorff, L. (2016). A triple helix model of medical innovation: supply, demand, and technological capabilities in terms of medical subject headings. *Res. Policy* 45, 666–681. doi: 10.1016/j.respol.2015.12.004
- Philpott, K., Dooley, L., O'Reilly, C., and Lupton, G. (2011). The entrepreneurial university: examining the underlying academic tensions. *Technovation* 31, 161–170. doi: 10.1016/j.technovation.2010.12.003
- Quartey, S. H., and Oguntayo, O. (2021). Understanding and promoting industrial sustainability in Africa through the triple helix approach: a conceptual model and research propositions. *J. Knowl. Econ.* 12, 1100–1118. doi: 10.1007/s13132-020-00660-2
- Rampersad, G. C. (2015). Developing university–business cooperation through work-integrated learning. *Int. J. Technol. Manag.* 68, 203–227. doi: 10.1504/IJTM.2015.069664
- Ramy, A., Flood, J., Ragab, M. A. F., and Arisha, A. (2018). A Scientometric analysis of knowledge management research and practice literature: 2003 – 2015. *Knowled. Manag. Res. Pract. J.* 16, 66–77. doi: 10.1080/14778238.2017.1405776
- Ranga, M., and Etzkowitz, H. (2013). Triple helix systems: an analytical framework for innovation policy and practice in the knowledge society. *Ind. High. Educ.* 27, 237–262. doi: 10.5367/IHE.2013.0165

- Ranga, M., and Garzik, L. (2015). From Mozart to Schumpeter: A Triple Helix System approach for enhancing innovation in the Salzburg region of Austria. Council for Research and Technology Development. Available at: https://www.researchgate.net/publication/283500397_From_Mozart_to_Schumpeter_A_Triple_Helix_System_approach_for_enhancing_innovation_in_the_Salzburg_region_of_Austria_From_Mozart_to_Schumpeter_A_Triple_Helix_System_approach_for_enhancing_innovation_in (Accessed October 19, 2021).
- Rothaermel, F. T., Agung, S. D., and Jiang, L. (2007). University entrepreneurship: a taxonomy of the literature. *Ind. Corp. Chang.* 16, 691–791. doi: 10.1093/icc/dtm023
- Ryan, P., Geoghegan, W., and Hilliard, R. (2018). The microfoundations of firms' explorative innovation capabilities within the triple helix framework. *Technovation* 76–77, 15–27. doi: 10.1016/j.technovation.2018.02.016
- Sam, C., and van der Sijde, P. (2014). Understanding the concept of the entrepreneurial university from the perspective of higher education models. *High. Educ.* 68, 891–908. doi: 10.1007/s10734-014-9750-0/TABLES/1
- Sansone, G., Battaglia, D., Landoni, P., and Paolucci, E. (2021). Academic spin-offs: the role of entrepreneurship education. *Int. Entrep. Manag. J.* 17, 369–399. doi: 10.1007/s11365-019-00601-9
- Schröder, S., Thiele, T., Jooß, C., Vossen, R., Richert, A., Isenhardt, I., et al. (2015). Text mining analytics as a method of benchmarking interdisciplinary research collaboration. Proceedings of the international Conference On Intellectual Capital, Knowledge Management and Organisational Learning, ICICKM, 2015-January, 5–6 November 2015 408–417
- Secundo, G., Schiuma, G., and Jones, P. (2019). Strategic knowledge management models and tools for entrepreneurial universities. *Manag. Decis.* 57, 3217–3225. doi: 10.1108/MD-12-2019-027/FULL/PDF
- Sedlacek, S. (2013). The role of universities in fostering sustainable development at the regional level. *J. Clean. Prod.* 48, 74–84. doi: 10.1016/j.jclepro.2013.01.029
- Serenko, A. (2013). Meta-analysis of scientometric research of knowledge management: discovering the identity of the discipline. *J. Knowl. Manag.* 17, 773–812. doi: 10.1108/JKM-05-2013-0166
- Serenko, A., Hardie, T., Bontis, N., Booker, L., and Sadeddin, K. (2010). A scientometric analysis of knowledge management and intellectual capital academic literature (1994–2008). *J. Knowl. Manag.* 14, 3–23. doi: 10.1108/13673271011015534
- Shane, S. (2004). *Academic Entrepreneurship: University Spin-offs and Wealth Creation*. Available at: https://books.google.com.my/books?hl=en&lr=&id=fMRGAgAAQBAJ&oi=fnd&pg=PR1&dq=shane+2004+new+horiz+entre&ots=7XTR9Oytob&sig=WSSD5v_8BVfWlXWmLq9CW9aRgw#v=onepage&q&f=false.
- Shinn, T. (2002). The triple helix and new production of knowledge. *Soc. Stud. Sci.* 32, 599–614. doi: 10.1177/0306312702032004004
- Siegel, D. S., Waldman, D. A., Atwater, L. E., and Link, A. N. (2003a). Commercial knowledge transfers from universities to firms: improving the effectiveness of university–industry collaboration. *J. High Technol. Managem. Res.* 14, 111–133. doi: 10.1016/S1047-8310(03)00007-5
- Siegel, D. S., Waldman, D., and Link, A. (2003b). Assessing the impact of organisational practices on the relative productivity of university technology transfer offices: an exploratory study. *Res. Policy* 32, 27–48. doi: 10.1016/S0048-7333(01)00196-2
- Siegel, D. S., and Wright, M. (2015). Academic entrepreneurship: time for a rethink? *Br. J. Manag.* 26, 582–595. doi: 10.1111/1467-8551.12116
- Sjöö, K., and Hellström, T. (2019). University–industry collaboration: a literature review and synthesis. *Serv. Ind. J.* 33, 275–285. doi: 10.1177/0950422219829697
- Skute, I. (2019). Opening the black box of academic entrepreneurship: a bibliometric analysis. *Scientometrics* 120, 237–265. doi: 10.1007/s11192-019-03116-w
- Slaughter, S., and Leslie, L. (1999). *Academic Capitalism: Politics, Policies, and the Entrepreneurial University (American Land Classics)*. Baltimore: The Johns Hopkins University Press
- Slaughter, S., and Rhoades, G. (2004). *Academic Capitalism and the New Economy*. London JHU Press
- Sugimoto, C. R., Ni, C., Russell, T. G., and Bychowski, B. (2011). Academic genealogy as an indicator of interdisciplinarity: an examination of dissertation networks in library and information science. *J. Am. Soc. Inf. Sci. Technol.* 62, 1808–1828. doi: 10.1002/ASI.21568
- Tang, P., Postolache, O. A., Hao, Y., and Zhong, M. (2019). Reefer container monitoring system. 2019 11th International Symposium on Advanced Topics in Electrical Engineering, ATEE 2019 IEEE, 1–6
- Thune, T. (2010). The training of “triple helix workers”? Doctoral students in university–industry–government collaborations. *Minerva* 48, 463–483. doi: 10.1007/S11024-010-9158-7/FIGURES/1
- Trencher, G., Yarime, M., McCormick, K. B., Doll, C. N. H., and Kraines, S. B. (2014). Beyond the third mission: exploring the emerging university function of co-creation for sustainability. *Sci. Public Policy* 41, 151–179. doi: 10.1093/SCIPOL/SCT044
- Tuunainen, J. (2005). Hybrid practices? Contributions to the debate on the mutation of science and university. *High. Educ.* 50, 275–298. doi: 10.1007/S10734-004-6355-Z
- Unger, M., and Polt, W. (2017). The knowledge triangle between research, education and innovation – a conceptual discussion. *Foresight STI Governance* 11, 10–26. doi: 10.17323/2500-2597.2017.2.10.26
- van Eck, N. J., and Waltman, L. (2014). “Visualizing bibliometric networks,” in *Measuring Scholarly Impact*. (Springer, Cham), 285–320.
- Watermeyer, R. (2014). Issues in the articulation of ‘impact’: the responses of UK academics to ‘impact’ as a new measure of research assessment. *Stud. High. Educ.* 39, 359–377. doi: 10.1080/03075079.2012.709490
- Weckowska, D. M. (2015). Learning in university technology transfer offices: transactions-focused and relations-focused approaches to commercialisation of academic research. *Technovation* 41–42, 62–74. doi: 10.1016/J.TECHNOVATION.2014.11.003
- Winterton, J., and Turner, J. J. (2019). Preparing graduates for work readiness: an overview and agenda. *Educ. Train.* 61, 536–551. doi: 10.1108/ET-03-2019-0044/FULL/PDF
- Yu, X., Yan, J., Zhang, F., Hamma, M., and Zhang, Q. (2020). Sustainable development of sci-tech service intermediaries based on triple helix model of innovation. *Int. J. Sustain. Dev. Plan.* 15, 513–519. doi: 10.18280/ijdp.150411
- Yu, S., and Yuizono, T. (2021). A proximity approach to understanding university–industry collaborations for innovation in non-local context: exploring the catch-up role of regional absorptive capacity. *Sustainability* 13, 1–19. doi: 10.3390/su13063539
- Zaring, O., Gifford, E., and McKelvey, M. (2021). Strategic choices in the design of entrepreneurship education: an explorative study of Swedish higher education institutions. *Stud. High. Educ.* 46, 343–358. doi: 10.1080/03075079.2019.1637841
- Zhang, Y., Chen, K., and Fu, X. (2019). Scientific effects of triple helix interactions among research institutes, industries and universities. *Technovation* 86–87, 33–47. doi: 10.1016/J.TECHNOVATION.2019.05.003
- Zupic, I., and Čater, T. (2014). Bibliometric methods in management and organisation. *Organ. Res. Methods* 18, 429–472. doi: 10.1177/1094428114562629



OPEN ACCESS

EDITED BY

Aleksander Aristovnik,
University of Ljubljana,
Slovenia

REVIEWED BY

Ciprian Marius Ceobanu,
Alexandru Ioan Cuza University,
Romania
Liviu Moldovan,
George Emil Palade University of Medicine,
Pharmacy,
Sciences and Technology of Târgu Mureș,
Romania

*CORRESPONDENCE

Maryam Ikram

✉ maryam.ikram.um@gmail.com

Husaina Banu Kenayathulla

✉ husaina@um.edu.my

SPECIALTY SECTION

This article was submitted to
Higher Education,
a section of the journal
Frontiers in Education

RECEIVED 09 January 2023

ACCEPTED 03 March 2023

PUBLISHED 23 March 2023

CITATION

Ikram M and Kenayathulla HB (2023) Education
quality and student satisfaction nexus using
instructional material, support, classroom
facilities, equipment and growth: Higher
education perspective of Pakistan.
Front. Educ. 8:1140971.
doi: 10.3389/feduc.2023.1140971

COPYRIGHT

© 2023 Ikram and Kenayathulla. This is an
open-access article distributed under the terms
of the [Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/)
(CC BY). The use, distribution or reproduction
in other forums is permitted, provided the
original author(s) and the copyright owner(s)
are credited and that the original publication in
this journal is cited, in accordance with
accepted academic practice. No use,
distribution or reproduction is permitted which
does not comply with these terms.

Education quality and student satisfaction nexus using instructional material, support, classroom facilities, equipment and growth: Higher education perspective of Pakistan

Maryam Ikram* and Husaina Banu Kenayathulla*

Department of Educational Management Planning and Policy, Faculty of Education, University of Malaya, Kuala Lumpur, Malaysia

Purpose: The primary purpose is to examine the impact between education quality (EQ) and student satisfaction (SS) in terms of instructional materials, support, classroom facilities and equipment, and growth in Pakistani private higher education institutes.

Design/methodology/approach: This study utilized correlation-focused quantitative research by randomly distributing a 54-item questionnaire to 440 postgraduate students in Pakistan's private higher education institutions (HEIs). SPSS (V.23) and PLS-SEM (V.3.3.3) were employed to investigate the data.

Findings: The findings demonstrate that EQ has a direct and significant positive effect on student satisfaction with instructional materials, support, classroom facilities and equipment, and growth in private higher education institutions.

Research implications: The current study will help policymakers, the Higher Education Commission (HEC), and institutions to pay greater attention to the significance of education quality indicators in making a difference in higher education, which may contribute to student satisfaction. In addition, their efforts will significantly contribute to the nation's progress. Furthermore, it will contribute to the betterment of the world by accomplishing the sustainable development goal of quality education set by the United Nations. The recent findings will also have far-reaching advantages for society, demonstrating the positive effects that high-quality education may have on a nation's progress by creating competent and productive students.

Limitations: Only private universities in Pakistan's higher education sector were considered for this study, and students enrolled in post-graduate degrees were the subjects of this investigation. This study was restricted to testing in only one province, Punjab, Pakistan. Another limitation of this study is that it is based on a research framework deduced from previous underpinnings and literature.

Originality: These findings contribute to the existing area of research on the direct and significant effects of EQ on SS in HEIs. These findings may positively impact student satisfaction in private higher education institutions. The findings can guide higher education institutions (HEIs) regarding the importance of EQ in achieving desirable student satisfaction (SS). Because the Higher Education Commission (HEC) efforts will contribute considerably to the growth of higher education institutions (HEIs) and the nation, this study is vital for policymakers and practitioners working in higher education.

KEYWORDS

education quality, instructional material, instructional support, classroom facilities and equipment, growth, students' satisfaction, Pakistani higher education

1. Introduction

Knowledge has grown exponentially in the twenty-first century (Hislop, 2005). The role of education has also shifted in this context, as it is hard to convey and accumulate such vast volumes of information in a typical classroom setting. Researchers notice new trends in Pakistani educational institutions to ensure students are well-versed in the most recent information (Hamza et al., 2018; Jan et al., 2018). These instruction techniques are outdated and must be improved for students to learn properly. It has been argued that educational processes do not adequately prepare students for these principles of expert competence (Renkl et al., 1996).

In the enormous race between public and private higher education institutes (HEIs), institutes should remain competitive to attract local and international students. This can be achieved by maintaining the service quality of institutions (Gul et al., 2019). Parents invest in their children's education since it has evolved into a profession and a social requirement. Higher education students place a greater premium on education quality; they are looking for a comprehensive education that will prepare them for the real world at the university premises to improve their skills and capabilities to develop an influential educational personality that always satisfies them (Malik and Danish, 2010). HEIs play a significant part in the world because they are considered a cornerstone for educating people, advancing technologies, and enhancing economic development (Lu et al., 2017). When students reach a higher level of achievement, they want higher quality education and expect greatness from the educational system. Universities provide more and different qualities of education and good services; the more and new prevailing enactment will be there from the students' side.

High-quality education can increase student satisfaction, leading students to clarify their vision and missions. Cheng and Tam (1997) developed the following seven paradigms of high education quality: (1) satisfaction, (2) mission attainment, (3) avoidance of difficulties, (4) tools (including time and money), (5) knowledge management, (6) authenticity, and (7) procedure. The satisfaction model may be used to develop and implement strategies for high-quality education and is a valuable alternative for researchers. Kuo, Walker, Belland, and Schroder believe that students' satisfaction is one of the most significant aspects in establishing the quality of educational courses in today's competitive environment (Kuo et al., 2013). The quality of services provided to students is being evaluated by universities as part of their efforts to develop new policies and approaches (Mark, 2013). For higher education institutions to remain competitive, they must meet and exceed the expectations and needs of their students at all levels (Khosravi et al., 2013). The improvement of workforce skills through teaching and learning is a potential driver of economic growth as well (Wafudu et al., 2022). Thus, universities must improve the quality of their teaching and learning to boost student satisfaction.

This study focuses on UNESCO education quality indicators. Student characteristics, context, enabling inputs, teaching and

learning, and educational results are indicators of education quality, as defined by UNESCO (2004). Ability, prior knowledge, learning challenges, and demography are characteristics of a learner to consider. Various factors must be considered when evaluating students' academic performance in a given situation. Enabling inputs include teaching and learning materials, physical infrastructure, facilities, and related human resources for students at all levels of education. There are several aspects of teaching and learning, including instructional time, teaching methods, assessment, and class size. In addition to reading and numeracy skills, students are expected to develop many other life skills and personal values. Hence, to address the independent variable (education quality), the current study concentrates on teaching and learning materials, physical infrastructure and facilities, teaching methods, and assessment.

Regarding education and services, universities are ideal places for students (Childers et al., 2014). Considering how students connect to their campus and their enthusiasm to use the services that may influence students' satisfaction levels is one way that educational institutions can enhance the quality of teaching in higher education institutes. In their study, Chang and Fisher (2001) found that a student's satisfaction is vital to attain their skills or knowledge at the learning environment level. Suppose a student feels that the lesson meets only his expectations and needs. In that case, he can be satisfied, and this is an approach to encourage the student to put his best endeavors into knowledge, boost their constructive mindset on learning, and show up for future classes (Geçer, 2013). This implies that institutions must focus on student satisfaction rather than just education quality.

According to research, higher education institutions environments influence students' opinions of quality. As a general rule, students who attend colleges and institutions where education quality is emphasized tend to have a more optimistic understanding of the quality of their learning (Akareem and Hossain, 2016). The quality of an institution of higher learning is also affected by factors such as the faculty's pedagogical approach and their attitude toward their work, facilities such as classrooms and labs, administrative practices such as how they behave, and the physical environment such as support infrastructure and general infrastructure (Mastoi and Hai, 2019). Therefore, educational institutions need to investigate the factors influencing student satisfaction with the quality of the services provided by HEIs.

According to the findings of a recent survey, a student's level of satisfaction with their educational institution is thought to be affected by factors including the quality of the facilities available to them, such as the library and lab, as well as their access to various forms of communication. Improving communication and other facilities, such as labs and library services, are among the factors contributing to a higher satisfaction level (Ali, 2019). In another Pakistani study, researchers investigated the aspects that affect students' satisfaction with the quality of the facilities offered by institutions, such as reputation, cost, and culture. Although service quality positively affects student satisfaction, reputation, and pricing have negative

effects (Saleem et al., 2017). The higher education sector plays a significant role in shaping student satisfaction across the majority of developed and developing countries (Ikram and Kenayathulla, 2022a).

Pakistani universities encounter many challenges in systematizing their operations and services, according to Riaz (1990) and Mahmood (1999). He identified the following characteristics as significant barriers: insufficient planning, lack of proficiency with computers, lack of a digital library, retroactive transformation, absence of quality standards, an overly complex setup, and technological deficiencies. According to Anwar (1993), libraries in Pakistan have difficulty automating their routine tasks. However, the critical issues at higher education institutions were that librarians lacked computer literacy, administrators and personnel lacked collaboration in sharing experiences, and there were no standards in place in higher education institutes. According to Ramzan (2004), the library suffers from inadequate sufficient and suitable budgets, standard library software, and adequate IT-literate staff.

Greater attention should be paid to higher educational policymaking, as it is a critical feature of higher education, since all aspects of the organizing process (including implications, limitations, and outcomes), as well as indicators that may be used to make effective policy decisions, are included (Cohen, 1980). According to Pakistan's 1979 national education policy, universities and libraries will provide sufficient educational equipment and labs with up-to-date technology. The Lahore University of Management Science and Agha Khan University were the two private universities created in Pakistan by the national education strategy of 1979. This has established a precedent for other private institutions in the private sector based on these basic metrics of success. The administration's management style, the caliber of the faculty, the school's legitimacy, the existence of student organizations, and a minimum of 80% student attendance all rank high on that list. An extra effort to improve higher education quality was made between 1998 and 2010 by bringing educational practices in line with international norms. Furthermore, the quality of education, which includes aspects such as student characteristics, background, enabling suggestions, teaching and learning, and learning goals, is thought to be among the essential aspects of higher education (UNESCO, 2004). Excellent policies in a minimum of four different social, economic, administrative, and political domains are the defining characteristics of high-quality institutions (Jazuli et al., 2022).

The education level offered at several universities is substandard (Abbasi, 2021). HEC officials revealed data on university performance. Nasir Shah, Director of Quality Assurance for the Higher Education Commission (HEC), informed the committee that 91 universities had submitted their yearly progress reports in response to the interim analysis of the Quality Enhance Cells (QEC) of the universities (2018–19). Annual reports indicated that the education provided by 32 different universities was deemed to be of an inadequate standard. In addition, 18 universities in Pakistan declined to submit yearly reports to the Higher Education Commission (HEC) (Abbasi, 2021).

Within the scope of the present investigation, student satisfaction (SS) served as the dependent variable. Student satisfaction has been the subject of numerous studies on universities' services in Pakistan's private and public education sectors. According to Butt and Rehman (2010), students' satisfaction with teachers, the learning environment, the courses offered, and the classroom facilities positively and significantly impact student satisfaction with their campus. The authors explained the findings in a study published in 2010.

Furthermore, Manzoor (2013) explored whether on-campus facilities, such as sporting facilities and transportation networks, positively impact scholarly satisfaction in universities, while off-campus facilities have no significant impact on scholarly satisfaction.

Najib et al. (2011) investigated student satisfaction levels with facilities provided by universities to students in Malaysia. According to the results of this analysis, student satisfaction with accommodation is one of the essential variables in Malaysian institutions. Students want housing managers and facility administrators from higher learning institutions to provide better accommodation to improve their services. Garwe (2016) explored the factors students consider when enrolling in higher education institutes. Several variables must be considered, including promotions and advertising, quality of instruction, opportunity, expenses with a pricing structure, and academic reputation, including recognition in the society where the university is located.

Pakistan has one of the world's lowest college enrolment rates, with only 3% of 17–23 year olds enrolled (Ghulam, 2017). As a result, there will be a reduction in the general quality of higher education (HE) in the coming years, which is detrimental to the prospects of higher education as a whole. Pakistan has suffered significantly from educational failures. Even though it has existed for 74 years, Pakistan does not find itself in an advantageous situation; it continues to spend only 2.9% of its GDP on education, which is less than the 4 percent recommended by UNESCO for all developing nations (World Bank, 2020). The top 300 universities worldwide do not include a single Pakistani institution. Most Pakistani students prefer to pursue further education elsewhere due to the country's underfunded educational institutions, outdated laboratories, and low technology standards, as well as a weak research culture and an unfair examination assessment system, which lead to poor satisfaction levels (Isani and Virk, 2005).

As a result, this research aims to investigate the direct and significant positive effect of EQ on SS with the instructional materials, instructional support, classroom facilities and equipment, and growth in HEIs.

As such, the following are the aims of this research:

1. To analyse the direct and significant positive effect of EQ on SS in terms of instructional material in HEIs.
2. To analyse the direct and significant positive effect of EQ on SS in terms of instructional support in HEIs.
3. To analyse the direct and significant positive effect of EQ on SS in terms of classroom facilities and equipment in HEIs.
4. To analyse the direct and significant positive effect of EQ on SS in terms of growth in HEIs.

2. Literature review

2.1. Total quality management theory

Several theories and models cover education quality and its indicators of education quality. W. Edwards Deming is one of the pioneers of total quality management (TQM) theory and built some of the most significant and unique tactics for increasing the efficiency and quality of any organisation (Deming, 1982). Using Deming's theory, quality can be improved by reducing the unpredictability and

uncertainty associated with how they are given. Deming (1986) defines that irregular service delivery upsets consumers or students and harms the reputations of firms or universities, according to Deming (1986). Variability in higher education can be defined as a single teacher using a student-centered teaching approach. However, one of them focuses solely on conveying information about the subject at hand. There may be a discrepancy between declared learning outcomes and an evaluation that measures something other than what was indicated (Redmond et al., 2008).

For all systems and organizations with a plan for continuous improvement, Deming's wheel can be used as a vital tool to help them achieve their goals (Deming, 1986). The Deming PDCA cycle recommends four main actions to enhance product quality.

1. Plan: The first stage in improvement is identifying the issues and proposing remedies (Deming, 1986). Deming advises companies to establish waste reduction and quality-improving practices and methods by creating high-quality products and essential services that customers want. Physical infrastructure and facilities, as well as teaching and learning materials, were included in the first step of this study. Higher education institutions should design optimum physical infrastructure and facilities for student learning.
2. Do: The second step is to implement a plan to check whether it will work. Implement a plan to measure performance (Deming, 1986). In this study, the 2nd step involved teaching methods. Higher education institutions should implement effective teaching methods to satisfy their students.
3. Check: The third stage is to keep an eye on the results to see how changes in quality affect the outcomes and detect new issues (Deming, 1986). Check the measurements and report the findings to decision-makers. In this research, 3rd step was assessment. Higher education institutes should check their plans by assessing their students.
4. Act: Concludes changes that need to be made and implemented. Implement the changes according to the previous results (Deming, 1986). The findings of this research will be used by the HEC, universities, and policymakers to inform their respective action plans.

2.2. Education quality in HEIs

Various interpretations of the term quality in education depend on context (Abukari and Corner, 2010). Higher education institutions with diverse student bodies are under enormous pressure to become more attentive to their students' needs and more efficient, effective, and student-centered in their operations. Quality in higher education matters most in today's academic research and analysis world, and many studies have been done to determine how to assess better and quantify excellence in HE.

One study, an evaluation of management students' insights about education quality in public institutes, presented by Narang (2012), exposed the features of quality and categorized them into five categories: physical services and accommodations, instructors, learning outcomes, receptiveness, and personality development, among others. Business students' satisfaction on campus was broken

down into many categories by Yusoff et al. (2015), including contented atmosphere, student assessment, and learning practices, teaching space setting, lectures and teaching and learning materials, books and tuition fees, funding opportunities, professional events, affiliation with faculty, educated and reactive faculty, staff usefulness, and feedback. Feedback, aligning assessments with learning aims and results, using grading criteria, and regularly supervising and adjusting assessment processes were the most popular assessment methods (Almosa and Alzahrani, 2022). Gruber et al. (2010) built a quality-measurement tool based on 15 quality parameters. His research in Germany at the University of Education included most facets of student life on campus, intending to assess student satisfaction with the institution. This list includes the following dimensions: organizational and student facilities, student climate, the attractiveness of the location, computer labs and equipment, libraries, reactive faculty, lecture halls, and cafeterias, the importance of teaching to practice, and university ranking, reputation settlement support from faculty presentations of information and university facilities.

2.3. Education quality in Pakistani HEIs

Pakistan's state of higher education was unstable during the period of independence. The only institute of advanced learning in 1947 was known as Punjab University (Khawaja, 1996). University Grant Commission (UGC) accreditation was created and was responsible for accrediting all universities in Pakistan during that period. This entity was renamed the Higher Education Commission (HEC) in 2002 after it underwent a major revision in 1974. The Higher Education Commission (HEC) monitors, regulates, and accredits Pakistan's efforts to improve higher education, an agency constitutionally mandated to function independently, autonomously, and independently. HEC contributed significantly to improving the quality standards for HE.

The Global Human Capital Report ranks Pakistan 125th out of 130 total countries, which assesses them according to their educational achievement. According to the report, Pakistan's human capital potential is stifled by poor-quality education and low enrollment rates. Sri Lanka was the only country in South Asia to make the top 100, ranking 70th. Sri Lanka's higher quality educational institutions and high enrolment rate positively affect the country. Nepal ranked 98th, India ranked 103rd, and Bangladesh ranked 111th. None of these South Asian countries, including Pakistan, have attained the 60 percent human capital development benchmark, with Sri Lanka being the one exception (World Economic Forum, 2017).

Furthermore, in 2007, 6 percent of Pakistanis (9 percent of males and 3.5 percent of women) earned a bachelor's or higher degree, according to the UNESCO Global Education Digest 2009. However, in 2010, this number dropped to 5% after a steady decline. According to Pakistan's objectives, this percentage will increase to 10% in 2015 and 15% by 2020. The annual decrease in enrolment was approximately 5% after the initial spike (Global Education Digest, 2010). Likewise, the ratio of students enrolled in higher education is unsatisfactory in Pakistan. The world's top 300 universities do not include a single Pakistani institution. Most Pakistani students prefer to pursue further education elsewhere because of the country's underfunded educational institutions, outdated laboratories, low technology standards, weak

research culture, and unfair examination assessment systems (Isani and Virk, 2005).

To that end, this research developed a theoretical framework based on the total quality management strategy put forward by Deming (1982). The conceptual framework has focused on the education quality indicators recommended by UNESCO (2004), and it has also been formulated based on the two-factor theory (Herzberg et al., 1959).

Education quality is determined by examining teaching and learning materials, physical infrastructure and facilities, teaching methods, and the assessment of educational institutions, as outlined by UNESCO (2004). These metrics were measured using a combination of measures to assess educational quality. In addition, satisfaction measurement includes four primary outcomes: instructional material, instructional support, classroom facilities and equipment, and growth (Herzberg et al., 1959). This study examined EQ's impact on SS in terms of instructional material, instructional support, classroom facilities and equipment, and the growth of private higher education institutions.

2.4. Hypotheses development

Therefore, this study evaluated the following null hypotheses:

H_{01} : There is no direct and significant positive effect of EQ on SS in terms of instructional material in HEIs.

H_{02} : There is no direct and significant positive effect of EQ on SS in terms of instructional support in HEIs.

H_{03} : There is no direct and significant positive effect of EQ on SS in terms of classroom facilities and equipment in HEIs.

H_{04} : There is no direct and significant positive effect of EQ on SS in terms of growth in HEIs.

3. Methodology

This study used a quantitative method that fits positivist philosophical ideas. The positivism paradigm employs various methods such as descriptive, correlational, quasi-experimental, and experimental to conduct research (Ikram and Kenayathulla, 2022b). In this study, a correlational design was taken, and the questionnaire was the primary focus of the investigation. The subsequent sections provide further information on the population, sample, and instruments, along with data collection techniques.

3.1. Population and sampling

This study's data pooled postgraduate students attending private HEIs in Lahore, Punjab Province, Pakistan. In Lahore, 48,487 students were attending private institutes of higher education at the time of access in December 2021. The data came from postgraduate students

TABLE 1 Demographic information of the respondents.

Description	Category	Frequency	%
Institute	Beaconhouse National University	24	5.7
	Forman Christian College	39	9.3
	Hajvery University	37	8.8
	Lahore Garrison University	32	7.6
	Lahore Leads University	21	5.0
	Lahore School of Economics	30	7.1
	Lahore University of Management Sciences	37	8.8
	Minhaj University	37	8.8
	The Superior College	65	15.4
	University of Central Punjab	65	15.4
	University of South Asia	34	8.1
Program	Master	83	19.7
	MPhil	331	78.6
	Doctorate	7	1.7
Field	Social science	178	42.3
	Arts	115	27.3
	Science	128	30.4
Gender	Male	198	47.0
	Female	223	53.0
Age	21–25	234	55.6
	26–30	133	31.6
	31–35	31	7.4
	36–40	18	4.3
	41–45	4	1.0
	46–50	0	0
	Over 51	1	0.2

at 11 private higher education institutes. The information was gathered by taking a random sampling method. In this investigation, a basic random sampling method was applied using a random application. Everyone in the population stands an equal probability of being selected with this strategy (Creswell, 2012). For a population of 48,487, a sample size of 381 is the bare minimum, as by the Krejcie and Morgan (1970) table (cited in Chua, 2016). This study aimed to obtain more than 381 responses based on this rule. The research tools included an information sheet detailing the study, a consent form, and a personal information sheet for each participant. Table 1 shows the respondents' demographic characteristics.

SPSS descriptive statistics were used to examine demographic information. According to the information shown in [Table 1](#), most of the respondents came from the Superior College and the University of Central Punjab. The vast majority of participants held an MPhil. Most people who answered had signed up for the social science program. In addition, there were more female respondents than male respondents. Lastly, most responses were between the ages of 21 and 25.

3.2. Instrumentation

The questionnaire comprised three primary sections: demographic information about the respondents, EQ, and SS. The demographic information included institutes, programs, fields, gender, and age. The EQ section has four sub-sections: teaching and learning materials (TL), physical infrastructure and facilities (PH), teaching methods (TM), and assessment (AS). As the EQ was evaluated based on quality indicators, as suggested by [UNESCO \(2004\)](#), various items from various surveys were adopted to evaluate education quality indicators, together with those from [Ferwana \(2018\)](#), [Goos and Salomons \(2016\)](#), [Law and Meyer \(2011\)](#), [Sultana et al. \(2009\)](#), [Teeroovengadum et al. \(2016\)](#), and [Vazirova \(2016\)](#). The instrument used in this investigation combines many other instruments. Combining many instruments is a crucial method that helps minimize each instrument's limitations and maximize its strengths ([Carroll et al., 2012](#)). This section featured eight items under the teaching and learning materials subheading, nine under the physical infrastructure and facilities subheading, seven under the teaching methods subheading, and six under the assessment subheading. The third section of the questionnaire was taken from [Gruber et al. \(2010\)](#) and [Olmos-Gómez et al. \(2020\)](#). It has four sub-sections: instructional material (seven items), instructional support (five items), classroom facilities and equipment (five items), and assessment (seven items). Respondents' opinions on the EQ and SS were calculated using a five-point Likert scale, with respondents being expected to select one answer for each item based on the options: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. The questionnaire of this study consisted of 54 questions, separated into two major portions: EQ and SS. The following sections summarize the questionnaire's validity and reliability as determined by the SPSS software program (V.24) and partial least squares structural equation modeling (PLS-SEM).

3.3. Validity

In addition to examining the convergent validity of the components, face validation was performed. Face validation was conducted by four professionals in educational management, planning, and policy with related knowledge and experience in the relevant subject. As indicated in [Table 2](#), the average variance extracted (AVE) was evaluated using PLS-SEM to assess the convergent validity of the correlation between scale constructs. A high degree of convergent validity was inferred from values of 0.5 and higher ([Hair et al., 2017](#)). Therefore, each AVE value fell within the permissible range of values.

3.4. Reliability

The evaluation of dependability comprised checking Cronbach's alpha and composite reliability (CR) for various structures. The value of Cronbach's alpha needed to be between 0.70 and 0.95 to be regarded as valid ([Hair et al., 2017](#)). [Hair et al. \(2017\)](#) proposed an additional measurement known as CR to estimate the scale's internal consistency. When CR was measured and found to have a value of 0.7 or higher, it suggested good reliability with an adequate level of internal consistency. The findings indicated that the outer loadings had values ranging from 0.640 to 0.899, which were higher than the cut-off level of 0.50, except for CF1, which was removed to improve the findings. In addition, the VIF values, which range from 1.009 to 3.863, are lower than the threshold level.

[Table 2](#) contains information regarding the validity and reliability of the questionnaire. The values provided in [Table 2](#) are all within the acceptable range, except for CF1, which was removed. These findings demonstrate that the instrument being used is reliable and that it can be put to use to collect and examine data.

4. Data analysis procedure

The researchers first carried out a pilot study to evaluate the validity and reliability of the instrument. Next, they conducted the actual analysis and gathered more than 381 responses to confirm no problems with the analysis ([Creswell, 2012](#)). Although 780 questionnaires were randomly distributed, only 440 were received. 421 responses that passed SPSS screening and cleaning were analyzed with PLS-SEM. According to [Hair et al. \(2017\)](#), PLS-SEM is the best approach for complicated, variable-rich models. In addition to effectively managing non-normal data, it can simultaneously evaluate the structural and measurement models. As a result, this is the right approach to consider in this inquiry. In the current investigation, hypotheses were formulated to determine whether there was a statistically significant relationship between the variables. As a result, the PLS-SEM statistical technique is the most appropriate one that may be utilized for testing hypotheses.

5. Findings

This part contains in-depth information regarding the evaluation of model fit and the outcomes of hypothesis testing with PLS-SEM, which was employed to analyse the data.

5.1. Measurement model assessment

Analysis of measurement models provides measurements that clarify the links between constructs and indicators ([Hair et al., 2017](#)). The measurement assessment model enables researchers to evaluate the suitability of the theory to evidence. Model assessment emphasizes the measurement models, and PLS-SEM estimates can be used to measure the reliability and validity of the various constructs.

In addition, measurement model assessment that addresses the instrument's validity and reliability are depicted in the figure that can be seen below ([Figure 1](#)).

TABLE 2 Validity and reliability of the instrument.

Variable	Construct	Items	Loadings	VIF	α	AVE	CR
Education quality	TL	TL1	0.774	2.330	0.919	0.642	0.934
		TL2	0.843	3.069			
		TL3	0.867	3.600			
		TL4	0.846	3.197			
		TL5	0.846	3.055			
		TL6	0.835	3.095			
		TL7	0.709	1.951			
		TL8	0.666	1.912			
	PH	PH1	0.762	2.046	0.910	0.585	0.926
		PH2	0.845	2.940			
		PH3	0.764	2.041			
		PH4	0.651	1.598			
		PH5	0.726	1.787			
		PH6	0.640	1.526			
		PH7	0.805	2.284			
		PH8	0.840	3.004			
		PH9	0.821	2.726			
	TM	TM1	0.709	1.795	0.880	0.582	0.885
		TM2	0.802	2.502			
		TM3	0.845	3.035			
		TM4	0.805	2.568			
		TM5	0.743	2.045			
		TM6	0.738	2.282			
		TM7	0.687	1.958			
	AS	AS1	0.776	1.949	0.879	0.625	0.909
		AS2	0.714	1.814			
		AS3	0.826	2.170			
		AS4	0.813	2.214			
		AS5	0.819	2.626			
		AS6	0.790	2.479			

(Continued)

TABLE 2 (Continued)

Variable	Construct	Items	Loadings	VIF	α	AVE	CR
Students' satisfaction	IM				0.926	0.694	0.941
		IM1	0.775	2.551			
		IM2	0.836	2.919			
		IM3	0.844	2.655			
		IM4	0.871	3.110			
		IM5	0.848	2.860			
		IM6	0.830	2.618			
		IM7	0.823	2.577			
	IS				0.857	0.636	0.897
		IS1	0.787	1.865			
		IS2	0.749	1.767			
		IS3	0.837	2.115			
		IS4	0.811	2.118			
		IS5	0.801	2.073			
	CF				0.801	0.618	0.874
		CF1	0.127	1.009			
		CF2	0.838	2.255			
		CF3	0.899	3.036			
		CF4	0.897	3.004			
		CF5	0.872	2.643			
	GR				0.916	0.666	0.933
		GR1	0.827	2.519			
		GR2	0.802	2.761			
		GR3	0.878	3.863			
		GR4	0.833	2.494			
		GR5	0.800	2.582			
		GR6	0.749	2.418			
		GR7	0.818	2.361			

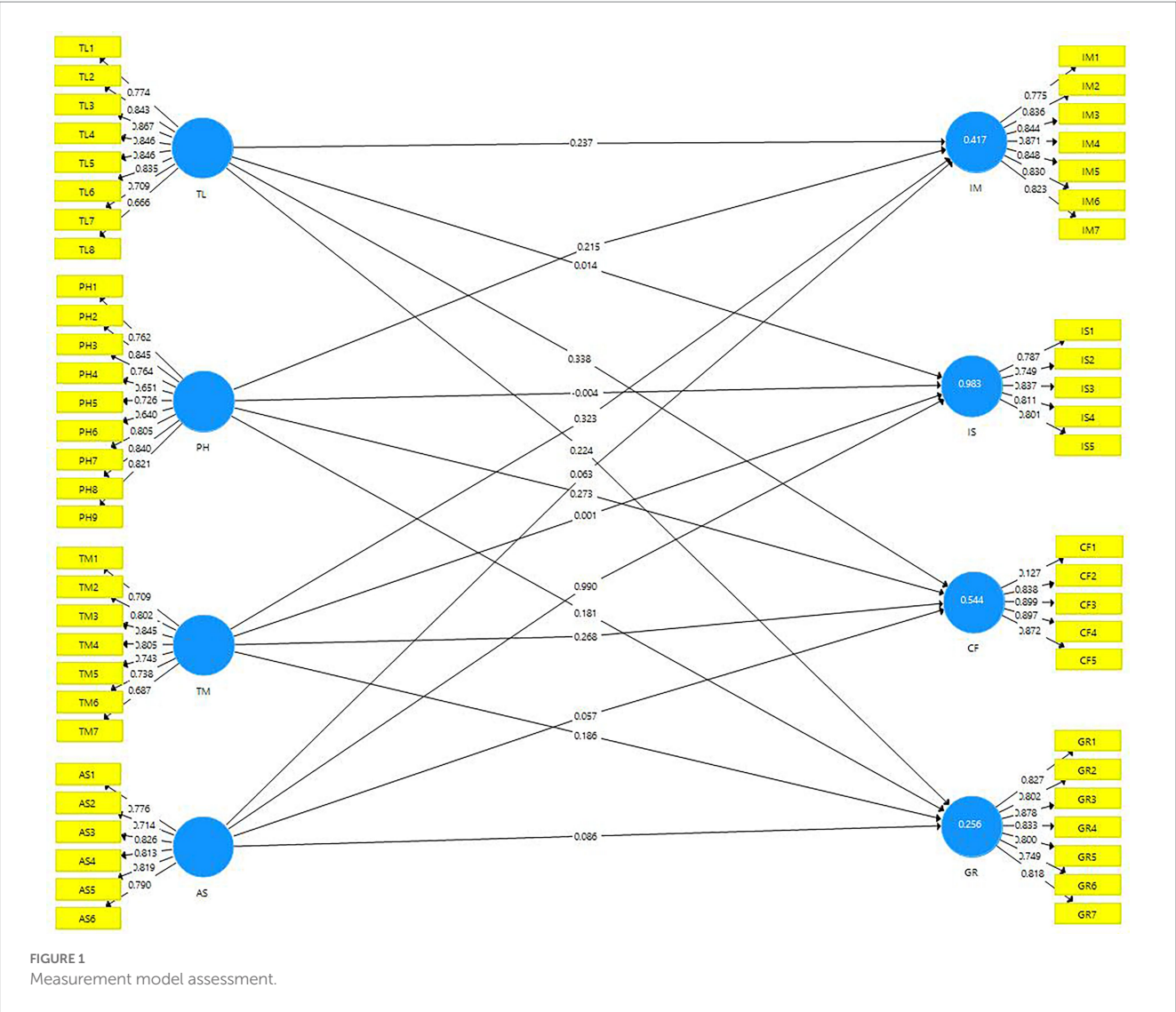


TABLE 3 The results of fornell-larcker criterion.

	AS	CF	GR	IM	IS	PH	TL	TM
AS	0.790							
CF	0.127	0.786						
GR	0.133	0.460	0.816					
IM	0.123	0.606	0.482	0.833				
IS	0.991	0.120	0.138	0.122	0.798			
PH	0.070	0.626	0.422	0.522	0.075	0.765		
TL	0.095	0.653	0.441	0.537	0.106	0.692	0.801	
TM	0.070	0.542	0.371	0.526	0.075	0.431	0.450	0.763

TL, Teaching and Learning Materials; PH, Physical Infrastructure and Facilities; TM, Teaching Methods; AS, Assessment; IM, Instructional Material; IS, Instructional Support; CF, Classroom Facilities and Equipment; GR, Growth. The Fornell-Larcker Criterion Test for discriminant validity requires values in bold to show to be greater than the remaining values in each column.

5.2. Discriminant validity

“Discriminant validity” refers to how different a construct is from other constructs (Hair, 2017). Fornell-Larcker criterion and Hetrotrit-monotrait (HTMT) ratio were applied to analyse

the data. Discriminant validity findings are presented in Tables 3, 4.

Based on the findings in Table 3, it can be concluded that the maximum correlation between any two constructs is less than the square root of the AVE values for each construct. Hence,

TABLE 4 Results of HTMT.

	AS	CF	GR	IM	IS	PH	TL	TM
AS								
CF	0.362							
GR	0.148	0.529						
IM	0.137	0.689	0.521					
IS	1.139	0.330	0.158	0.137				
PH	0.088	0.696	0.462	0.564	0.098			
TL	0.108	0.723	0.475	0.583	0.121	0.754		
TM	0.086	0.612	0.408	0.581	0.093	0.473	0.490	

TL, Teaching and Learning Materials; PH, Physical Infrastructure and Facilities; TM, Teaching Methods; AS, Assessment; IM, Instructional Material; IS, Instructional Support; CF, Classroom Facilities and Equipment; GR, Growth.

TABLE 5 Model fit.

Variables	Saturated model	Estimated model
SRMR	0.078	0.081
D_ULS	8.925	9.86
d_G	n/a	n/a
Chi-square	Infinite	infinite
NFI	n/a	n/a

n/a = Not Available.

discriminant validity can be established under the Fornell-Larcker criterion. To measure discriminant validity, the researchers used a third measurement, the heterotrait-monotrait ratio (HTMT). The HTMT value standard is between 0 and 1. Alarcón and Sanchez (2015) and Henseler et al. (2015) found that discriminant validity is harmed if the value of the HTMT is greater than 1. After analyzing the HTMT, the findings revealed that discriminant validity could be achieved through the utilization of the HTMT. The HTMT findings are stated in Table 4.

Based on the discussion above, the HTMT values were within the range, according to Alarcón and Sanchez (2015) and Henseler et al. (2015). Hence, discriminant validity can be established under HTMT. According to Alarcón and Sanchez (2015), Henseler et al. (2015), and the above reasoning, the HTMT values are acceptable. Consequently, discriminant validity may also be demonstrated using HTMT.

5.3. Model fit by PLS-SEM

For both the saturated and estimated models, the SRMR values were 0.078 and 0.081, respectively, and the cut-off value was 0.08 (Hu and Bentler, 1998); it suggests that the fit is satisfactory and makes it clear that the data also fit the model. The value of d ULS for the saturated model was 8.925, whereas that for the estimated model was 9.860. However, the other measures to assess the fit model, including d_G, normed fit index (NFI), chi-square, and RMS_theta, are not available on the output of SEM-PLS, as shown in Table 5.

5.4. Structural model assessment

The hypotheses were examined using the bootstrapping method during the structural model evaluation. According to the study findings, the effect size, R^2 , for IM was 0.407, IS was 0.085, CF was 0.530, and GR was 0.255. The values of R^2 show the fit of the regression model to the observed data: 40.7% for IM, 8.5% for IS, 53.0% for CF, and 25.5% for GR, indicating that 40.7, 8.5, 53.0, and 25.5% of the data fit the regression model (Henseler et al., 2009). Four null hypotheses were formulated for this study. Path coefficients (β) (between -1 and 1), T -values (more than 1.96), and value of p (less than 0.05) were used to test the null hypothesis. The null hypothesis was rejected when the value of p was equal to or exceeded 0.05. In contrast, if that value exceeds 0.05, the null hypothesis must be accepted (Hair et al., 2014; Fraenkel et al., 2015). The hypotheses were assessed using a structural model assessment, and those findings are shown in Figure 2.

The following section can find more information regarding the testing of hypotheses utilizing path coefficient (β), t -value, and value of p .

5.5. Hypotheses testing

Table 6 demonstrates the results of testing hypotheses, and PLS-SEM statistical method was utilized for the study. Four different null hypotheses were investigated based on the path coefficient (β), the t -value (>1.96), and the value of p (0.001). Hair et al. (2017) gave researchers these values to help them decide whether or not to accept the hypothesis being tested. The alternative hypothesis was accepted when the value of p was less than or equal to 0.001. Therefore, the alternative was accepted, and the null hypothesis was rejected (Fraenkel et al., 2015; Hair et al., 2017).

According to the findings shown in Table 6, none of the four null hypotheses was supported by this investigation. The testing of hypotheses is discussed in detail in the following four sections.

5.5.1. Section 1: impact of EQ on SS in terms of instructional material

The findings do not support accepting the first null hypothesis, H_{01} . The null hypothesis H_{01} has been rejected, as shown. The effects of EQ and IM were as follows: ($\beta = 0.638$, $t = 15.492$, $p < 0.000$). The value of β (0.638) indicates a moderate positive correlation between EQ and IM. This indicated that when education quality improves, there tends to be a corresponding improvement in the quality of instructional material used in higher education and vice versa. However, the strength of this relationship is only moderate, which means that while there is a positive relationship between EQ and IM, there are likely other factors that also contribute to the quality of instructional material beyond just education quality. In addition, the t -value was greater than 1.96, and the value of p was significant. Above mentioned results indicate that the null hypothesis cannot be accepted. Thus, EQ has direct and significant positive impacts on SS in terms of instructional material in HEIs.

5.5.2. Section 2: impact of EQ on SS in terms of instructional support

The findings do not support the second null hypothesis, H_{02} . Thus, the null hypothesis is rejected. The outcome of the effect between the

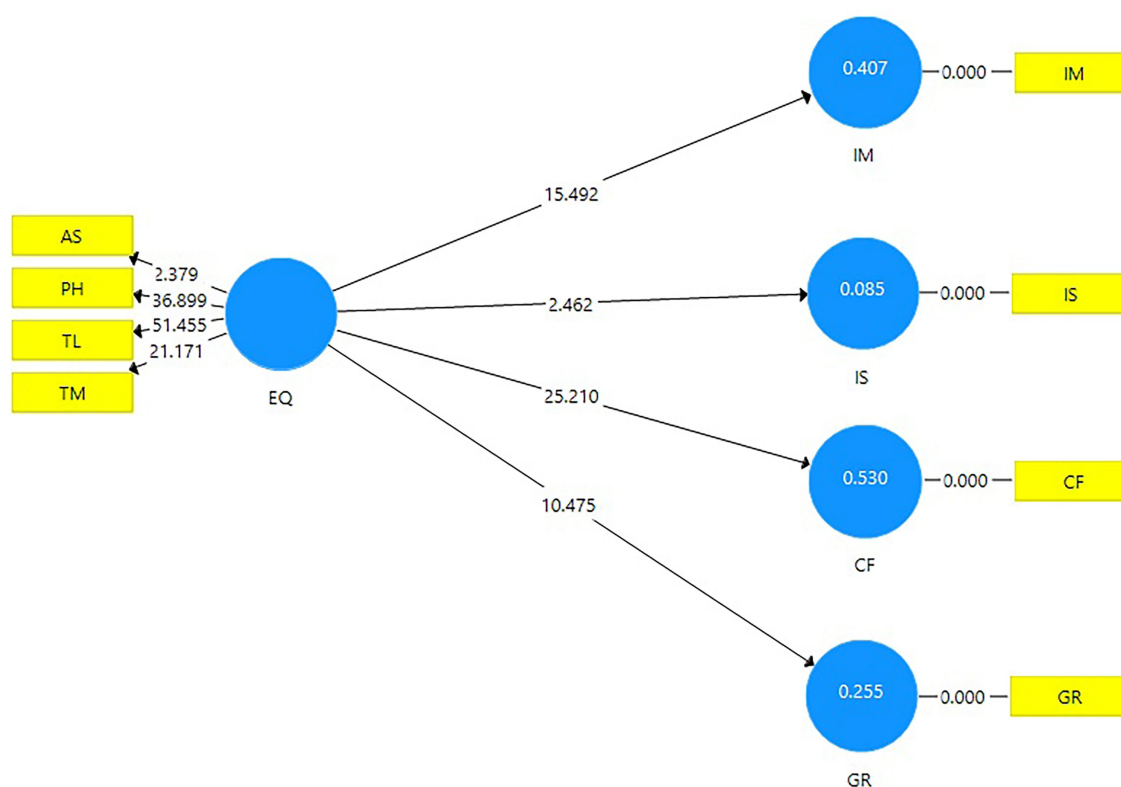


FIGURE 2
Structural model assessment.

TABLE 6 The results of hypothesis testing.

H	Path Coefficient (β)	t -Value (>1.96)	p -Value (<0.05)	Decision
H ₀₁ EQ \rightarrow IM	0.638	15.492	0.000**	Rejected
H ₀₂ EQ \rightarrow IS	0.291	2.462	0.014**	Rejected
H ₀₃ EQ \rightarrow CF	0.728	25.21	0.000**	Rejected
H ₀₄ EQ \rightarrow GR	0.505	10.475	0.000**	Rejected

Significance level ** $p < 0.05$.

EQ, Education Quality; IM, Instructional Material; IS, Instructional Support; CF, Classroom Facilities and Equipment; GR, Growth.

EQ and IS was ($\beta = 0.291$, $t = 2.462$, $p < 0.001$). The value of β (0.291) indicates a negligible correlation between EQ and IS. A negligible correlation indicated that any relationship between these variables is weak or non-existent. This could mean that other factors, such as instructional material, classroom facilities, equipment, and growth, have a greater influence on the level of instructional support provided to students in higher education. Additionally, the t -value exceeded 1.96, and the value of p was significant. Based on the t -value and value of p , the null hypothesis is rejected. Therefore, EQ had a direct and significant positive but negligible impact on SS in terms of instructional support in private HEIs.

5.5.3. Section 3: impact of EQ on SS in terms of classroom facilities and equipment

The findings do not support the third null hypothesis, H₀₃. The findings of the influence between EQ and CF were ($\beta = 0.728$, $t = 25.21$, and $p < 0.001$). The value of β (0.728) indicates a high positive correlation between EQ and CF, and a high positive correlation suggests that changes in one variable have a significant impact on the other. In this case, when an institution invests in improving the quality of education being provided, it is likely to also invest in improving the quality of classroom facilities and equipment. This could include things like providing up-to-date technology, comfortable seating, and adequate space for students to work and learn. The t -value exceeded 1.96, and the value of p was statistically significant. Consequently, the null hypothesis was rejected. EQ direct and significantly positively affects SS in terms of classroom facilities and equipment in private HEIs.

5.5.4. Section 4: impact of EQ on SS in terms of growth

The findings do not support the fourth null hypothesis, H₀₄. Null hypothesis H₀₄ has been rejected, as shown. The influence between EQ and GR had the following results: ($\beta = 0.505$, $t = 10.475$, $p < 0.000$). The value of β (0.505) indicates a moderate positive correlation between EQ and GR. A moderate relationship indicated that when education quality is high, there tends to be greater growth in higher education, and when education quality is low, there tends to be less growth in higher education.

A moderate correlation suggests that there is a reasonably strong relationship between education quality and growth in higher education, but that other factors may also play a role in determining growth rates. There may be other variables, such as changes in government funding or demographic shifts, that also have an impact on growth in higher education. If the institution's mission statement is well-defined, its leaders organize various educational and co-curricular activities, and they appropriately monitor the progress of their students, mentors can have an impact on student achievement, which can ultimately lead to greater student satisfaction (Ikram et al., 2021). In addition, the t -value was greater than 1.96, and the value of p was significant. The results indicate that the null hypothesis cannot be accepted. So, EQ has a direct and significant positive impact on SS in terms of the growth in private HEIs.

6. Discussion

The current investigation aimed to determine whether or not EQ affects SS in HEIs. The results of the hypothesizing imply, in the aggregate, that EQ has a significantly positive effect on SS in HEIs. According to the findings, EQ significantly positively impacts instructional materials, support, classroom facilities and equipment, and overall growth. Although there is some overlap between studies that pointed to not a direct but an indirect effect of the quality of services on students' satisfaction, one of those studies used a moderating element (Arif, 2011; Jabeen et al., 2014; Militaru et al., 2015). The outcomes of the current study contrast with those of other studies that have been conducted on this topic in the field of higher education. The findings showed a direct and significant positive association between EQ and SS in private HEIs.

Though, the findings of this study follow those of earlier investigations and are supported by Elliott and Shin (2002), Bigné et al. (2003), Ham and Hayduk (2003), Butt and Rehman (2010), De Jager and Gbadamosi (2013), Saleem et al. (2017), and Barua and Uddin (2021). These studies examined the effect of quality of service or education on satisfaction, and all of these studies concluded that quality has a significant effect on student satisfaction but these studies explored student satisfaction without dimensions. Prior research concentrated mostly on identifying teaching and learning materials, physical infrastructure and facilities, teaching methods, and assessment from the perspectives of service quality. Few research on student satisfaction (SS) in higher education has been undertaken. However, none of the earlier studies investigated student satisfaction with dimensions and education quality, as recommended by UNESCO (2004). This study elaborates on education quality (EQ) indicators recommended by UNESCO in Pakistan's higher education sector with students' satisfaction with four dimensions. Hence, these studies reveal a direct positive effect of quality on satisfaction in the educational sector. It should be noted that the results of the current research arrived at a similar conclusion in terms of the direct and significant positive effect between quality and student satisfaction (Elliott and Shin, 2002; Bigné et al., 2003; Ham and Hayduk, 2003; Butt and Rehman, 2010; De Jager and Gbadamosi, 2013; Saleem et al.,

2017; Barua and Uddin, 2021). As this study is about private higher education institutions, the results can be taken into account as the benchmark for public higher education institutions in Pakistan.

According to the above analysis, EQ directly and significantly positively affects SS in HEIs. This finding suggests that higher education presents unique conditions that permit EQ to affect SS.

7. Implications

7.1. Theoretical implications

The findings of this study add to the body of research that looks at how education quality indicators affect student satisfaction. Previous literature has pointed out that teaching and learning materials, physical infrastructure, and facilities are critical for satisfaction in the educational sector. The current study also supported this finding, which clarified that teaching and learning materials, physical infrastructure, and facilities are significant in higher education. In addition, the findings also showed that Deming's PDCA cycle of total quality management theory (Deming, 1986) is a suitable model for improving the quality of services, which is missing in previous literature.

The results of this investigation add to the existing literature on the topic of student satisfaction. Motivator factors, responsibility to provide instructional material and instructional support, advancement in the classroom facilities and equipment, and growth developed by Herzberg et al. (1959). Therefore, the findings also showed that Herzberg's two-factor theory is a suitable tool for application in higher education institutions to evaluate students' satisfaction in terms of responsibility to provide instructional material and instructional support, advancement in classroom facilities and equipment, and growth.

7.2. Practical implications

7.2.1. For policymakers

This research's findings will significantly contribute to the existing body of knowledge concerning EQ and SS. It will shed light on the significance of enhancing the quality of education due to its positive and significant effects on SS in higher education, including teaching materials, support, classroom facilities and equipment, and growth. To make a difference in HE and ultimately lead to the desired student satisfaction, practitioners and policymakers in the field be required to pay closer consideration to the significance of education quality indicators. Thus, the development of teaching and learning materials, physical infrastructure and facilities, teaching methods, and assessment in HE must consider the significance of having an acceptable level of EQ to achieve satisfactory outcomes for both students and higher education institutes.

7.2.2. For higher education commission (HEC)

According to research, some factors may influence the correlation between education quality and SS in HEIs. As a result, these aspects should be explored and examined to assist higher education institutes in capturing higher education quality and

determining the best strategy for improving student satisfaction. The findings enlighten the higher education commission (HEC) on the significance of producing the best indicators of education quality, which directly impact instructional materials, support, classroom facilities, equipment, and growth. As a result, researchers have suggested that UNESCO's education quality indicators should be developed further. This study is essential for the Higher Education Commission (HEC), whose efforts will contribute significantly to the nation's progress. In addition, the current investigation has presented a thorough conclusion regarding the relationship between EQ and SS, namely that there is a direct and significant relationship between education quality indicators and instructional materials, support, classroom facilities, equipment, and growth. The study's findings may positively impact students and higher education institutions.

7.2.3. For institutions

HEIs must pay more attention to developing teaching materials, support, classroom facilities and equipment, and growth. As specified by UNESCO (2004), higher education institutions must improve the quality of their education by developing teaching and learning materials, physical infrastructure and facilities, teaching methods, and assessment. Teaching and learning materials should cover the implemented curriculum and material resources, while physical infrastructure and facilities should cover the appearance and design of lecture halls, registration procedures, examination methods, results, library services, and cafeterias. In addition, they must enhance their teaching methods to include support for teaching and learning, professional development, and the supervision of teachers. However, assessments should include academic achievement. When higher education institutions combine all these quality indicators, it will directly and positively affect students in higher education institutes.

7.2.4. For society

Recent findings have substantial implications for scientific investigation, practice, and society. The implications for future investigation are centered on examining the characteristics that enable higher education institutions to positively impact student satisfaction and examining other factors that institutions can affect in HE. The implications for practice are centered on considering these findings when developing future quality plans for HE. The findings of this research will also have significant advantages for society in the sense that they will show how a good education may contribute to the betterment of society by producing qualified students who go on to achieve desired outcomes that aid in the growth of the nation. These findings will have a positive influence on society as a whole. These benefits are provided because the current results have already been achieved.

8. Limitations of the study

Pakistani participants in private higher education were the most significant limitation of the current study. Scientific research activities like government grants, research infrastructure including laboratory facilities, equipment, and technology necessary for conducting experiments, faculty, postdoctoral researchers, and graduate students,

and the success of research programs are not considered in this research. However, the outcomes of this study have yielded important insights and a broad conclusion regarding the impact of education quality on students' satisfaction with instructional materials, support, classroom facilities and equipment, and growth. This study's findings can potentially have a favorable impact on students, particularly in private HEIs.

9. Recommendations for future research

It is essential to build various quality indicators compatible with SS and conduct an additional study on their compatibility. Future studies should explore elements that enable public and private higher education institutions to significantly and directly affect SS. Future research must also determine the extent to which EQ affects instructional materials, support, classroom facilities, and equipment, and the growth of higher education institutions. Finally, additional research will be required to investigate whether demographic factors moderate the impact of education quality indicators on SS in HEIs.

10. Conclusion

According to the current research findings, EQ has a direct and significant positive influence on students' satisfaction in terms of the growth of private higher education institutions, as well as instructional materials, support, classroom facilities, and equipment. Higher education institutions should prioritize EQ training because of its direct impact on SS, which in turn will improve student retention and graduation rates. Although previous studies have revealed that the effect of quality on SS in the educational sector is indirect, the present findings indicate that EQ directly affects SS in private HEIs. This refers to the various aspects of the higher education sector that directly impact education quality on SS. Therefore, future research should investigate the crucial aspects that enable public and private higher education institutions to benefit from SS and increase student satisfaction.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

MI: paper concept, original write-up, and analysis. HK: editing, reviewing, and supervision. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated

organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/feduc.2023.1140971/full#supplementary-material>

References

- Abbasi, K. (2021). *Performance of Several Varsities Unsatisfactory, Senate Body Told*. Islamabad, Pakistan: DAWN.COM <https://www.dawn.com/news/1657725>.
- Abukari, A., and Corner, T. (2010). Delivering higher education to meet local needs in a developing context: the quality dilemmas? *Qual. Assur. Educ.* 18, 191–208. doi: 10.1108/09684881011058641
- Akareem, H. S., and Hossain, S. S. (2016). Determinants of education quality: what makes students' perception different? *Open Rev. Educ. Res.* 3, 52–67. doi: 10.1080/23265507.2016.1155167
- Alarcón, D., and Sanchez, J. A. (2015). *Assessing Convergent and Discriminant Validity in the ADHD-R IV Rating Scale: User-Written Commands for Average Variance Extracted (AVE), Composite Reliability (CR), and Heterotrait-Monotrait Ratio of Correlation (HTMT)*. Spain: Spanish STATA Meeting, 1–39.
- Ali, M. (2019). Aspects that affect students' satisfaction with higher education quality management in Pakistan. *Munich Personal RePEc Archive (MPRA)*:96180.
- Almossa, S. Y., and Alzahrani, S. M. (2022). Assessment practices in Saudi higher education during the COVID-19 pandemic. *Humanit. Soc. Sci. Commun.* 9, 1–9. doi: 10.1057/s41599-021-01025-z
- Anwar, M. A. (1993). "Use of information technology in the libraries of Pakistan" in *Challenges in Automating the Library Services*. ed. M. Fida (Peshawar: Department of Library and Information Science, University of Peshawar), 3–14.
- Arif, S. (2011). Quality management of technology related services for student satisfaction in private universities of Pakistan. *Interdiscip. J. Contemp. Res. Bus.* 3, 653–667.
- Barua, D., and Uddin, M. S. (2021). Service quality dimensions of higher education institutions and students' satisfaction: Bangladesh perspective. *Int. J. Soc. Sci. Stud.* 9, 13–19. doi: 10.11114/ijss.v9i2.5126
- Bigné, E., Moliner, M. A., and Sánchez, J. (2003). Perceived quality and satisfaction in multiservice organisations: the case of Spanish public services. *J. Serv. Mark.* 17, 420–442. doi: 10.1108/08876040310482801
- Butt, B. Z., and Rehman, K. U. (2010). A study examining the students satisfaction in higher education. *Procedia. Soc. Behav. Sci.* 2, 5446–5450. doi: 10.1016/j.sbspro.2010.03.888
- Carroll, R. J., Midthune, D., Subar, A. F., Shumakovich, M., Freedman, L. S., Thompson, F. E., et al. (2012). Taking advantage of the strengths of two different dietary assessment instruments to improve intake estimates for nutritional epidemiology. *Am. J. Epidemiol.* 175, 340–347. doi: 10.1093/aje/kwr317
- Chang, V., and Fisher, D. (2001). The Validation and Application of a New Learning Environment Instrument to Evaluate Online Learning in Higher Education. *AARE Annual Conference*, 1–16.
- Cheng, Y. C., and Tam, W. M. (1997). Multi-models of quality in education. *Qual. Assur. Educ.* 5, 22–31. doi: 10.1108/09684889710156558
- Childers, C., Williams, K., and Kemp, E. (2014). Emotions in the classroom: examining environmental factors and student satisfaction. *J. Educ. Bus.* 89, 7–12. doi: 10.1080/08832323.2012.738258
- Chua, Y. P. (2016). *Mastering Research Methods*. 2nd Edn. Shah Alam, Selangor: McGraw-Hill.
- Cohen, P. A. (1980). Effectiveness of student-rating feedback for improving college instruction: a meta-analysis of findings. *Res. High. Educ.* 13, 321–341. doi: 10.1007/BF00976252
- Creswell, J. W. (2012). *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research*. 4th Edn. New York: Pearson.
- De Jager, J., and Gbadamosi, G. (2013). Predicting students' satisfaction through service quality in higher education. *Int. J. Manag. Educ.* 11, 107–118. doi: 10.1016/j.ijme.2013.09.001
- Deming, W. E. (1982). *Quality, Productivity and Competitive Position*. Cambridge, MA: Massachusetts Institute of Technology, Center for Advanced Engineering Study.
- Deming, W. E. (1986). *Out of the Crisis*. Cambridge, MA: Massachusetts Institute of Technology.
- Elliott, K. M., and Shin, D. (2002). Student satisfaction: an alternative approach to assessing this important concept. *J. High. Educ. Policy Manag.* 24, 196–209. doi: 10.1080/136008002200001351
- Ferwana, M. N. (2018). *Service Quality in Higher Education: Identifying Core Determinants and Sub-Factors from Postgraduate Students' Perspective in the Gaza Strip*. The Islamic University of Gaza, Palestine.
- Fraenkel, J. R., Wallen, N. E., and Hyun, H. H. (2015). *How to Design and Evaluate Research in Education*. 9th Edn. New York: McGraw-Hill.
- Garwe, E. C. (2016). Increase in the demand for private higher education: unmasking the "paradox." *Int. J. Educ. Manag.* 30, 232–251. doi: 10.1108/IJEM-05-2014-0064
- Geçer, A. (2013). Lecturer-student communication in blended learning environments. *Educ. Sci. Theory Pract.* 13, 362–367.
- Ghulam, M. (2017). Indicators for quality in higher education: comparison between Pakistan and Germany. *Online J. Qual. High. Educ.* 4, 8–16.
- Global Education Digest. (2010). Comparing education statistics across the world. Available at: <https://uis.unesco.org/sites/default/files/documents/global-education-digest-2010-comparing-education-statistics-across-the-world-en.pdf>
- Goos, M., and Salomons, A. (2016). Measuring teaching quality in higher education: assessing selection bias in course evaluations. *Res. High. Educ.* 58, 341–364. doi: 10.1007/s11162-016-9429-8
- Gruber, T., Fuß, S., Voss, R., and Zikuda, M. G. (2010). Examining student satisfaction with higher education services: using a new measurement tool. *Int. J. Public Sect. Manag.* 23, 105–123. doi: 10.1108/09513551011022474
- Gul, S., Jan, S., and Shah, F. A. (2019). The impact of service quality on students satisfaction in higher education institutes of Khyber Pakhtunkhwa. *Rev. Econ. Dev. Stud.* 5:33. doi: 10.26710/reads.v5i1.536
- Hair, J. F., Black, W. C., Babin, B. J., and Anderson, R. E. (2014). *Multivariate Data Analysis*. 7th Edn. United States of America: Pearson Prentice Hall.
- Hair, J. F., Hult, G. T. M., Ringle, C. M., and Sarstedt, M. (2017). *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. 2nd Edn. Thousand Oaks, CA: Sage.
- Ham, L., and Hayduk, S. (2003). Gaining competitive advantages in higher education: analyzing the gap between expectations and perceptions of service quality. *Int. J. Value-Based Manag.* 16, 223–242. doi: 10.1023/A:1025882025665
- Hamza, M., Haq, I.-U., Hamis, S., Nadir, M., and Mehmood, N. (2018). Effect of moderate learning style-teaching mode mismatch on academic performance among 2nd year medical students in Pakistan. *Indian J. Psychiatry* 60, 109–113. doi: 10.4103/psychiatry.IndianJPsychiatry
- Henseler, J., Ringle, C. M., and Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *J. Acad. Mark. Sci.* 43, 115–135. doi: 10.1007/s11747-014-0403-8
- Henseler, J., Ringle, C. M., and Sinkovics, R. R. (2009). The use of partial least squares path modeling in international marketing. *Adv. Int. Mark.* 20, 277–319. doi: 10.1108/S1474-7979(2009)0000020014
- Herzberg, F., Mausner, B., and Snyderman, B. B. (1959). *The Motivation to Work*. 2nd Edn. New York: John Wiley & Sons.
- Hislop, D. (2005). *Knowledge Management in Organizations: A Critical Introduction*. 1st Edn. United States of America: ProQuest.
- Hu, L., and Bentler, P. M. (1998). Fit indices in covariance structure modeling: sensitivity to underparameterized model misspecification. *Psychol. Methods* 3, 424–453. doi: 10.1037/1082-989X.3.4.424

- Ikram, M., Ghavifekr, S., and Kenayathulla, H. B. (2021). Instructional leadership practices among school principals in Asian countries: a systematic review. *Int. Online J. Educ. Leadersh.* 5, 4–24.
- Ikram, M., and Kenayathulla, H. B. (2022a). A systematic literature review of student satisfaction: what is next? *Int. J. Adv. Res. Educ. Soc.* 4, 50–75. doi: 10.55057/ijares.2022.4.4.5
- Ikram, M., and Kenayathulla, H. B. (2022b). Out of touch: comparing and contrasting positivism and interpretivism in social science. *Asian J. Res. Educ. Soc. Sci.* 4, 39–49. doi: 10.55057/ajress.2022.4.2.4
- Isani, U. A. G., and Virk, M. L. (2005). *Higher Education in Pakistan: A Historic and ISO (n.d.) International Organization for Standardization: ISO: 9000*. Proquest.
- Jabeen, S., Din, A. M., and Sadiq, M. F. (2014). Students' satisfaction from E-learning system: a case study of virtual University of Pakistan. *Int. J. E-Adoption* 6, 1–13. doi: 10.4018/ijea.2014070101
- Jan, S., Hussain, A., Ibrahim, M., and Saeed, S. (2018). Use of internet by the teaching faculty of Peshawar medical college, Peshawar, Khyber Pakhtunkhwa, Pakistan. *J. Pak. Med. Assoc.* 68, 459–462.
- Jazuli, M. R., Idris, M. M., and Yaguma, P. (2022). The importance of institutional quality: Reviewing the relevance of Indonesia's Omnibus Law on national competitiveness. *Humanit. soc. Sci. Commun.* 9, 1–13. doi: 10.1057/s41599-022-01343-w
- Khawaja, A. H. (1996). *Difficulties and possibilities in university*. Pakistan Perspectives, University of Karachi, 1.
- Khosravi, A. A., Poushaneh, K., Roozegar, A., and Sohrabifard, N. (2013). Determination of factors affecting student satisfaction of Islamic Azad University. *Procedia. Soc. Behav. Sci.* 84, 579–583. doi: 10.1016/j.sbspro.2013.06.607
- Krejcie, R. V., and Morgan, D. W. (1970). Determining sample size for research activities. *Educ. Psychol. Meas.* 30, 607–610. doi: 10.1177/001316447003000308
- Kuo, Y., Walker, A. E., Belland, B. R., and Schroder, K. E. E. (2013). A predictive study of student satisfaction in online education programs. *Int. Rev. Res. Open Dist. Learn.* 14, 16–39. doi: 10.19173/irrodl.v14i1.1338
- Law, D. C. S., and Meyer, J. H. F. (2011). Adaptation and validation of the course experience questionnaire in the context of post-secondary education in Hong Kong. *Qual. Assur. Educ.* 19, 50–66. doi: 10.1108/09684881111107753
- Lu, J., Laux, C., and Antony, J. (2017). Lean six sigma leadership in higher education institutions. *Int. J. Product. Perform. Manag.* 66, 638–650. doi: 10.1108/IJPPM-09-2016-0195
- Mahmood, K. (1999). The development of computerised library services in Pakistan. *Asian Libr.* 8, 307–328.
- Malik, M. E., and Danish, R. Q. (2010). The impact of service quality on students' satisfaction in higher education institutes of Punjab. *J. Manag. Res.* 2, 1–11. doi: 10.5296/jmr.v2i2.418
- Manzoor, H. (2013). Measuring student satisfaction in public and private universities in Pakistan. *Glob. J. Manag. Bus. Res. Interdiscip.* 13, 4–16.
- Mark, E. (2013). Journal of Higher Education Policy and Management Student satisfaction and the customer focus in higher education. *J. High. Educ. Policy Manag.* 35, 2–10. doi: 10.1080/1360080X.2012.727703
- Mastoi, A. G., and Hai, L. X. (2019). Higher education service quality based on students' satisfaction in Pakistan. *Eur. Sci. J.* 15, 32–62. doi: 10.19044/esj.2019.v15n11p32
- Militaru, G., Deselnicu, D., and Pollifroni, M. (2015). An exploratory study of student satisfaction: the moderating role of digital technologies. Proceedings of the 9th International Management Conference. *Manag. Innov. Competitive Adv.*, 234–241.
- Najib, N. U. M., Yusof, N. A., and Osman, Z. (2011). Measuring satisfaction with student housing facilities. *Am. J. Eng. Appl. Sci.* 4, 52–60. doi: 10.3844/ajeassp.2011.52.60
- Narang, R. (2012). How do management students perceive the quality of education in public institutions? *Qual. Assur. Educ.* 20, 357–371. doi: 10.1108/09684881211263993
- Olmos-Gómez, M. D. C., Suárez, M. L., Ferrara, C., and Olmedo-Moreno, E. M. (2020). Quality of higher education through the pursuit of satisfaction with a focus on sustainability. *Sustainability* 12, 1–20. doi: 10.3390/su12062366
- Ramzan, M. (2004). Levels of information technology (IT) applications in muslim world libraries. *Electronic Libr.* 22, 274–280. doi: 10.1108/02640470410541688
- Redmond, R., Curtis, E., Noone, T., and Keenan, P. (2008). Quality in higher education: the contribution of Edward Deming's principles. *Int. J. Educ. Manag.* 22, 432–441. doi: 10.1108/09513540810883168
- Renkl, A., Mandl, H., and Gruber, H. (1996). Inert knowledge: analyses and remedies. *Educ. Psychol.* 31, 115–121. doi: 10.1207/s15326985ep3102
- Riaz, B. (1990). LUMS library: Experience with automation. *Punjab University Library Science Alumni Association News* 2, 92–95.
- Saleem, S., Moosa, K., Imam, A., and Ahmed Khan, R. (2017). Service quality and student satisfaction: the moderating role of university culture, reputation and price in education sector of Pakistan. *Iran. J. Manag. Stud.* 10, 237–258. doi: 10.22059/ijms.2017.217335.672304
- Sultana, N., Yousuf, M. I., Din, M. N. U., and Rehman, S. (2009). The higher the quality of teaching the higher the quality of education. *Contemp. Issues Educ. Res.* 2, 59–64. doi: 10.19030/cier.v2i3.1088
- Teeroovengadum, V., Kamalanabhan, T. J., and Seebaluck, A. K. (2016). Measuring service quality in higher education: development of a hierarchical model (HESQUAL). *Qual. Assur. Educ.* 24, 244–258. doi: 10.1108/QAE-06-2014-0028
- UNESCO. (2004). *The 10 dimensions of quality in education* Available at: [https://learningportal.iiep.unesco.org/en/issue-briefs/monitor-learning/quality-and-learning-indicators#:~:text=Defining Quality&text=UNESCO's framework on the variables, to learning%2C and demographic variables.&text=\(UNESCO%2C 2004%3A 36\)](https://learningportal.iiep.unesco.org/en/issue-briefs/monitor-learning/quality-and-learning-indicators#:~:text=Defining Quality&text=UNESCO's framework on the variables, to learning%2C and demographic variables.&text=(UNESCO%2C 2004%3A 36)).
- Vazirova, N. (2016). *Measuring Service Quality in Higher Education: A Study of Post-Graduate Students in Northern Cyprus (issue February)*. Cyprus: Eastern Mediterranean University.
- Wafudu, S. J., Kamin, Y. B., and Marcel, D. (2022). Validity and reliability of a questionnaire developed to explore quality assurance components for teaching and learning in vocational and technical education. *Humanit. Soc. Sci. Commun.* 9, 1–10. doi: 10.1057/s41599-022-01306-1
- World Bank. (2020). *GDP on education for developing countries*. <https://data.worldbank.org/indicator/SE.XPD.TOTL.GD.ZS?locations=PK>
- World Economic Forum. (2017). The global human capital report. In World economic forum. Available at: <https://www.weforum.org/reports/the-global-human-capital-report-2017/>
- Yusoff, M., McLeay, F., and Woodruffe-Burton, H. (2015). Dimensions driving business student satisfaction in higher education. *Qual. Assur. Educ.* 23, 86–104. doi: 10.1108/QAE-08-2013-0035



OPEN ACCESS

EDITED BY

David Alonso García,
Complutense University of Madrid,
Spain

REVIEWED BY

Carlos Martínez-Hernández,
Complutense University of Madrid,
Spain

Ana Valtierra,
Complutense University of Madrid,
Spain

*CORRESPONDENCE

Sandrine Simon
✉ sandrine.simon.dina@gmail.com

SPECIALTY SECTION

This article was submitted to
Higher Education,
a section of the journal
Frontiers in Education

RECEIVED 22 December 2022

ACCEPTED 17 February 2023

PUBLISHED 05 April 2023

CITATION

Simon S, Vieira I and Jecu M (2023) Multi-level
education for sustainability through global
citizenship, territorial education and art forms.
Front. Educ. 8:1129824.
doi: 10.3389/feduc.2023.1129824

COPYRIGHT

© 2023 Simon, Vieira and Jecu. This is an
open-access article distributed under the terms
of the [Creative Commons Attribution License](#)
(CC BY). The use, distribution or reproduction
in other forums is permitted, provided the
original author(s) and the copyright owner(s)
are credited and that the original publication in
this journal is cited, in accordance with
accepted academic practice. No use,
distribution or reproduction is permitted which
does not comply with these terms.

Multi-level education for sustainability through global citizenship, territorial education and art forms

Sandrine Simon^{1*}, Inês Vieira^{2,3} and Marta Jecu¹

¹Interdisciplinary Research Centre for Education and Development (CeIED), Lusófona University, Lisbon, Portugal, ²Observatory for Education and Training Policies (Op.Edu), Interdisciplinary Research Centre for Education and Development (CeIED), Lusófona University, Lisbon, Portugal, ³Centro Interdisciplinar de Ciências Sociais.NOVA University Lisboa FCSH, Lisbon, Portugal

This article is aimed at addressing concepts, approaches and challenges that are both very characteristic of the era we are living in and that would also greatly benefit from being more and better integrated into our learning systems (both in the formal and non-formal educational systems and lifelong learning). Those issues and themes have emerged from, or have been exacerbated by, socio-economic systems in place since the middle of the 20th century, promoting amongst other things, a consumption society based on a linear over-exploitation of natural resources, the globalization of exchanges, a rapid urbanization process and not-always-harmonious mixes of cultures and communities. The COVID-19 pandemic seems to have culminated in triggering reflections on what matters most and, conversely, on what makes our world so un-sustainable and non-resilient. From these, a new momentum has been generated on reviewing where our efforts on teaching and learning about 'sustainability' got us to. Our focus here is on new approaches to education for sustainability at global, community and personal levels, as well as at levels that connect those. From linking the local to the global through 'global citizenship,' to experiential learning generated through practical projects such as urban agriculture, to an emotional involvement into understanding sustainability issues through art forms, we re-visit sustainability through the eyes of the learners, questioning the boundaries of the 'sustainability educational project' beyond the ones which, for (too) long, have paralleled those of neo-liberal reforms.

KEYWORDS

global citizenship education, commons, social and environmental justice, experiential and territorial education, education for sustainability, arts education, sustainable and ecological art, slow artistic education

1. Introduction

Education for Sustainability (EfS) has gone a long way. The transformation of our societies, economic systems, and of our inter-relations with ecological systems into more sustainable ones has not. Observing how the integration of sustainability considerations into the educational system was undertaken throughout time helps, in part, in understanding why this is the case.

It was during the 1972 United Nations Conference on the Human Environment that the term 'Environmental Education' (EE) was first mentioned and that the establishment of the International Environmental Education Programme (IEEP) was recommended. Environmentalism was alive and well. Initial EE focused on helping students to understand better the natural environment

from a scientific perspective. Although the socio-economic and political dimensions of ‘un-sustainable’ practices had been discussed, “the multi-disciplinary approach to EE was left to small bands of enthusiasts in each country” (Fien, 2020, p. 4). This situation remained throughout the 1970s and it is only at the end of the 1980s that a broader understanding of the issues at stake helped to reform EE. After the [World Commission on Environment and Development \(WCED\) \(1987\)](#) defined sustainable development, the focus turned toward Education for Sustainable Development (ESD) which involved integrating key sustainable development issues into teaching and learning. The UN Decade of ESD (DESD: 2005–2014) mobilized the educational resources of the world to help create a more sustainable future. Agenda 21, the official document of the 1992 Earth Summit, described various ways to do so. The United Nations Educational, Scientific and Cultural Organization (UNESCO) coordinated DESD initiatives and published their findings ([Buckler and Creech, 2014](#)). One of the hopes was that development issues would be better linked to environmental issues and that sustainable development would be understood in an interdisciplinary way, encompassing ecological, economic and social dimensions. What was achieved in these 10 years, as [Fien \(2020, p. 1\)](#) stresses, was however disappointing, with “student levels of awareness of key concepts for sustainability being low, and few being able to correctly define essential concepts – e.g., precautionary principle and sustainable development.” With this in mind, researchers explored further the shortcomings of the ‘greening’ of the educational system. A plethora of individual initiatives, project-centred educational programmes were put in place around the world, some of which focused on identifying common features and characteristics of EfS. However, these paralleled a rather imposing Global Education Reform Movement (GERM) (in the 1990s), targeted at creating a ‘world class education’ everywhere and at generating a process of comparison between educational systems, on which their evaluation would be based¹. As [Teodoro \(2020\)](#) deplored, the rise of neo-liberalism in the 1980s–90s deprived the traditional professional university culture from its freedom of enquiry and progressively created “a paradigm of ‘entrepreneur education’” (p. 84). The GERM was criticized ([Cowen and Kazamias, 2009](#)) for the technical difficulties in making international comparisons, its generalization of societal values based on Western economic principles and its enhancement of competition in the learning environment. Its methodical obsession to homogenize pedagogical approaches to entirely different communities also raised serious criticisms. Through these reforms, an underlying belief in the neo-classical approach to economic issues was in fact translated into the ways in which development and environmental problems were being tackled. This resulted in a detachment of our communities from nature. The socio-economy-environment interactions advocated by ecological economists ([Martinez-Alier, 1987](#)) as being core to the notion of development, were never integrated in educational reforms – which consequently did not help to modify attitudes, beliefs systems and all that had contributed to creating environmental crises in the first place. And so, in an attempt to enforce, generalize and harmonize educational systems, themselves loosely connected with uniformed and timid

initiatives in EE, we might have deprived EfS from the practical, contextual, and political dimensions that make sustainability directly relevant to people. 35 years have passed since the WCED defined sustainable development as “a type of development that meets the needs of the present generation without putting at risk the capacity of generations to come in meeting their own requirements” ([World Commission on Environment and Development \(WCED\), 1987, p. 43](#)). The recent COVID crisis triggered reflection on how we organize our economic systems, and ‘develop’ our societies. A potential conclusion is that, far from being resilient, our societies are not sustainable either. If there was a time to learn from our mistakes and give EfS a new momentum, now would be a good one.

The COVID pandemic also encouraged people to question, more specifically, *globalization*. Authors such as [Teodoro \(2020\)](#), [Santos \(2006\)](#), and [Sahlberg \(2016\)](#) have explained the mechanisms by which the 1990s calls for a standardized ‘world class education’ were mainly targeted at adapting educational institutions to new configuration systems in world organizations. This ‘educational reform’ was very different from the humanistic approach to ‘Global Citizenship Education’ put forward by [UNESCO \(2014, p. 14\)](#) which “referred to a sense of belonging to a common humanity, and emphasized socio-political, economic and cultural inter-dependency, and interconnectedness between the local, the national and the global.” Exploring how EfS could establish better connections with global citizenship will be the object of our first part.

The second part tackles the territorial, community level of new forms of EfS, showing that the 1990s educational reforms also contrasted with efforts to develop educational approaches that would help communities to ‘put sustainability into practice.’ It explores the types of knowledge and learning processes needed to understand what urban sustainable communities would look like if cities were to reduce their dependency on food produced outside, in a less globalized world. A strong focus is put on the so-far little explored area of research in Territorial Education (TE), as well as on experiential learning. It suggests that EfS needs to make the key concepts that are relevant to the sustainable development goals emerge from skills acquisition.

Still within the realm of communities’ involvement, but with a stronger focus on the creative involvement in ‘learning and acting’ for sustainability, the third part focuses on art forms as a vehicle to reflect, question, and act on sustainability issues. Here, art is both a research tool and a technique for applied practice. In artistic projects, lead by artists, curators or local communities, innovative strategies in communitarian art projects are tested out, with the objective of defending and disseminating the principles of global citizenship.

The structure of the paper hence addresses and binds multi-levels of learning, illustrating in which direction, why and by whom the ‘boundaries of EfS’ could be extended in the near future.

2. Global citizenship education

Globalization, through its complex and plural dimensions and impacts on society, defies the educational field to develop analytical and interventional approaches to face structural issues that threaten peace and survival on Earth. Global Citizenship Education (GCE) can thus be framed, and reflected theoretically and practically, in its attempts to defend people and the planet in inclusive, sustainable, and democratic ways. This first part aims to explore the concept of global

¹ Reinforced by the Programme for International Student Assessment (PISA), carried out by the Organization for Economic Cooperation and Development (OECD).

citizenship and its impacts on education. It is proposed as an introductory approach that will allow deepening knowledge about possible framings of sustainability, which will be further explored through experiential territorial learning and artistic approaches in the following parts.

2.1. Political framing

Built upon previous constructions with other terminologies (e.g., ‘intercultural dialogue,’ ‘peace’ or ‘democratic education,’ and particularly the synthesis proposed by ‘global education’ – [Europe-Wide Global Education Congress, 2002](#)), GCE can be framed politically, on a global scale, from an initiative (and correlated discourses) produced within the United Nations (UN), particularly involving UNESCO: the Global Education First Initiative (GEFI). Between 2012 and 2016, in the mandates of the UN Secretary-General Ban-Ki Moon, GEFI was retained as a global advocacy platform with three priorities: to put every child in school; to improve the quality of learning; and to foster global citizenship. Overall, GEFI was aimed to accelerate progress toward the Education for All goals and the education-related Millennium Development Goals and subsequent Sustainable Development Goals (SDGs), so as to implement the 2030 Agenda. GEFI was guided by a strategic plan and action framework that, among other objectives, aimed to “Broaden outreach and engagement on global citizenship education with a focus on learning and teaching for sustainable development” ([GEFI-Global Education First Initiative, n.d.](#)).

It can thus be observed that this concept of global citizenship is conceived as interweaving the UN sustainability and education agendas. For UN’s impact on – and commitment by – other national and federal agendas, we can notice this political construction on other institutions; namely the Council of Europe on its agenda for sustainable development and quality education. Deepening the Council’s vision on quality of education for all, it echoes SDG 4.7 – Education for sustainable development and global citizenship, which aims to “ensure that, [by 2030], all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture’s contribution to sustainable development.” ([SDG 4.7, n.d.](#)). Within the Council of Europe, understanding education’s impact on sustainability is also reflected in the adoption of the Charter on Education for Democratic Citizenship and Human Rights Education by the 47 member states in the framework of [Recommendation CM/Rec\(2010\)7 \(2010\)](#). The Council of Europe’s member states have been adopting different legislation pieces that incorporate these principles of global citizenship, democratic education, and sustainability promotion.

Regarding the skills to be developed in GCE, [UNESCO \(2014, p. 9\)](#) synthesizes the need to develop collective identities, knowledge about global issues and values, cognitive skills to think in critical, systematic and creative ways, social skills for conflict resolution, communication and interaction within social diversity, and behavioral skills to act collaboratively and responsibly while looking for global solutions and fighting for a common good.

2.2. Theoretical-conceptual debates

Considering the potential and political reach of GCE, its development is important at the theoretical and conceptual levels; yet it can be noticed that this approach is mostly “an intervention in search for a theory” ([Torres, 2017, p. 1](#)). Some of the possible theoretical-conceptual debates, which we propose to deepen in this section, concern different levels and forms of globalization, critical approaches, commons, and possibilities in education.

2.2.1. Globalization

One of the concepts that mostly helps to locate the field of GCE is: globalization. Yet, there is arguably no main notion of globalization as the concept has been defined in very different ways ([Torres, 2015, p. 262–264](#)), from economic and geopolitical perspectives to cultural ones. We will provide a brief synthesis of just a few of its possible conceptualizations that can be important for the debate around GCE. Departing from a territorial and economical focus, globalization can be related to the intensification of world-wide relationships with deep changes in time and space, associated to a late capitalism or postmodern feature within a world system organized by a global capitalist economy ([Harvey, 1989, 1996](#)). This system and its global changes carry important consequences in terms of social inequalities, which are an unbalancing factor for the economic and social dimensions of sustainability, and toward which GCE should be positioned, challenging neoliberalism – with the precaution of not being coopted by falling into a neoliberal rationality ([Torres, 2017](#)).

Impacting the political level, globalization is also related to the declining importance of isolated notions such as that of nation-state, with the rise of different collective social actors on the political landscape. These changes can be related to the interconnectedness made possible through the expansion of networks and technologies of communication and travel ([Castells, 1996](#)), with dematerializing effects on central values systems ([Ball, 1998](#)). The lesser capacity of sedentary notions (nation-state, but also ethnicity and other space-bound concepts) to explain the later organization of society has also been linked to a mobilities turn in social sciences ([Malkki, 1997; Cresswell, 2006; Sheller and Urry, 2006](#)). GCE can benefit from this turn for its comprehension and work on social diversity and potentially porous frontiers.

All these transformations bring consequences to the understanding of social change, individual and group identities.

Attention should be put also in the directions through which globalization happens, from top-down (framed by neoliberalism and appealing to the opening of financial-related frontiers) to bottom-up (through pro-representational social movements) processes, involving cultural hybridism and the intersection of information, knowledge, and networks ([Torres, 2015](#)).

2.2.2. Critical effects and approaches in education

A dominant form of neoliberal globalization marks educational policy worldwide, impressing a competitive feature that endorses the creation of measurable and internationally comparable standards of educational performance ([Teodoro, 2022](#)) – among other common features that focus on individual competences, knowledge, and entrepreneurship, with a parallel of center-periphery structures on schooling polarizations ([Ball, 1998](#)). This process is affected by the crisis

of the national social contract, as the national time-space loses the stage toward the growing importance of global and local scales, with impacts in government legitimacy, social and economic welfare, and collective safety and identities (Teodoro, 2020). The uncertainty of contemporary globalized life has an important congestion effect with impacts on education, namely due to the combination of (1) a neoliberal turn toward a 'market model' education, and (2) changes in the trajectory of economic growth and job patterns which had allowed the massive expansion of middle classes in the post-war, with a lack of response to the promised futures and consequences in the lesser support to efforts of democratizing education and social policy (Ball, 1998).

These processes and their educational effects can be associated to cultural, political and economic forces and certain ideological visions about what schools and education should be and to whom they should serve; instead of hiding this, critical scholars can retain it as a departure for their analysis, bringing to the public the effects of these policies, defying such positions and defending other types of education, namely those based in human flourishing (Apple, 2019) such as GCE and other approaches to EfS.

A critical reflection on the problems of mass education does not necessarily lead to a drop out of schools as key educational contexts (in the path that could be drawn from Illich, for example – Illich, 1971). Schools can be seen as spaces of critical development, namely as spaces of resonance, as opposed to alienation, considering they are the places where a substantial part of one's relationships with the world are formed (Rosa, 2019). But it is important to also pay attention to other educational contexts, namely non-formal ones, where attitudes and values related to collaboration, responsibility and care (core in GCE) can be developed or contrasted.

In educational research, Critical Social Theory (CST) has been reinforcing the importance of dialectic discourse, democratic organization, and emancipatory action (Pacheco, 2001), questioning the philosophical, economic and organizational principles of education (Darder et al., 2017). In GCE (and EfS more broadly), critical social theory may contribute both to the analysis and action of sustainability, by exploring the roots of social and environmental justice problems and, from their comprehension, creating the basis for a sustainability-oriented educational praxis (Evans, 2010).

The Frankfurt school of thought within CST can be associated with important contributions to GCE, namely in a context where politics of truth and knowledge can be retained as critical praxis, thus seeing the creation of critical and active citizens, with global mentality and competencies, as a part of the solution for global problems (Biccum, 2018).

2.2.3. Commons and global citizenship

Debated in different discipline arenas, of which we highlight political ecology, the commons can be primarily located in the reflections about property, going beyond the binary view that the only solutions are privatization or government control, pointing to other forms of social organization such as community-based approaches to resource management (Turner, 2017). Assuming the complexity and potential hybridity of property systems and going from the name to the verb, 'commoning' (root word for the concept of commons, alluding to Middle Age farmers community praxis of collectivizing the royal lands – Linebaugh in de Angelis, 2021, p. 15) has important consequences. First, it involves "a political and moral commons of production in resistance to the individualization and privatization inherent to capitalism," but it also encourages working toward

"attempts to develop conditions that support shared use, management, and production of needed resources" (Turner, 2017, p. 267).

Through an interpretive and metaphorical reading of this process, we find in Torres the understanding that global citizenship requires three types of global commons (Torres, 2017, p. 15–16). The first is the Earth, in a view of shared use and protection to the whole planet (and not solely to some types of property or natural resources), considering it as a common home in need of protection through education for sustainable development and global citizenship. The second is global peace, an intangible culture with immaterial value for the survival of humanity, based in the need of building solidarity while acknowledging and accepting difference (like Beck's cosmopolitan imperative – Beck, 2006). The third type of global commons is people, highlighting the need for people to live democratically in a diversified world, both pointing to the fulfillment of individual and cultural interests and to the guarantee of the inalienable rights to life, freedom, and the pursuit of happiness.

2.3. Educating for global citizenship

GCE can thus be framed as a commoning, critically informed and sustainability-oriented educational approach, which citizenship dimension embraces a post-national consideration of rights and responsibilities (Soysal, 1994), with reflexes in different levels of social life.

GCE can benefit from critical realism, acknowledging its principles of ontological realism (a real world exists independently of one's knowledge and positioning), epistemological relativism (knowledge about reality, namely science, is socially produced under specific conditions) and judgmental rationality (not all interpretations have the same epistemic or moral value, rational choices can be made) (Bahskar in Khazem, 2018, p. 125–126), and adapting them to the core features of education on global issues, particularly sustainability.

Positioned within the broad field of education, an agenda and political culture can be drawn around concepts of possibility (as inspired by Freire). Teodoro (2020) suggests three main directions for this: (1) cosmopolitan solutions, considering we are all citizens of the same world, with important differences of inclusion and privilege, so there is a concomitant needed fight for the educational good and against poverty, injustice and social exclusion; (2) contrasting the fear of alterity in pedagogical practices and policies, posing side by side the principles of equality and recognition of differences; and (3) excellence of schools and education for all the students.

Linking these considerations to what has been achieved so far in EfS is as important as ensuring that EfS does not lose track of – nor neglects – the key components of GCE which, to some extent, highlights alternative, more humanistic, understandings of and responses to globalization. Suggestions of how this may be translated at 'closer-to-home' levels are discussed in the next two parts of the article.

3. Contextualizing EfS: Territorial education and experiential learning

3.1. The need for contextualization: New focus on the territory

Lahire (2012) emphasizes that no other notion is as essential to the reasoning of human sciences – and as neglected – as the notion of

context. Yet, the multiple and complex links between education and territory, as Boix-Tomás et al. (2015) highlighted, “have only really been tackled for fifteen years” (p. 12). The integration of the territorial aspects of educational contexts into debates on EfS is helping to apprehend teaching and learning as dynamics that both can *adapt to* territorial specificities and *contribute to* territorial sustainability. It helps to re-establish respect for an adapted relationship with the local territory without losing a global perspective (Boix-Tomás et al., 2015). This ‘adapted relationship’ was reflected through new initiatives in landscape education (Crespo, 2017). Following the European Landscape Convention in Florence (Council of Europe, 2000), landscape was defined as “an area, as perceived by people, whose character is the result of the action and interaction of natural-human factors.” Understanding the territory through landscape education therefore implies introducing new forms of eco-social literacy (Salonen and Konkka, 2015) through, for instance, forms of didactic of geography at different scales (Ponce et al., 2021), itself promoted by the Commission on Geographical Education of the International Geographical Union (IGU-CGE) in the Lucerne Declaration (IGU-CGE, 2007). It also relates to service learning through Community Economic Development and Ecological Economics, both described later in more depth.

The original interest in the *territory* accompanied what Courlet and Pecqueur described as a “trust issue” with regards to the “*Etat-Nation*” (nation-state), a questioning of liberalism and growth models and ways in which the dogma of the “homogeneous space” is being contested (2013, p. 7). This led to the emergence of “local and territorial development” which sees the territory as being aligned with the deepest challenges of current societies and “has to be approached as a *complex system* made of stakeholders linked by dynamic socialites and connected to the outside world” (Courlet and Pecqueur, 2013, p. 15).

TE was originally closely linked to the *theories of localization* which suggest that “the diminution of transportation costs amplifies the polarization of activities” (Courlet and Pecqueur, 2013, p. 35). Technically, sustainable development is taking our societies toward “new proximities,” due to the requirements of recycling, energy saving and reclaim. In food systems, notably, traceability will be imposed and lead to a reinforcement of geographical and institutional proximity and a shortening of food chains linking producers to consumers. But the importance of the territorial context goes beyond this, highlighting cultural, political, ecological specificities to a milieu and the necessity to understand and respect the place of citizens in their territory in order to apprehend how to undertake sustainable transformation of territories, itself enhanced through education. Numerous institutional networks have recognized this and have been mobilized in many countries and in all kinds of territories, to facilitate the integration of school in their territory, in line with programs on ESD (Francis et al., 2011) and EfS (Kulikova et al., 2021).

3.2. Practical examples

3.2.1. From living schools ...

Howard et al. (2019) presented the Living School concept as a more practical way of approaching EfS at primary and secondary school levels. As they explain, “in keeping with the ethos of ecological thinking and the interdependence of communities, the values of local relevance, and cultural appropriateness, an approach to scalable educational change through sustainable Community Economic

Development (CED) is offered” (p. 2). CED has been defined as a set of actions by people, at the local level, to create sustainable economic opportunities and to improve social conditions contributing to the well-being for all. As explained by Schaffer et al. (2006), it occurs when people in a community take action and, as a result, local leadership and initiative are then seen as the resources for change. The full integration of CED in sustainability focused curricula in Living Schools illustrates a strong wish to recognize the economic, developmental dimension of sustainability, inter-related with ecological dimensions. Linking those to socio-cultural dimensions is also crucial. Although, historically, economic development and community development were viewed as separate concepts, researchers were encouraged to progressively integrate them, highlighting the benefits of partnership-building within communities (Beauregard, 1993; Reese and Fastenfest, 1996).

The main message of the Living Schools approach is that the learning outcomes of education for sustainability have to be meaningful in practice for communities, who therefore need to get a sense of ownership of the concept of sustainability. They do so first by directly benefitting from a strong focus on positive education, as well as social-emotional learning (Collaborative for Academic, Social, and Emotional Learning (CASEL), 2013) and health (Morrison and Peterson, 2013). Also, thanks to a focus on problem-solving and outdoor learning (Williams and Brown, 2012), learners acquire the skills and competencies that are needed to prepare young generations for the 21st century – including critical thinking, communication, collaboration, creative problem solving, character education, and citizenship but also innovation, creativity, computer-enhanced learning and entrepreneurial mindsets (Fullan and Langworthy, 2013).

As O'Brien and Howard (2016, p. 123) stress, “the curriculum of the Living School is founded on understanding the vitality of one's place within the larger landscape as being inextricable from human wellbeing.” To that extent, it links the local practical context to values defended through GCE.

3.2.2. ...to innovative higher education in agro-ecology, landscape architecture and ecological economics

Recent initiatives in more practical approaches to EfS at university level have also been occasionally observed – although, as the general tendency tends to show, there is a lack of integration of the goals of the UN DESD 2005–2014 (Farinha et al., 2018), of long-term objectives (Teixeira and Koryakina, 2016), and of an underpinning framework (Dlouhá et al., 2016) in strategies in higher education.

This has been the case in forms of sustainable territorial pedagogies developed in the sphere of tourism. Thus the Sustainable Tourism Pedagogy (STP) modele (Jamal et al., 2011) could contribute to giving insights for designing territorial education initiatives from a sustainable approach.

This has also been the case with the transdisciplinary agro-ecology educational projects presented by Francis et al. (2011), focused on sustainable farming and food systems. These have created an effective learning landscape “for students to deal with complexity, uncertainty and a range of biological and social dimensions, life-cycle analysis and long-term impacts” (Francis et al., 2011, p. 226). In those, students had to develop new governance and management systems in order to, for instance, better manage interconnections between agriculture and overarching resource systems of food, energy, water and land-use, using

a whole set of skills – such as negotiating, open-mindedness, and appreciation of different perspectives. In parallel, in Landscape Architecture courses, Keeler (2011) documented the benefits derived from the ‘Urban Farm educational Program’ (University of Oregon). He concluded that “place-based education implies a process of re-storying, whereby students are asked to becoming part of the community, rather than a passive observer of it” (2011, p. 11). Away from top-down approaches to education and training, TE through this type of projects, “focuses on the collective influence and responsibility in creating inclusive and responsive public spaces” (Smaniotto Costa and Ioannidis, 2017, p. 53). The territory, through its ecological but also its cultural characteristics, therefore both becomes an educational agent and content (Villar-Caballo, 2001).

Like in the case of educational projects at school levels, one important conclusion is that, in order to grasp the practical dimensions of what makes a territory sustainable, one has to embrace practical projects and acquire skills. As Kolb (1984), learners need experiential components to really understand concepts. Many researchers have also highlighted the importance of adopting a systems perspective (Bawden, 1991) to appreciate the multiple dimensions (economic, social, political and environmental) of sustainability. In the examples of agro-ecology or landscape architecture university courses quoted earlier, systemic learning is fundamental because the focus of study deals with human-natural systems – i.e. the dynamic interactions between human and ecological systems, as studied in an alternative approach such as ecological economics. Authors such as Earle et al. (2017), strongly defended this point and developed an in-depth plea for reforming higher education courses in economics, criticizing the fact these have become solely focused on one approach – that of neo-classical, market-centred, economics –, hence neglecting not only the historical, ecological, socio-cultural (and many more) dimensions of our societies but also rejecting alternative perspectives and critical thinking. This is problematic since the organization, running and ranking of our societies and of their ‘health/performance’ are dominated by an economics discourse focused on the growth of Gross Domestic Product (GDP) which itself ignores environmental values. If university courses in economics are not open to becoming more pluralistic, it is difficult to understand how decision-makers of tomorrow will even consider integrating SDGs in their strategies. New courses in ecological economics (at undergraduate and postgraduate levels, as illustrated)² address this issue by specifically focusing on a new paradigm to approach human- socio-economic – relationships to the surrounding natural environment upon which it depends for its economic activities and survival. The educational value of Ecological Economics projects on the ground has also been highlighted (Healy et al., 2012) and is crucial in new developments of EfS.

3.3. Learning from practical community projects extended to circular economy networks

EfS has an important role to play *beyond* formal educational institutions (such as schools and universities). The problem-centred

pedagogical angle adopted when developing experiential learning toward making places more sustainable has led some researchers to extend the emphasis put on agro-ecology (mentioned in the context of higher education) to a particular interest in Urban Agriculture (UA) as a way of addressing jeopardized food security in growing urban environments post-Covid. As the Food and Agriculture Organization of the United Nations (FAO) stressed, “the pandemic has disrupted urban food systems worldwide [and] this has presented a number of challenges for cities and local governments” (FAO, 2020, p. 5).

Food production in a city constitutes indeed a relevant case study and platform for the application of TE, since UA both facilitates a practical understanding of what greening a city, contributing to food security, and linking food production to other activities in a ‘circular – zero waste – economy’ mean. The evolution of policy responses by local authorities and citizens in many places (India, Kerala; Lisbon, Portugal; Milan, Italy; Thailand, as explained in IPES Food, 2020) shows that learning platforms are also developing outside the educational system, extending to its subject of study itself: the city as a sustainable territory. This learning also relies on the creation of strong solidarity and knowledge networks. The FAO (2020, p. 5) suggested the establishment of an *Urban Food Actions (UFA) COVID-19 Knowledge Hub* to facilitate not only local governments’ access to reliable information on practices by national peers but also by peers around the globe. It also emphasized that international city networks such as the Milan Urban Food Policy Pact (MUFPP, 2015) can play a crucial role in fostering dialogs.

Simon (2022) examined how practical TE, through UA and experiential learning focused on how to produce food differently and with different stakeholders involved, could help urban communities to build more resilience through strengthening food security. Through a networked set of UA initiatives, improving the interconnections between agricultural and non-agricultural activities so that principles of a circular economy are put into place at the city scale, with wastes from one production unit being used as an input in another production process, could also help to make a city more sustainable. For instance, organic wastes from UA units and households could be used to generate organic compost. In a circular economy where “closing the loop” (reducing waste) is considered as a sustainable outcome, the territory matters (Ellen MacArthur Foundation, 2020): it is thanks to the interconnection between existing stakeholders, and the creation of new start-ups that will help in using certain wastes better, that the loop can be closed.

Work is now focused on re-designing the cities of tomorrow and envisaging and imagining the long-term changes that Covid-19 will have triggered. In Europe, the *New Urban Agenda* represents a shared vision for a better and more sustainable future. As the document stresses, if well-planned and well-managed, urbanization can be a powerful tool for sustainable development and can have a real transformative power.

The relationship between territorial economies, governance and globalization is interesting in that, as Courlet and Pecqueur highlight, “whilst questions related to the governance of civil society and to sustainable development clearly encompass a global dimension, they also, paradoxically, require more and more proximity” (2013, p. 17). The globalization movement does not necessitate a *homogenization* of the economy of the planet, as Innerarity (2020) explained through his notion of *glocalization*. A global dimension that remains core to sustainable development relates to common values encompassed in

² <https://ecolecon.eu/ecological-economics-courses-and-programmes/>

the humanistic concept of GCE, as defended by UNESCO (2014) and discussed previously.

The next part of the article focuses on more personal and creative dimensions in learning about sustainability.

4. Artistic education for sustainability

The objective of this part of the article is to present key positions on artistic education for sustainability that are based on 'slow' and immersive educational projects. Education is usually understood in these projects as a mutual knowledge transfer between the artists, educators, institutions and communities, groups and agendas. Education is experienced as a creative exchange and a process in which the roles (educator, educated) are inter-changeable – as the last example included in this text will show. This part of the article presents non-formal and in-formal artistic educational projects for sustainability that aim to stimulate knowledge production and elaboration of solutions that can revitalize specific social, economic and environmental contexts. These performative, creative and exploratory artistic micro-solutions to existing problems pursue concrete results: elaborating grass-roots democratic models, formulating critiques of art and society, fostering social responsibility and inclusiveness of marginalized groups and raising a concern for non-human life forms.

This part of this article is based on artwork analysis as well as on the overview of a selection of theories from the field of art education. Our aim is to show that, since the period of the *neo-avant-gardes* in the 1960s, contemporary art has been marked by initiatives for sustainability – identified under the large umbrella of terms such as 'artistic educational projects,' 'sustainable art and education' or 'intervention art.' Focused on developmental, creative and project-based learning, this part also formulates a critique of projects and practices that – although presenting the appearance of inclusive and reciprocal educative models – end up reiterating hegemonic cultural policy (Foster, 1995).

4.1. Introduction to artistic education for sustainability

As a starting point, it would be important to differentiate between sustainable art and ecologic art, as proposed by Artsper Magazine (2021) and Kagan (2014). While sustainable art is concerned mainly with social responsibility and inclusiveness on a global environmental scale – a direction that this article is focusing on –, ecological art is dealing mainly with specific material use.

Sustainable art is preoccupied with knowledge production and the understanding of environmental challenges, using the creative and applied tools that art offers for stimulating and practicing communitarian awareness and sensitivity to the environment. Sustainable artistic educative programs, workshops, collective artworks, performances aim to foster concrete involvement of the citizen. The ultimate aim is the restoration of social or ecological dysfunctions, remediation and the raising of public awareness (Fowkes and Fowkes, 2006).

Sustainable contemporary art has been a major preoccupation since the 1970s as can be observed in works of artists such as Walther

de Maria, Dennis Oppenheim, Joseph Beuys (in the 1960s) and more recently Tadashi Kawamata, El Anatsui, Olafur Eliasson, Andy Goldsworthy, Thomas Hirschhorn – to cite just very few. Prevalent in their approaches is the fact that the artist mounts collective actions that develop creative approaches to existing societal problems, with the aims of new skills development toward promoting a just, sustainable and non-hierarchic society, searching for the elaboration of micro-solutions for the improvement of environmental quality. Sustainable art has also a self-reflexive orientation, also problematising the impact of art production on a social, economic, biophysical level in the global world, an aspect that will be addressed further on.

Ecological art, on the other hand, is a genre of art and artistic practice that incorporates resources and ecology in its very body, using nature, natural materials, sustainable and vernacular techniques. As Tim Morton states, it 'includes its environments in its very form' (Morton, 2018, p. 52). Ecological art aims to preserve, remedy and/or vitalize earth's life forms.

4.2. Key positions in artistic education for sustainability

UNESCO's constitution goes back to 1945, right after the end of World War II. In 1954, UNESCO founded the International Society for Education Through Art (INSEA), dedicated from the beginning to art-education for peace, strategies to attain equitable societies, human rights and sustainability.

One of the most important figures of the contemporary history of arts, the critic Herbert Read, was elected president of INSEA at its founding (Steers, 2022). He launched the notion of education through 'living art,' intended for environmental and personal self-realization (Read, 1943) – an idea which considerably influenced the *neo-avant-garde*³ and which manifested itself through concepts such as performance art, action art, happening etc.

Sir Herbert Read (1893–1968) explained the goals of what he called 'aesthetic education': learning natural communication, based on the individual's affiliation with the environment – something which he explained should be an essential component of children education. He stated the importance of the art of the present to serve to environmental global interests. The development of the human is seen by him as conjoined with the development of the environment, they are co-dependent and have to be thought of together. Art is seen as a tool that can merge the fields of contemporary humanism with environmental education.

One of UNESCO's first international conferences, where 20 countries convened, was entitled 'The Visual Arts in General Education' and was held in 1951 at the University of Bristol, England. This conference was followed by the founding of INSEA. Since then, INSEA's mission has been to promote art and artistic education for social transformation and to advocate education through art with the objective of achieving a more peaceful world, more equitable societies, and to build awareness of human rights (INSEA, 2022). These ideas

³ The Neo-avant-garde is considered to be a loose grouping of North American and Western European artists of the 1950s and '60s who reprised and revised the modernist avant-garde of the 1910s and '20s.

implemented by one of the most influential critics of art of that time, deeply shaped the conceptual content of the Land Art movement (Coutts and Torres de Eça, 2019). This movement operated an important shift from a thematic approach to nature to a vision of sustainability with a humanist, pedagogic and social orientation.

Beginning with the *neo-avant-garde*, institutional criticism progressively became associated with environmental awareness. Indeed, artistic education for sustainability can be also connected to what has been called the 'environmental turn' of the 1950–70s, from which other preoccupations such as 'engaged art,' postcolonial ecological critiques and the central notion of eco-justice further emerged. At that time, art started to be seen as action, performance and social critique, which were practiced often collectively. In the works of artists such as Allan Kaprow, Joseph Beuys, Yoko Ono, Nancy Holt and Ana Mendieta, ecological awareness and the idea of sustainability were translated into social actions thought for food and other resource sharing in the context of expanding cities, performative collective actions in nature, where the audience becomes the co-author of the piece, gatherings to celebrate nature and artistic retreats. In all these actions, art is not concerned (as it was the case in previous decades) with the realization of an esthetically accomplished work, but with the transmission of knowledge, ecological education, learning alternative social models, sharing sustainable skill development, and practicing different forms of connecting collectively to nature.

These movements also had an activist component, militating toward collective ecological consciousness and transmitting micro-strategies for counter-acting the fast expansion of the capitalist consumerism and the exploitation of resources, especially in the United States. The artists Walter de Maria, Dennis Oppenheim and Robert Smithson are other significant names in this field connected to Land Art actions.

The end of the cold war in 1989 impacted art by generating a global awareness of ecological and social problems. Fowkes and Fowkes (2006) connected the urgency associated to the concept of sustainability to the end of the Cold War in 1989. It was associated at that time with a new awareness of the global character of ecological and social problems.

As Maja and Reuben Fowkes show in the first chapter of their recently appeared volume (Fowkes and Fowkes, 2022), starting in the 1990s, artists began to be increasingly identified as social actors, with the potential to practice, show and teach alternatives to the dominant ideological paradigms, to post-colonial exploitation and to politically motivated excessive resource exploitation.

In 2010, the theoretician Irit Rogoff launched the notion of an 'educational turn' in the field of art. Marked by a holistic approach to art, it is dedicated to highlighting the interconnectedness between global social and environmental phenomena. Art is perceived as a tool for social militancy, raising awareness toward the urgency of collective intervention (Stojanovic, 2017, pp. 58–60).

In the following, we will see some examples of how artists, often in cooperation with subcultural movements, have established parallel institutions (Bourriaud, 1998) – universities, summer schools, workshops, farms, and entire mini-communities – that challenge classical teaching and provide alternative understandings of nature (Weintraub 2012). These creative ways of stimulating knowledge transfer are meant to offer functional alternatives to production processes in the global world, whilst stimulating a 'slow' efficiency and counteract performance optimization.

Kevin Hetherington's definition of the proximal knowledge best describes the meaning production in such actions: 'Proximal

knowledge is unsightly. (...) Proximal knowledge is not necessarily representational at all, rather it is performative, multiple, and heterogeneous in its outcomes' (Hetherington, 2020, p. 21). Thomas Hirschhorn (born 1957 in Bern) is one of the most important exponents of these movements. His large-scale workshops, collective discussions in informal 'universities' and reading schools, his collective buildings and demolition processes are taking place in urban sub-cultural communities, in disadvantaged neighborhoods and in drug-dominated urban areas.

Using art practices in formal and non-formal contexts raising awareness of environmental education, the Spanish artist Lucia Loren is engaging collective learning processes for ecological justice. Contemporary art strategies (performance, creative expression, handicraft, workshop) promote in her work the awareness of social justice and ecological well-being. In her 2016 work 'Biodivers' in Valencia, she planted marigolds and lavender in an abandoned agricultural plot together with the local villagers. These plants are promoting the pollination of other plants, hence revitalizing a dry and non-utilized territory and introducing these two plants into the circuit of local production.

Another influential educational artistic project is *Sustainable Art School*, with a complex website gathering projects made all over the world and diversified partners. From collective projects, such as one focused on paper fabrication which uses a variety of techniques collected from all over the world and introduced in communities where book production was missing, this project merges actors and methodologies from education and contemporary arts.

Finally, in the European Project CREARTE, some teachers and artists from Cyprus and Portugal made similar projects addressing various issues related to the necessity of introducing creative pedagogy for children and involving primary schools in marine sustainability.

4.3. Critique of artistic projects in sustainable education

We hereby aim to give some possible answers to the question of how can sustainable art educators, artists or project managers use contemporary artistic strategies to challenge essentialist and opportunistic teaching situations. The question addresses the potential of participatory art forms to explore alternative and more sustainable conceptions of human subjectivity, beyond just reiterating political agendas that are not formulated on a bottom-up basis. How can art education work in favor of a sense of interconnectedness between the individual, the social and the environmental dimensions of being, without instrumentalising the social conditions found in the field and finally feeding back the cultural market system?

Starting in the 2010s, the critique of 'instrumental art' and of the artist as self-proclaimed representative of communities, became very present. Knudsen and Kolvraa (2021, p. 4 and 19) problematise artistic projects education as reiterating a position of power and cultural hegemony. Self-reflexive and critical theory de-conspired an artist who was assuming the role of 'saviour' of a community through artistic practice, producing an implicitly domineering discourse, formulating a utopia that results from an elitist social position, reproducing stereotyped ecological ideology.

As a concluding note, we would like to cite an innovative model of artistic educational project for sustainability: 'Cosmopolis' – a series

of 3 exhibitions that took place at the Pompidou Centre in Paris, in 2017–2019, curated by Kathryn Weir. This example captures the quintessence of the ideas discussed so far, as it fuses historic and recent practices in artistic sustainable education, incorporates a critical attitude toward the field's own ambiguities, and also proposes a truly innovative structure. Organized around a number of workshops/stations hosted in the exhibition space in the Pompidou Centre, it promoted different forms of knowledge exchange. The project was based on a year-long thematic research in different rural and urban locations and communities worldwide, and on building a solid and updated theoretical grounding of all the methodologies involved. The actions developed created a functioning network of knowledge and information transfer between the audience, the concerned communities, artist collectives, activist groups, citizens, curators, theoreticians and the Pompidou Centre, while the usual hierarchy of production (an art exhibition as outcome of an educational program) was diverted (Papastergiadis, 2018).

5. Conclusion

A few decades have passed since the concept of sustainable development was created. Since then, a young 21st century has seen new faces of globalization emerge – be they strictly neo-liberal or else more humanistic – and theorisations of sustainability have swung between the two. The recent COVID-crisis we have experienced worldwide raised – or justified – doubts concerning certain types of global practices, as well as concerns with the fact that efforts to make our societies more sustainable – including through education – had not succeeded. Re-adjusting our efforts to improve EfS is utterly topical and urgent. In the current context, thinking in terms of *alternative modernity* – as Santos had already advocated in 2006, presenting it as a new way of understanding and apprehending the reality that surrounds us – can help us in exploring the type of knowledge that is needed to improve our societies. These “epistemologies of knowledge” need to be recognized at multiple scales of our planet, societies, communities and individual experiences.

As Teodoro (2020, p. 18) explained, “we should consider a methodological strategy that enables us to take into account different levels of analysis, namely: the supra-national, focusing on international orientations of educational policies; the national, centred on specific cases of national member states and their interpretations and strategies of [more global] educational policies; the institutional, addressing specific educational institutions; and finally, the individual level of analysis, which allows us to explore the ways individuals deal with the changes taking place in educational policies.”

In this article, we suggested three avenues that could help in transforming EfS at multiple levels whilst allowing different ways of approaching learning methods as well as social transformations that are context and cultural dependent. Whilst, at a planetary level, GCE (explored in Section 2.) interweaves the UN sustainability and educational agendas, deepens our knowledge about possible framings of sustainability and offers alternative understandings of globalization and common(s) routes, territorial and experiential learning (in Section 3.) and artistic education for sustainability (in Section 4.) reach out for the territorial and personal scales and for practical examples of educational and artistic approaches in sustainability. A multitude of initiatives have been suggested, carried out, and experimented on.

Although we mentioned some of them in this article, many more exist that deserve paying attention to and drawing lessons from. To some extent, it feels like the time when the drive behind designing EfS was very conceptual and homogenized is over. It is now time to integrate various more practical, ‘experienced’ and context-based types of learning as prime sources of inspiration to carry on improving EfS and adapting it to a fast changing world. More research is needed on such approach. This, we emphasize, will not only help us in advancing research in education, but it will also help us to understand better what ‘sustainability’ means, for whom, and its links with ‘global citizenship’.

A potential opening to our reflection is therefore that global citizenship, as opposed to a homogenized neo-liberal model of development, might be particularly helpful in carrying the sustainable development goals through to operationalisation. Indeed, it might facilitate their integration into new types of learning processes (experiential, place-based, and/or artistic) that resonate better for both learners and educators and feel therefore more meaningful and worthy of being embraced in the future.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

SS took the lead in structuring the manuscript. Each author elaborated a particular part (conceptualization and investigation): IV developed section 2, SS developed section 3, and MJ developed section 4. IV reviewed and edited the text. All authors approved the final version of the manuscript.

Funding

Authors’ work benefited from the FCT grant (UI/BD/150716/2020) and the COFAC work contracts COFAC/CeiED-ECIJ/0001/2020 and COFAC/CeiED-ECIA/0002/2020, besides the institutional support granted by CeiED through FCT funding (UIDB-4114-2020).

Acknowledgments

The authors express their thanks to Lusófona University which hosted the PhD seminar *Global citizenship, territorial education and art forms for Sustainability* that they designed and taught in July 2022 and from which this article emerged. A warm thank you to António Teodoro for challenging and supporting us to elaborate this article.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated

References

- Apple, M. (2019). On doing critical policy analysis. *Educ. Policy* 33, 276–287. doi: 10.1177/0895904818807307
- Artsper Magazine (2021). Art and nature: The emergence of ecological ArtArtsper magazine 10.02.2021. Available at: <https://blog.artsper.com/en/a-closer-look/art-and-nature-the-emergence-of-ecological-art/> (accessed October 23, 2022)
- Ball, S. J. (1998). Big policies / small world: An introduction to international perspectives in education policy. *Comp. Educ.* 34, 119–130. doi: 10.1080/03050069828225
- Bawden, R. J. (1991). Systems thinking and practice in agriculture. *J. Dairy Sci.* 74, 2362–2373. doi: 10.3168/jds.S0022-0302(91)78410-5
- Beauregard, R. A. (1993). "Constituting economic development: a theoretical perspective" in *Theories of local economic development: Perspectives from across the disciplines*. eds. R. D. Bingham and R. Mier (London: Sage), 267–283.
- Beck, U. (2006). *The cosmopolitan vision*. Cambridge, UK & Malden, MA: Polity.
- Biccum, A. R. (2018). Editorial: global citizenship education and the politics of conceptualization. *Int. J. Develop. Educ. Global Learn.* 10, 119–124. doi: 10.18546/IJDEGL.10.2.01
- Boix-Tomás, R., Champollion, P., and Duarte, A. M. (2015). Territorial specificities of teaching and learning. *Sisyphus* 3, 1–124. doi: 10.25749/sis.7880
- Bourriaud, N. (1998). *Relational aesthetics*. Paris: Les Presses Du Réel.
- Buckler, C., and Creech, H. (2014). *Shaping the future we want: UN decade of education for sustainable development: Final report*. Paris: UNESCO.
- Castells, M. (1996). *The rise of the network society*. Cambridge: Blackwell.
- Collaborative for Academic, Social, and Emotional Learning (CASEL) (2013). Elective social and emotional learning programs. Preschool and Elementary School Edition. Available at: <http://www.casel.org/s/2013-casel-guide-pdf>
- Council of Europe (2000). The European Landscape convention. Council of Europe. Available at: <https://rm.coe.int/16807b6bc7>
- Courlet, C., and Pecqueur, B. (2013). *L'économie territoriale*. Grenoble: Presses Universitaires de Grenoble.
- Coutts, G., and Torres de Eça, T. (Eds.) (2019). *Learning through art lessons for the 21st century*. Portugal: INSEA Publications.
- Cowen, R., and Kazamias, A.M. (Eds.) (2009). *International handbook of comparative education*. Dordrecht: Springer Science and Business Media.
- Crespo, J.M. (2017). *Landscape education in the primary education degree: Proposal of a didactic model*. PhD. Dissertation. Madrid: Universidad Complutense de Madrid.
- Cresswell, T. (2006). *On the move: Mobility in the modern western world*. London: Routledge.
- Darder, A., Torres, R., and Baltodano, M. (2017). "Critical pedagogy: an introduction" in *The critical pedagogy reader*. eds. D. Torres and D. Baltodano (New York: Routledge), 1–24.
- de Angelis, M. (2021). "Bens comuns (commons)" in *Pluriverso. Um Dicionário Do Pós-Desenvolvimento*. ed. Kothari (São Paulo: Elefante), 215–220.
- Dlouhá, J., Glavic, P., and Barton, A. (2016). Higher education in central European countries and critical factors for sustainability transition. *J. Clean. Prod.* 151, 670–684. doi: 10.1016/j.jclepro.2016.08.022
- Earle, J., Moran, C., and Ward-Perkins, Z. (2017). *The econocracy. On the perils of leaving economics to the experts*. London: Penguin Books.
- Ellen MacArthur Foundation (2020). *The circular economy: A transformative COVID-19 recovery strategy: How policy makers can pave the way to a low carbon, prosperous future*. Cowes, UK: Ellen MacArthur Foundation.
- Europe-Wide Global Education Congress (2002). The "Maastricht global education declaration". Available at: <https://rm.coe.int/168070e540> (accessed December 5, 2022)
- Evans, T. (2010). Critical social theory and sustainability education at the college level. why It's critical to be critical. *J. Sustain. Educ.* 1.
- Farinha, C. S., Azeiteiro, U., and Caeiro, S. S. (2018). Education for sustainable development in Portuguese universities: The key actors' opinions. *International Journal of Sustainability in Higher Education*. 19, 912–941. doi: 10.1108/IJSHE-09-2017-0168
- FAO (2020). *Urban food systems and COVID-19: The role of cities and local governments in responding to the emergency*. Rome: FAO.
- Fien, J. (2020). *Educational policy and practice for sustainable development. Encyclopaedia of life support system EOLSS*. Paris: UNESCO.
- Foster, H. (1995). "The artist as ethnographer?" in *The traffic in culture: Refiguring art and anthropology*. eds. G. Marcus and F. Myers (Berkeley: University of California Press), 302–309.
- Fowkes, M., and Fowkes, R. (2006). Principles of sustainability in contemporary art. Praesens: Central European contemporary art. *Review* 1, 5–12.
- Fowkes, M., and Fowkes, R. (2022). *Art and climate change*. London: Thames & Hudson.
- Francis, C. A., Jordan, N., Porter, P., Breland, T. A., Lieblein, G., Salomonsson, L., et al. (2011). Innovative education in agro-ecology: experiential learning for a sustainable agriculture. *Crit. Rev. Plant Sci.* 30, 226–237. doi: 10.1080/07352689.2011.554497
- Fullan, M., and Langworthy, M. (2013). *Towards a new end: New pedagogies for deep learning*. Seattle: Collaborative Impact.
- GEFI-Global Education First Initiative (n.d.). UN DESA-sustainable development. Available at: <https://sdgs.un.org/partnerships/global-education-first-initiative-gefi> (accessed December 5, 2022).
- Harvey, D. (1989). *The condition of postmodernity: An inquiry into the origins of cultural change*. Oxford: Blackwell.
- Harvey, D. (1996). *Justice, nature and the geography of difference*. Oxford: Blackwell.
- Healy, H., Martínez-Alier, J., Temper, L., Walter, M., and Gerber, J.-F. (2012). *Ecological economics from the ground up*. London: Routledge.
- Hetherington, K. (2020). "Foucault and the museum" in *Museum theory*. eds. A. Witcomb and K. Message (West Sussex: Wiley Blackwell), 21–40.
- Howard, P., O'Brien, C., Kay, B., and O'Rourke, K. (2019). Leading educational change in the 21st c. creating living schools through shared vision and transformative governance. *Sustainability* 11:4109. doi: 10.3390/su11154109
- IGU-CGE (2007). Lucerne declaration on geographical education for sustainable development. International Geographical Union. Available at: <https://www.iau-hesd.net/sites/default/files/documents/lucernedeclaration.pdf>
- Illich, I. (1971). *Deschooling society*. New York: Harper & Row.
- Innerarity, D. (2020). "New governance for a sustainable 'glocalization'" in *Reconstruction and post pandemic recovery COVID-19; a key element of social cohesion, Reciprocamente* (Madrid: EUROsociAL), 4–5.
- INSEA (2022). Manifesto. Available at: <https://www.insea.org/our-manifesto/> (accessed October 23, 2022).
- IPES Food (2020). COVID-19 and the crisis in food systems: Symptoms, causes and potential solutions. Available at: https://www.ipes-food.org/_img/upload/files/COVID-19_CommuniqueEN.pdf (accessed November 9, 2022).
- Jamal, T., Taillon, J., and Dredge, D. (2011). Sustainable tourism pedagogy and academic-community collaboration: a progressive service-learning approach. *Tour. Hosp. Res.* 11, 133–147. doi: 10.1057/thr.2011.3
- Kagan, S.J. (2014). The practice of ecological art. Plastik: art & science. Available at: https://www.researchgate.net/publication/274719395_The_practice_of_ecological_art (accessed October 23, 2022).
- Keeler, H. (2011). *Considering the urban farm program and the role of place-based experiential education in the pedagogy of landscape architecture*. Masters Dissertation. Eugene: Department of landscape Architecture, University of Oregon.
- Khazem, D. (2018). Critical realist approaches to global learning: A focus on education for sustainability. *Int. J. Dev. Educ. Glob. Learn.* 10, 125–134. doi: 10.18546/IJDEGL.10.2.02
- Knudsen, B., and Kølvrå, C. (2021). Affective infrastructures of re-emergence? *Heritage Soc.* 12:1. doi: 10.1080/2159032X.2021.1883981
- Kolb, D. (1984). *Experiential learning: Experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice Hall.
- Kulikova, E., Molokova, E., and Vlasova, N. (2021). Sustainable territorial development in the context of higher education structure. *E3S Web of conferences*. 296:08023. doi: 10.1051/e3sconf/202129608023
- Lahire, B. (2012). *Monde pluriel. Penser l'unité des sciences sociales*. Paris: Seuil.
- Malkki, L. (1997). National Geographic: the rooting of peoples and the Territorialization of National Identity among scholars and refugees. *Cult. Anthropol.* 7, 24–44. doi: 10.1525/can.1992.7.1.02a00030
- Martinez-Alier, J. (1987). *Ecological economics. Energy, environment and society*. Basil: Blackwell.

- Morrison, W., and Peterson, P. (2013). *Schools as a setting for promoting positive mental health: Better practices and perspectives, 2nd Edn* Summerside, PE, Canada: Pan-Canadian Joint Consortium for School Health.
- Morton, T. (2018). *Being ecological*. London: Penguin.
- MUFPP (2015). Milan urban food policy pact. Available at: <http://www.milanurbanfoodpolicypact.org/text/> (accessed November 9, 2022)
- O'Brien, C., and Howard, P. (2016). The living school: the emergence of a transformative sustainability education paradigm. *J. Educ. Sustain. Dev.* 10, 115–130. doi: 10.1177/0973408215625549
- Pacheco, J.A. (2001). *Currículo: teoria e prática*. Porto: Porto Editora.
- Papastergiadis, N. (2018). From Cosmopolis to cosmopolitan spaces. E-flux architecture. Available at: <http://www.e-flux.com/architecture/urban-village/169806/fromCosmopolis-to-cosmopolitan-spaces/> (accessed October 23, 2022)
- Ponce, A. I., Martínez Hernández, C., and Rico Gómez, M. L. (2021). Heritage, geographical scale and didactic potentiality: students and teachers' perspectives. *PLoS One* 16:e0251398. doi: 10.1371/journal.pone.0251398
- Read, H. (1943). *Education through art*. New York: Pantheon Books.
- Recommendation CM/Rec(2010)7 (2010). *Council of Europe Charter on Education for Democratic Citizenship and Human Rights Education: recommendation Cm/Rec(2010)7 and Explanatory Memorandum (2010) / adopted by the Committee of Ministers of the council of Europe on 11 May 2010*. Strasbourg: Council of Europe Publishing.
- Reese, L. A., and Fastenfest, D. (1996). Local economic development over time. *Econ. Dev. Quart.* 10, 280–289.
- Rosa, H. (2019). *Resonance. A sociology of our relationship to the world*. Cambridge, UK & Medford, MA, USA: Polity Press.
- Sahlberg, P. (2016). "The global reform movement and its impact on schooling" in *The handbook of global education movement*. eds. K. Mundy, A. Green, B. Lingard and A. Verger (Chichester: Wiley Blackwell), 128–144.
- Salonen, A. O., and Konkka, J. (2015). An ecosocial approach to well-being: a solution to the wicked problems in the era of anthropocene. *Foro de Educación* 13, 19–34. doi: 10.14516/fde.2015.013.019.002
- Santos, B. S. (2006). *A Gramática do Tempo: por uma nova cultura política*. São Paulo: Cortez Editora.
- Schaffer, R., Deller, S., and Marcouiller, D. (2006). Rethinking community economic development. *Econ. Dev. Q.* 20, 59–74. doi: 10.1177/0891242405283106
- SDG 4.7 (n.d.). Education for sustainable development and global citizenship, no date. Council of Europe. Available at: <https://www.coe.int/en/web/education/4.7-education-for-sustainable-development-and-global-citizenship> (accessed December 5, 2022).
- Sheller, M., and Urry, J. (2006). The new mobilities paradigm. *Environ Plan A* 38, 207–226. doi: 10.1068/a37268
- Simon, S. (2022). A new phase in the history of education for sustainability. The emergence of territorial education in a post-COVID recovery period. *World J. Educ. Res.* 9, 75–96. Available at <http://www.scholink.org/ojs/index.php/wjer/article/view/4954/5827>
- Smaniotto Costa, C., and Ioannidis, K. (Eds.) (2017). *The making of the mediated public space. Essays on emerging urban phenomena. Series culture and territory*. Lisbon: Edições Universitárias Lusófonas.
- Soysal, Y. (1994). *Limits of citizenship, migrants and postnational membership in Europe*. Chicago: The University of Chicago Press.
- Steers, J. (2022). InSEA: Past present and future. Available at: <https://www.insea.org/our-manifesto/> (accessed 23rd October 2022)
- Stojanovic, D. (2017). Educational turn in art: turning art into the production of a new knowledge. *Zbornik Akademije Umetnosti* 20175, 56–64. doi: 10.5937/ZbAkUm1705056S
- Teixeira, P., and Koryakina, T. (2016). Political instability, austerity and wishful thinking: Analysing stakeholders' perceptions of higher education's funding reforms in Portugal. *Eur. J. Educ.* 51, 126–139. doi: 10.1111/ejed.12126
- Teodoro, A. (2020). *Contesting the global development of sustainable and inclusive education. Educational reform and the challenges of neoliberal globalization*. New York & London: Routledge.
- Teodoro, A. (Ed.), (2022). *Critical perspectives on PISA as a means of global governance. Risks, limitations, and humanistic alternatives*. New York & London: Routledge.
- Torres, C. A. (2015). Global citizenship and global universities: the age of global interdependence and cosmopolitanism. *Eur. J. Educ.* 50, 262–279. doi: 10.1111/ejed.12129
- Torres, C. A. (2017). *Education for global citizenship* Oxford Research Encyclopedia of Education. doi: 10.1093/acrefore/9780190264093.013.91
- Turner, M. D. (2017). Political ecology III: The commons and commoning. *Prog. Hum. Geogr.* 41, 795–802. doi: 10.1177/0309132516664433
- UNESCO (2014). *Global citizenship education: Preparing learners for the challenges of the 21st century*. Paris: UNESCO.
- Villar-Caballo, M. B. (2001). A cidade educadora: nova perspectiva de organização e intervenção municipal. *Lisboa Instituto Piaget*.
- Weintraub, L. (2012). *To life! Eco art in pursuit of a sustainable planet*. Berkeley: University of California Press.
- Williams, D., and Brown, J. (2012). *Learning gardens and sustainability education: Bringing life to schools and schools to life*. London: Routledge.
- World Commission on Environment and Development (WCED) (1987). *Our Common Future*. Oxford: Oxford University Press.



OPEN ACCESS

EDITED BY

Ana Luísa Rodrigues,
University of Lisbon, Portugal

REVIEWED BY

Buratin Khampirat,
Suranaree University of Technology, Thailand
Joana Carneiro Pinto,
Catholic University of Portugal, Portugal

*CORRESPONDENCE

Tom Reschke
✉ tom.reschke@jurs.uni-heidelberg.de

RECEIVED 23 December 2022

ACCEPTED 19 May 2023

PUBLISHED 13 June 2023

CITATION

Reschke T, Lobinger T and Reschke K (2023)
The potential of an exam villa as a structural
resource during prolonged exam preparation at
university. *Front. Educ.* 8:1130648.
doi: 10.3389/feduc.2023.1130648

COPYRIGHT

© 2023 Reschke, Lobinger and Reschke. This is
an open-access article distributed under the
terms of the [Creative Commons Attribution
License \(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use, distribution or
reproduction in other forums is permitted,
provided the original author(s) and the
copyright owner(s) are credited and that the
original publication in this journal is cited, in
accordance with accepted academic practice.
No use, distribution or reproduction is
permitted which does not comply with these
terms.

The potential of an exam villa as a structural resource during prolonged exam preparation at university

Tom Reschke^{1*}, Thomas Lobinger¹ and Katharina Reschke²

¹Institute for Civil Law, Labor and Commercial Law, Heidelberg University, Heidelberg, Germany,

²Institute for Education Studies, Heidelberg University, Heidelberg, Germany

Introduction: Drawing on the Demand-Control Model, this study examined whether using an exam villa as a supportive learning environment provides a structural resource for law students during exam preparation. First, we hypothesized that villa students show higher decision latitude and satisfaction and less stress compared to non-villa students. Second, we expected villa use to predict stress and satisfaction over and beyond the demand-control dimensions. Third, decision latitude was tested to mediate of the relationship between villa use and both outcomes.

Methods: Our cross-sectional study included $N = 205$ advanced law students that gave self-reports on their stress and satisfaction, villa use, their perceived demands and decision latitude along with some control variables. All students were within a period of long-lasting exam preparation stretching over 12 to 18 months whereas $n = 41$ students used the villa.

Results: Using the exam villa was associated with both less subjective stress and more satisfaction. SEMs revealed villa use to predict stress but not satisfaction over and beyond the demand-control dimensions with 73% of overall explained variance in stress and 62% of variance in satisfaction. Decision latitude mediated the relationship between villa use and both outcomes.

Discussion: The findings support the potential of structural resources in reducing stress among students undergoing prolonged academic stress.

KEYWORDS

academic stress, satisfaction, university students, decision latitude (DL), structural resource, setting-based approaches

1. Introduction

High-stress levels and growing mental health problems have been shown to challenge university students (Robotham and Julian, 2006; Beiter et al., 2015; Ribeiro et al., 2018; Rabkow et al., 2020), while exam periods appear to be particularly stressful (Zunhammer et al., 2013; Lyndon et al., 2014; Campbell et al., 2018). Stress is defined as an unpleasant experience that results from the perceived discrepancy between certain demands and the individual resources to cope within a given situation. Therefore, stress depends upon individual cognitive appraisal and emerges when demands are numerous and prolonged, and coping resources are taxed or even exceeded (Lazarus and Folkman, 1984). There is ample evidence that study programs with state examination formats such as in medical and law school have characteristics of prolonged academic stress given the time-consuming and academically challenging nature of exam preparation (e.g., Duan et al., 2013; Multrus et al., 2017; Giglberger et al., 2022). Studies have found prolonged academic examination stress to be not only related to high-stress levels but also to potential health problems such as

symptoms of anxiety, depression, or somatization (Weik and Deinzer, 2010; Zunhammer et al., 2013; Giglberger et al., 2022).

We based our study on the Demand-Control Model (DCM; Karasek, 1979) which is one of the predominant models for explaining stress in work-related contexts. The DCM makes predictions about stressful work environments by postulating two important dimensions: psychosocial demands and control (decision latitude) within a given work situation. Demands refer to physical, psychological, social, or structural conditions that require an individual to invest effort to complete certain tasks (e.g., workload and time pressure). Control refers to physical, psychological, social, or structural resources that provide an individual with opportunities to make use of different inherent skills in order to complete a task as well as decide to which task attention is allocated under which circumstances. The DCM distinguishes four types of work activities: passive, active, low-strain, and high-strain work activities, which are all characterized by scoring either low or high on the demand-control dimensions that can lead to the development of stress and health-related problems. High-strain work activities are existing when an individual perceives high work-related demands and low decision latitude at the same time and the model assumes such a constellation to be associated with elevated stress as well as risks to physical and mental health (Karasek, 1979; Karasek and Theorell, 1990). A more positive constellation results from an active work activity where an individual experiences high work-related demands combined with high decision latitude. Research that applied the DCM in the university context found empirical support that perceiving high demands and low decision latitude were associated with more stress and less satisfaction as well as symptoms of depression and anxiety (Karasek, 1979; Karasek and Theorell, 1990; Cotton et al., 2002; Chambel and Curral, 2005). More recent research demonstrated that high demands were associated with high levels of study-related stress and decision latitude could positively predict study-related satisfaction (Sieverding et al., 2013; Schmidt et al., 2015).

In this framework, past studies have not only explored explaining factors of study-related stress but also pointed to setting-based initiatives (i.e., utilizing structural opportunities and resources) to reduce stress in university students (Fernandez et al., 2016; Upsher et al., 2022). The other major direction of research focused on individual-based initiatives (i.e., utilizing individual opportunities and resources) to explain and reduce stress among students. Recent evidence suggests that stress management interventions are an effective means to reduce stress as well as symptoms of anxiety and depression among students (e.g., for a recent review and meta-analysis by Amanvermez et al., 2020). Cognitive-behavioral therapy, and mindfulness- and mind-body-oriented programs have continuously been reported to be most effective especially when lasting over several weeks (Worsley et al., 2022). While many of those programs are effective at building and improving students' individual resources, few interventions aim at the potential of structural resources. In fact, focusing on setting-based initiatives would be promising because it could act on the potential sources of stress. For the situation of students, this could translate into curriculum-embedded strategies that

reduce academic demands and enhance decision latitude, for instance. Setting-based initiatives such as creating specific learning environments may even help to prevent the need for individual intervention efforts. Currently, more research in this direction would lead to a better understanding of the effectiveness of setting-based initiatives (Fernandez et al., 2016; Upsher et al., 2022).

The law faculty of one large German university established an innovative structural approach to address students' needs during prolonged and stressful exam preparation for their first state examination (Lobinger, 2016). This offered support is an exclusive villa that is open to advanced law students to use while preparing their final examinations. Students apply for one out of 50 personal workspaces to use up to 12 months. Selection is not based on previous grades but determined based on the highest need and most expected benefit for the individual student. Students are invited to use their fixed personal workspaces on a 24/7 basis which helps them avoid crowded libraries and study at their own pace. The villa provides a conducive learning environment including rooms for group learning, a small law-specific library, and a kitchen where students of the same field of study can meet and exchange ideas. Given such amenities, it appears worthwhile to examine the role of such an exam villa as a structural resource for study-related stress and satisfaction. The exam villa provides a systematic means of empowering students to arrange and organize their current study situation (e.g., deciding over individual study hours and separating work from leisure). It provides a special work environment that helps students to perceive more individual control over their exam preparation.

The present study aimed at exploring the potential of the exam villa as a setting-based initiative to reduce stress in university students. The DCM states decision latitude to be a central factor that is directly associated with positive effects. Therefore, we assume that using the villa would lead to an increase in decision latitude which can in turn reduce study-related stress and enhance satisfaction. To our knowledge, no empirical studies have examined whether such a structural initiative to reduce stress among students turns out to be an effective means. In addition, little is known about resourceful influential factors during prolonged academic examination stress in higher education contexts. Accordingly, we derived the following research hypotheses:

Hypothesis 1a. Villa students perceive significantly higher levels of decision latitude compared to non-villa students with no between-group differences on demands.

Hypothesis 1b. Villa students report both significantly lower levels of stress and higher levels of satisfaction compared to non-villa students.

Hypothesis 2a. Villa use significantly predicts stress even when important predictors such as the demand-control dimensions and other control variables are considered.

Hypothesis 2b. Villa use significantly predicts satisfaction even when important predictors such as the demand-control dimensions and other control variables are considered.

Hypotheses 3a. Decision latitude significantly mediates the relationship between villa use and stress.

Hypotheses 3b. Decision latitude significantly mediates the relationship between villa use and satisfaction.

2. Method

2.1. Sample and procedure

Our study consisted of $N = 205$ students (65% female) from one large German university. All of them were advanced law students enrolled for at least six semesters ($M = 9.21$, $SD = 1.64$). To participate in the study, students had to meet the inclusion criterion of being in the midst of their exam preparation to pursue their first law degree. At the time of data collection, there was a total number of $N = 393$ students in exam preparation. There were no exclusion criteria other than that. Students varied in time spent for their exam preparation which ranged from 12 to 24 months. An amount of $n = 41$ students used a personal workspace in the exam villa ("villa students"). Since there are only 50 spaces available in the exam villa, we reached 82% of all villa students which can be interpreted as a representative subsample. All other students did not use a workspace in the villa ("non-villa students"). The mean age was 24.22 years ($SD = 2.19$). Data were collected cross-sectionally in early 2017 using economic self-report measures. Paper-and-pencil questionnaires were handed out in exam-relevant seminars and in the exam villa itself. We also informed students about the study on the faculty's website. To obtain a representative sample, we also contacted various cohorts of students who were in the process of preparing for their examinations via an internal faculty email distribution list. Identical online questionnaires were made available by sending students emails that included a questionnaire link. This made it possible to reach more participants because the majority of students no longer attend regular courses during exam preparation. Each questionnaire took about 20 min to complete, and informed consent was obtained. Students completed the questionnaires mostly at their homes or at the exam villa if they owned a personal workspace. The paper questionnaires could be anonymously dropped into a designated ballot box. Students received no financial compensation for their participation. The entire study got supervised and approved by the local ethics committee.

2.2. Measures

2.2.1. Demands and decision latitude

We measured perceived study demands and decision latitude using the questionnaire on structural conditions (*StrukStud*; Schmidt et al., 2018). The questionnaire stems from research based on the DCM and its corresponding Job Content Questionnaire (Karasek, 1979, 1985; Karasek et al., 1998) that received further refinement and adaptation to fit the situation of university students (Schmidt et al., 2018). We focused on the two core dimensions, namely study demands and decision latitude. Decision latitude includes the subdimensions skill discretion and decision authority to assess structural study conditions during exam preparation. Students were asked to answer demands with seven items [e.g., "In my studies, I have to work hard" and "In my studies, I have enough time to get tasks done (reverse coded)"] and decision latitude with eight items (e.g., "In my studies, I develop my own special abilities" and "My studies allow me to make my own decisions"). The answer

format was a rating scale ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). We decided to remove one demand item and three decision latitude items due to better fit to the situation of advanced law students as well as to insufficient singular factor loadings of these items within the structural equation models. Internal consistencies were $\alpha = 0.76$ for demands and $\alpha = 0.69$ for decision latitude.

2.2.2. Study-related stress

We assessed students' stress with the Leipzig Short Questionnaire on Chronic Stress (LKCS; Reschke and Schröder, 2016; Reschke and Mätzchen, 2020). This measure was developed as a screening tool in the realm of a stress management training program targeting adults in their working contexts (Reschke and Schröder, 2010). We applied it to the situation of advanced law students and considered prolonged exam preparation to be the students' working context. The brief questionnaire contains seven items that intend to measure seven different domains of chronic stress: (1) loss of control ("I have the feeling of being rushed, trapped or cornered"), (2) loss of meaning ("I sometimes ask myself if all the effort is actually worth it"), (3) negative emotions ("Dissatisfaction and frustration are parts of my everyday life"), (4) early psychosomatic symptoms/sleep disorder ("I wake up regularly during the night or long before I have to get up"), (5) inability to rest ("Even after days off and hours of rest, I feel drained and lethargic"), (6) burden of critical life event ("There are sensitive aspects of my life that upset me when I merely think of them"), and (7) lack of social support ("When I want to talk about my problems, it is hard to find someone who will listen and understand"). Students answered all items on a rating scale ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). We excluded the single item on social support from our analyses due to the assumed confounding effect of other people. The internal consistency was $\alpha = 0.79$.

2.2.3. Study-related satisfaction

We measured satisfaction with the Satisfaction with Life and Studies Scale (LSZ; Holm-Hadulla and Hofmann, 2007). This questionnaire builds on the Satisfaction With Life Scale (Diener et al., 1985) and concentrates on the satisfaction component of subjective wellbeing and its cognitive evaluation. The scale we used contained seven items and was tailored to higher education research by including study satisfaction as a subdomain of life satisfaction. We assumed both life and study satisfaction to be mutually important during exam preparation, and previous studies report all items to load on a single factor with $\alpha = 0.79$ (Holm-Hadulla et al., 2009; Schmidt et al., 2018). The life satisfaction domain included four items that measured students' satisfaction with their personal life situation in terms of their perceived performance and functioning as well as overall life satisfaction ("How healthy and productive do you currently feel?" "How well do you currently manage yourself?" "How well do you currently get along with others?" and "How satisfied are you with your current life?"). The study satisfaction subdomain contained three items that focused on performance and situational aspects of studying ("How satisfied are you with your current academic achievements?" "How

satisfied are you with your current study situation?” and “How satisfied are you with your current general study conditions?”). Students were asked to refer back to the last 7 days and answer all items on a rating scale ranging from 1 (*not at all*) to 5 (*very much*). We excluded one life satisfaction item from our analyses because we assumed a confounding effect of other people (“How well do you currently get along with others?”). The internal consistency was $\alpha = 0.83$.

2.2.4. Use of exam villa

We also wanted to know whether students used a personal workspace in the exam villa during exam preparation. Compared to students that did not use the villa, villa students could benefit from an exclusive learning environment with rooms for group learning and other amenities. Students could use their workspaces day and night including weekends for up to 12 months and reported their frequency of use on a brief rating scale with 0 (*never*), 1 (*sometimes*), and 2 (*often*).

2.2.5. Control variables

We added three more variables to control for potential confounding effects. First, we included workload to assess the overall study effort that students would dedicate to their exam preparation in terms of hours spent per week (“How much time per week do you usually spend on your studies?”). Second, we considered time to examination as we expected this variable to influence subjective stress and satisfaction levels. Studies have shown increased subjective stress levels during examination periods when compared to pre-examination periods (e.g., Lyndon et al., 2014; Giglberger et al., 2022). Students got to choose their temporal distance to their planned exam campaign (*March 2017*, *September 2017*, *March 2018*, and *September 2018*). Third, we also included a brief measure to assess students’ personality traits because neuroticism is known to serve as a potential negativity bias in studies with subjective stress ratings (Schmidt et al., 2015). We applied the Big Five Inventory-10 to measure important personality dimensions with 10 items (*BFI-10*; Rammstedt and John, 2007). To account for negative affectivity, we focused on the neuroticism subscale that contained two items (“I see myself as someone who is relaxed, handles stress well (reverse coded)” and “I see myself as someone who gets nervous easily”). Students rated both items on a rating scale ranging from 1 (*disagree strongly*) to 5 (*agree strongly*).

2.3. Statistical analyses

2.3.1. *t*-tests for independent samples

We applied a set of *t*-tests for independent samples to examine the role of villa use on the demand-control dimensions between villa students and non-villa students (Hypothesis 1a). We also wanted to know whether both groups differed on study-related stress and satisfaction (Hypothesis 1b). For interpreting the magnitude of the mean differences, we calculated effect sizes (Cohen’s *d*).

2.3.2. Structural equation models

We used structural equation modeling (SEM) to predict study-related stress and satisfaction during exam preparation. Specifically, we wanted to know whether villa use would serve as a significant predictor of both outcomes over and beyond the demand-control dimensions as well as relevant control variables. Based on the findings of previous research, we modeled the data with a hierarchical approach and included the variables in three subsequent steps depending on their presumed importance and novelty (Sieverding et al., 2013; Schmidt et al., 2015). Therefore, we specified three models for each outcome that would each take more variables into consideration. In the first step, we set up a baseline model that included sex, age, time to examination, workload, and neuroticism as relevant control variables. In this first model, all predictor variables were assessed with one item and thus modeled as manifest variables except for neuroticism. In the second step, we added demands and decision latitude as further predictor variables. Both dimensions were specified as latent variables with about five indicators each. The third and last step introduced villa use as our central between-subject variable to examine whether it would still make a relevant contribution toward explaining both outcomes. Villa use was assessed with one item and thus specified as a manifest variable. Both study-related stress and satisfaction were modeled as latent variables with six indicators each. All SEMs were computed using Mplus 7.11 (Muthén and Muthén, 2013).

2.3.3. Mediation

We also used SEM to analyze the role of the demand-control dimensions and whether decision latitude in particular would mediate the relationship between villa use and study-related stress and satisfaction (Hypothesis 3a+b). We computed the indirect effects of villa use over the demand-control dimensions on both outcomes. Therefore, we first specified a basic model with villa use as a predictor for each outcome. We then computed two mediation models and specified the demand-control dimensions as mediators of the relationship between villa use and both outcomes.

2.3.4. Evaluation of model fit

To evaluate the model fits of our SEMs, we assessed the χ^2 -value with its degrees of freedom, the comparative fit index (CFI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). Due to its dependency on sample size often leading to significant values, we interpreted the χ^2 value with caution (Ullman, 2007). CFI values >0.95 , RMSEA values <0.06 , and SRMR values <0.08 are considered good model fits (Hu and Bentler, 1999; West et al., 2012). Because the literature remains inconclusive about the final definition of a “good” model, we considered the fit of a model as satisfactory when the majority of the three fit indices (CFI, RMSEA, and SRMR) were within an acceptable range (Lai and Green, 2016).

2.3.5. Missing data

To handle missing data, we used the full information maximum likelihood (FIML) approach within Mplus. This method has the advantage to produce less biased estimates than traditional methods

such as listwise or pairwise deletion. FIML estimates the model parameters by taking cases with missing values into consideration while maintaining statistical power (Schafer and Graham, 2002; Enders, 2010).

2.3.6. Confidence intervals

We computed confidence intervals (95%) to examine the significance of an indirect effect within the mediation models. Each mediator was tested using the bootstrap method in Mplus with 10,000 drawn samples. Mediation occurred when indirect effects significantly differed from zero in that the confidence intervals did not include zero.

3. Results

3.1. Descriptive statistics and intercorrelations

Means (*M*), standard deviations (*SD*), and intercorrelations between the examined variables are presented in Table 1 and briefly mentioned in the following. Villa use was related to study-related stress ($r = -0.20, p < 0.01$) and satisfaction ($r = 0.15, p < 0.05$) as well as to decision latitude ($r = 0.15, p < 0.05$) and time to examination ($r = -0.16, p < 0.05$). Stress was associated with demands ($r = 0.56, p < 0.001$) and decision latitude ($r = -0.39, p < 0.001$) as well as neuroticism ($r = 0.44, p < 0.001$) and age ($r = 0.16, p < 0.05$). Satisfaction was correlated with all variables [e.g., stress ($r = -0.70, p < 0.001$), demands ($r = -0.47, p < 0.001$), and decision latitude ($r = 0.46, p < 0.001$)] except for workload. The demand-control dimensions also correlated with each other ($r = -0.32, p < 0.001$). There were also other significant intercorrelations that can be seen in Table 1.

3.2. t-tests

With regard to hypothesis 1a, the results of the independent *t*-tests supported that villa students differed on their perceived decision latitude but not on demands. On average, villa students ($M = 2.57, SD = 0.47$) perceived significantly higher levels of decision latitude than non-villa students [$(M = 2.38, SD = 0.53), t_{(198)} = -2.06, p = 0.041, d = 0.36$], although they did not differ on demands [$t_{(198)} = 0.66, p = 0.51$]. The effect size of the difference in decision latitude is small to medium and suggests that villa students perceived more control over their study situation during exam preparation than non-villa students.

Turning to hypothesis 1b, the results of independent *t*-tests supported that students who used the exam villa differed in their experienced study-related stress and satisfaction compared to students who did not use it. On average, villa students ($M = 2.34, SD = 0.7$) reported significantly lower stress levels than non-villa students [$(M = 2.68, SD = 0.66), t_{(198)} = 2.91, p = 0.004, d = 0.51$]. In addition, villa students ($M = 2.75, SD = 0.70$) reported significantly higher satisfaction levels than non-villa students [$(M = 2.49, SD = 0.73), t_{(198)} = -2.01, p = 0.046, d = 0.35$]. Both effect sizes are about medium in magnitude and indicate meaningful

TABLE 1 Descriptive statistics and intercorrelations among the study variables.

Variables	<i>M</i>	<i>SD</i>	Min	Max	<i>S</i>	<i>K</i>	2	3	4	5	6	7	8	9
1. Age	24.22	2.19	21	42	3.52	23.30	−0.12	0.00	0.12	0.06	−0.05	0.16*	−0.16*	0.08
2. Time to examination	1.75	0.83	1	4	0.75	−0.42		−0.19**	0.19**	0.16*	0.02	−0.06	0.18**	−0.16*
3. Workload	45.93	12.15	10	80	0.04	0.50			−0.03	0.19**	0.10	0.10	−0.10	0.12
4. Neuroticism	3.25	1.03	1	5	−0.16	−0.89				0.30***	−0.19**	0.44***	−0.33***	−0.13
5. Study demands	3.35	0.45	1.67	4.00	−0.64	0.12					−0.32***	0.56***	−0.47***	−0.05
6. Decision latitude	2.41	0.53	1	3.80	−0.11	−0.19						−0.39***	0.46***	0.15*
7. Stress	2.62	0.69	1.17	4.00	−0.04	−0.62							−0.70***	−0.20**
8. Satisfaction	2.54	0.74	1	4.50	0.26	−0.35								0.15*
9. Villa use	0.40	0.80	0	1	1.47	0.17								—

S, Skewness; *K*, Kurtosis.
**p* < 0.05.
***p* < 0.01.
****p* < 0.001.

TABLE 2 Results of confirmatory factor analyses (CFA) for demands, decision latitude, study-related stress, and satisfaction.

Factor loadings and fit statistics	Demands	Decision latitude	Stress	Satisfaction
	β (SE)	β (SE)	β (SE)	β (SE)
Items				
Item 1	0.63 (0.06)	0.53 (0.07)	0.75 (0.04)	0.58 (0.06)
Item 2	0.53 (0.07)	0.75 (0.07)	0.59 (0.05)	0.71 (0.05)
Item 3	0.74 (0.05)	0.54 (0.07)	0.88 (0.03)	0.80 (0.04)
Item 4	0.56 (0.06)	0.42 (0.08)	0.34 (0.07)	0.56 (0.06)
Item 5	0.47 (0.07)	0.30 (0.08)	0.58 (0.05)	0.75 (0.04)
Item 6	0.64 (0.06)		0.56 (0.06)	0.51 (0.06)
Model fit				
χ^2	7.08	6.05	12.55	12.48
<i>df</i>	8	4	8	7
CFI	1.00	0.99	0.99	0.99
RMSEA	0.00	0.05	0.05	0.06
SRMR	0.02	0.02	0.03	0.03

SE, standard error.

differences which provides support that students who used the villa were both less stressed and more satisfied than students that did not use the villa to prepare their exams.

3.3. Structural equation models

The results of confirmatory factor analyses (CFA) for demands, decision latitude, study-related stress, and satisfaction are presented in Table 2. The results of a set of hierarchical SEMs are summarized in Table 3. When turning to the prediction of study-related stress, the first model (M1) including only control variables showed an acceptable fit [$\chi^2_{(43,N=205)} = 99.31, p < 0.001, CFI = 0.896, RMSEA = 0.080, SRMR = 0.053$]. We found time to examination ($\beta = -0.15, p < 0.05$) and neuroticism ($\beta = 0.64, p < 0.001$) to significantly predict stress. Both control variables explained 43% of variance in the outcome. The next model (M2) including the control variables and the demand-control dimensions also fitted the data to an acceptable degree [$\chi^2_{(205,N=205)} = 365.47, p < 0.001, CFI = 0.866, RMSEA = 0.062, SRMR = 0.061$]. Demands ($\beta = 0.59, p < 0.001$) significantly contributed to the prediction, while decision latitude did not predict stress. The overall explained variance increased to nearly 71%. The third model (M3) including the control variables, the demand-control dimensions, and villa use as predictors showed an acceptable fit as well [$\chi^2_{(220,N=205)} = 395.12, p < 0.001, CFI = 0.856, RMSEA = 0.062, SRMR = 0.060$]. We found that using the exam villa ($\beta = -0.13, p < 0.05$) significantly predicted the outcome and did so over and beyond the control variables as well as demands and decision latitude. Including the exam villa made up an additional amount of 2% in explained variance. Taken together, all predictors within the third model explained an overall variance of 73% in study-related stress. These results supported hypothesis 2a that using

the exam villa significantly predicted study-related stress during exam preparation.

When looking at the prediction of study-related satisfaction, the first model (M1) including only control variables showed a good fit [$\chi^2_{(41,N=205)} = 54.06, p = 0.08, CFI = 0.977, RMSEA = 0.039, SRMR = 0.040$]. Time to examination ($\beta = 0.31, p < 0.001$) and neuroticism ($\beta = -0.51, p < 0.001$) were significant predictors of satisfaction. These variables explained 32% of variance in the outcome. The next model (M2) including the control variables and the demand-control dimensions fitted the data well [$\chi^2_{(202,N=205)} = 273.03, p < 0.001, CFI = 0.941, RMSEA = 0.041, SRMR = 0.058$]. Demands ($\beta = -0.32, p < 0.01$) and decision latitude ($\beta = 0.41, p < 0.001$) significantly contributed to the prediction of satisfaction. The overall explained variance increased to nearly 61%. The third model (M3) including the control variables, the demand-control dimensions, and villa use as predictors also showed a good fit [$\chi^2_{(217,N=205)} = 314.50, p < 0.001, CFI = 0.922, RMSEA = 0.047, SRMR = 0.059$]. We found that villa use ($\beta = 0.06, p = 0.35$) did not significantly predict satisfaction. However, including villa use as a predictor made up an additional amount of 1% in explained variance. All in all, the predictors within the third model explained an overall variance of 62% in study-related satisfaction. Contrary to hypothesis 2b, villa use did not significantly predict satisfaction. Even though using the villa did not have a direct effect on satisfaction, it might be possible that villa use exerts an indirect effect. The upcoming section addresses the results of mediational analyses.

3.4. Mediation

With regard to hypotheses 3a and 3b, the results of two mediation models supported decision latitude to fully mediate

TABLE 3 Structural equation models predicting study-related stress and satisfaction.

Predictor variables, explained variance, and fit statistics	Stress			Satisfaction		
	M1	M2	M3	M1	M2	M3
Control variables						
Sex	−0.03	−0.03	−0.03	0.02	0.07	0.07
Age	0.07	0.04	0.05	−0.07	−0.06	−0.06
Time to examination	−0.15*	−0.21***	−0.23***	0.31***	0.29***	0.30***
Workload	0.11	−0.02	−0.01	−0.06	−0.06	−0.06
Neuroticism	0.64***	0.34***	0.33***	−0.51***	−0.21*	−0.21*
Main variables						
Demands		0.59***	0.59***		−0.32**	−0.33***
Decision latitude		−0.07	−0.06		0.41***	0.40***
Villa use			−0.13*			0.06
Explained variance	0.43	0.71	0.73	0.32	0.61	0.62
Model fit						
χ^2	99.31	365.47	395.12	54.06	273.03	314.50
df	43	205	220	41	202	217
CFI	0.896	0.866	0.856	0.977	0.941	0.922
RMSEA	0.080	0.062	0.062	0.039	0.041	0.047
SRMR	0.053	0.061	0.060	0.040	0.058	0.059

M1–M3, Models 1–3; df, degrees of freedom; CFI, comparative fit index; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual.

Sex: 0 = female, 1 = male.

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

the relationship between villa use as well as study-related stress and satisfaction. The mediational models and model fit indices are depicted in Figures 1A, B. The model fit indices indicated an acceptable model fit for both mediational models.

While villa use significantly predicted study-related stress and satisfaction in the basic models, these effects became non-significant when including demands and decision latitude as joint mediators. We found a significant indirect effect of villa use on stress through decision latitude [$\beta = -0.05$, CI (−0.14, −0.01)]. In addition, we found a significant indirect effect of villa use on satisfaction through decision latitude [$\beta = 0.09$, CI (0.01, 0.20)]. Demands did not significantly mediate the aforementioned relationships with none of the outcomes.

4. Discussion

This was the first study that examined whether using an exam villa as a supportive learning environment would act as a structural resource for study-related stress during a prolonged exam preparation period.

4.1. Villa as a structural resource

In line with hypothesis 1a, students that used the villa to prepare their final exams perceived more decision latitude (i.e., more

control over their study situation) than non-villa students, but there were no differences on demands. Previous studies showed academic demands to play an important role at the university level (Chambel and Curral, 2005; Sieverding et al., 2013; Schmidt et al., 2015). We, therefore, assumed that the academic pressures associated with exam preparation were challenging for all students in our sample. However, villa use did account for differences in decision latitude suggesting that villa students felt more empowered to master academic challenges. In line with the theoretical assumptions of the DCM, the villa appears to be a structural resource that helps students make their own decisions (e.g., starting to study early in the morning when libraries are still closed). This becomes especially important when high demands make students' individual resources such as health-promoting behaviors less likely to be maintained during exam preparation (e.g., sufficient sleeping or regular physical activity; Lobinger, 2016).

When shifting the focus to hypothesis 1b, villa students did indeed report lower levels of experienced stress and higher levels of satisfaction than non-villa students. These findings suggest that villa students that perceived higher levels of decision latitude also experience less stress. This is in line with previous work where students that reported higher levels of decision latitude (along with lower demands) were also less stressed during an examination period (Schmidt et al., 2015). Moreover, students that took advantage of the villa environment were more satisfied than students that did not use this structural resource. Meeting students' special needs during exam preparation periods could therefore

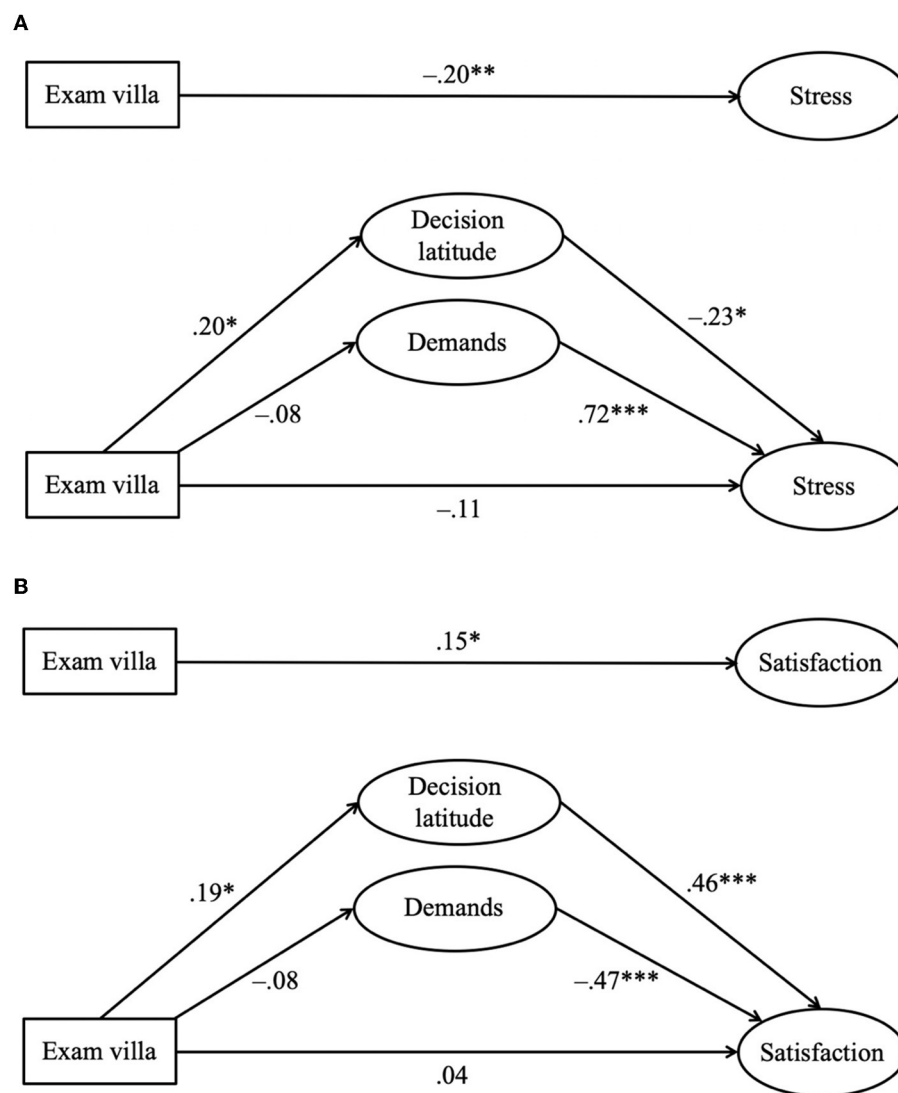


FIGURE 1

(A) Basic and mediational model for the relationship between villa use and study-related stress and its direct effects. Demands and decision latitude were included as mediators. Model fit: $\chi^2_{(129, N=205)} = 218.68, p < 0.001, CFI = 0.911, RMSEA = 0.058, SRMR = 0.089$. (B) Basic and mediational model for the relationship between villa use and study-related satisfaction and its direct effects. Demands and decision latitude were included as mediators. Model fit: $\chi^2_{(129, N=205)} = 251.38, p < 0.001, CFI = 0.884, RMSEA = 0.068, SRMR = 0.090$. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

be a promising way for improving both study conditions and students' wellbeing.

In line with our hypothesis 2a, villa use predicted study-related stress and did so over and beyond demands and decision latitude. Consistent with previous studies, demands were the strongest predictor of students' experienced stress (Chambel and Curral, 2005; Sieverding et al., 2013; Schmidt et al., 2015). Therefore, it was not surprising that stress was also strongly predicted by time to examination and neuroticism. The closer students were to the date of their respective exam campaign, the more stressed they felt. Our results point to the stress-reducing potential of the villa as a structural resource. Even though the additional amount of variance in stress explained by villa use was small, the villa had incremental validity. The villa had the power to assert itself as an important variable even over study demands as a strong

predictor. Therefore, the villa environment seems to play a role on how students experience the stressors associated with exam preparation. For the situation of advanced law students, this seems to be especially relevant because previous studies indicated students to suffer from high levels of stress during exam preparation (Busch, 1990; Sanders and Dauner-Lieb, 2013; Giglberger et al., 2022). Our results underline the importance of the villa as a structural resource because of its power to predict stress in the face of prolonged and challenging study periods.

When turning to hypothesis 2b, villa use did not make a significant contribution to explaining study-related satisfaction over the demand-control dimensions. Consistent with previous studies, decision latitude was the strongest predictor of students' experienced satisfaction (Chambel and Curral, 2005; Sieverding et al., 2013). Satisfaction was also strongly predicted by time to

examination and neuroticism. That means that students felt more satisfied when there was more time left until they had to face the examination. There are two potential reasons why the villa could not significantly predict satisfaction. First, demands and decision latitude were both strong predictors of students' satisfaction in our study. This is why villa use most likely did not make a surmounting contribution to explaining satisfaction. Second, we assumed decision latitude to be a mediator of the relationship between villa use and study-related satisfaction and stress.

4.2. Decision latitude as a mediator

In line with hypothesis 3a, we did indeed find decision latitude to mediate between villa use and stress. We found an indirect effect of villa use on students' stress over decision latitude. This means that decision latitude explains the relationship between villa use and stress. Turning to hypothesis 3b, we did also find decision latitude to be a mediator of the relationship between villa use and satisfaction. Again, we found an indirect effect of villa use on students' satisfaction over decision latitude. These findings support the role of the villa as a structural resource in impacting stress and satisfaction by increasing decision latitude. The villa constitutes a structural resource because of decision latitude being the crucial component by providing students with more control over their study situation. The villa is a supportive environment that offers different learning opportunities. Students become empowered to take an active role in selecting and organizing learning tasks.

We did not find an indirect effect of villa use on stress and satisfaction via demands. Consistent with our expectations, villa use did not have an effect on students' perceived demands. Again, this indicates the villa to be a structural resource that provides a structure in which students can experience more space and freedom in a literal meaning (Lobinger, 2016). Consistent with what is known in stress research, it is not about the demands but rather about the resources that make the difference for successful coping with a given situation. The villa is a structural resource that has positive effects on students' stress and satisfaction mediated by decision latitude. Our findings are in line with research on setting-based initiatives for stress reduction that showed available study resources to have positive effects on various student outcomes (e.g., Robins et al., 2015; Fernandez et al., 2016).

4.3. Limitations and implications for future research

The present study has some limitations that need to be mentioned. First, our cross-sectional design limits causal conclusions, and future research should follow students over longer periods of time to examine the positive effects of setting-based initiatives. We gathered data using self-reports which should be accompanied by physiological stress assessments such as cortisol levels in saliva. Furthermore, the sample consisted of advanced law students only which could make it difficult to generalize the results to other groups of students. We only reached nearly 50% of the total sample of law students in their exam preparation.

It is possible that students who took part in the study were more interested in the topic and had higher levels of motivation. However, we tried to avoid bias in the effects on the outcomes by including a set of control variables (e.g., neuroticism). Due to limited workspaces available in the exam villa, there also was a large difference in the number of villa students vs. non-villa students. It is important to note, however, that villa students did not significantly differ on any of the control variables compared to non-villa students. Nonetheless, future studies should use randomization to avoid self-selection biases and allocate students to the villa (experimental group) vs. non-villa (control group). An experimental manipulation should include a pre-post design to examine the causal effects of exam villa use. Yet, this would be challenging because this approach would limit students' freedom to decide how they want to study to prepare for their examinations. In turn, students would likely experience less decision latitude which could make exam preparation more stressful and less satisfying. Future research should also consider assessing the actual time of villa use by asking students how many hours per day/week they use their individual workspace. This approach would also create more variance in the villa variable which is likely to have a positive effect on the relationships with the outcomes. Additionally, we only focused on study-related stress and satisfaction as outcomes. Future work should examine whether villa use and the demand-control dimensions can also predict students' achievement. It would be worthwhile to know whether structural resources such as an exam villa can have positive effects on academic grades both in mock examinations within exam preparation and in the final examinations themselves. In this context, it would also be interesting to examine whether the relationship between villa use and grades is mediated by satisfaction. Finally, even though the data on which the study is based date from 2017, we assume that this does not diminish the significance of the results. The examination structure of law studies in Germany has remained unchanged for centuries (Heidebach, 2022).

4.4. Implications for theory and practice

Our study has important theoretical and practical implications for preventing and intervening efforts in higher education contexts. Our study showed that the DCM (Karasek, 1979) can be applied to university students to predict and explain stress. Going beyond previous studies, we were able to apply the model to the situation of students who were in a study phase of prolonged academic stress. Consistent with the DCM, the use of a structural resource appears to have a positive effect on both students' stress experiences and satisfaction and this effect is due to an increased perception of decision latitude. Law students undergoing exam preparation have to deal with high academic demands, but their perceived capacity to influence decisions that affect their everyday learning seems to be an important resource. Decision latitude is exerting an effect that goes beyond demands. This leads us to assume that high levels of decision latitude are more important than high levels of demands for certain work-related contexts such as in exam preparation. In terms of DCM, it is possible that a work situation with a high demand profile does not require exactly the same

level of decision latitude, but rather that its level must exceed demands to be experienced as an active work situation. According to the DCM, students who used the villa can be counted to the active job category. In contrast, students who did not have access to the villa can be counted in the high-strain job category. The findings that villa students had lower stress levels and higher levels of satisfaction compared to non-villa students can be seen as a confirmation of the DCM in the university context. Our study goes beyond prior work because it looked at the demand-control dimensions as potential mediators between work-related initiatives and psychological outcomes.

As practical implications, the results suggest to act on structural conditions by increasing decision latitude. Structural resources that are rooted within the study environment are likely to be more profound and sustainable than common individual-based initiatives such as student counseling or stress management seminars. This is because supportive learning environments help students better cope with academic demands as they occur in everyday study situations. Universities would do well to realize concepts like the exam villa to contribute to a better learning atmosphere. Such study environments bring with them motivational effects that create a common learning spirit and contribute to facilitating supportive action at universities. Once established, concepts like the villa can make students of different cohorts benefit from the same structure over years. This brings with it an important advantage when compared to individual-based initiatives that are usually finite in time and require staff for maintenance (e.g., student counseling services). Universities are advised to not only create supportive initiatives but also spread the word and actively invite students to take part and benefit.

5. Conclusion

Higher education institutions pose unique environments where the setting has a substantial impact for helping students to pursue their studies successfully (Fernandez et al., 2016). This was the first study to show that using an exam villa poses an innovative structural resource during challenging study periods. As a setting-based initiative, advanced law students that used the villa for preparing their final exams experienced less study-related stress and more satisfaction. Decision latitude played a central role for these positive effects to unfold. Structural initiatives such as the villa make up promising learning environments that contribute to the reduction of stress beyond individual-based initiatives.

References

- Amanvermez, Y., Rahmadiana, M., Karyotaki, E., de Wit, L., Ebert, D. D., Kessler, R. C., et al. (2020). Stress management interventions for college students: A systematic review and meta-analysis. *Clin. Psychol.: Sci. Pract.* doi: 10.1111/cpsp.12342
- Beiter, R., Nash, R., McCrady, M., Rhoades, D., Linscomb, M., Clarahan, M., et al. (2015). The prevalence and correlates of depression, anxiety, and stress in a sample of college students. *J. Affect. Disord.* 173, 90–96. doi: 10.1016/j.jad.2014.10.054
- Busch, M. (1990). Die Vorbereitung auf das Erste juristische Staatsexamen – Eine Umfrage unter Freiburger Examensabsolventen [Preparation for the First State

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by Ethikkommission der Fakultät für Verhaltens- und Empirische Kulturwissenschaften der Ruprecht-Karls-Universität Heidelberg. The patients/participants provided their written informed consent to participate in this study.

Author contributions

TR conducted data collection, designed the study, and wrote the manuscript. TL supervised data collection and manuscript. KR performed the data analyses and wrote the methods section of the manuscript. All authors contributed to the article and approved the submitted version.

Funding

This work was funded by the Federal Ministry of Education and Research (BMBF) and Baden-Württemberg under the Excellence Strategy of the Federal Government and the Länder.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

- Examination in Law - A Survey Among Freiburg Graduates]. *Juristische Schulung* 12, 1028–1029.

- Campbell, R., Soenens, B., Beyers, W., and Vansteenkiste, M. (2018). University students' sleep during an exam period: The role of basic psychological needs and stress. *Motivat. Emot.* 42, 671–681. doi: 10.1007/s11031-018-9699-x

- Chambel, M. J., and Curral, L. (2005). Stress in academic life: Work characteristics as predictors of student well-being and performance. *Appl. Psychol.* 54, 135–147. doi: 10.1111/j.1464-0597.2005.00200.x

- Cotton, S. J., Dollard, M. F., and de Jonge, J. (2002). Stress and student job design: Satisfaction, well-being, and performance in university students. *Int. J. Stress Manag.* 9, 147–162. doi: 10.1023/A:1015515714410
- Diener, E., Emmons, R. A., Larsen, R. J., and Griffin, S. (1985). The satisfaction with life scale. *J. Personal. Assess.* 49, 71–75. doi: 10.1207/s15327752jpa4901_13
- Duan, H., Yuan, Y., Zhang, L., Qin, S., Zhang, K., Buchanan, T. W., et al. (2013). Chronic stress exposure decreases the cortisol awakening response in healthy young men. *Stress* 16, 630–637. doi: 10.3109/10253890.2013.840579
- Enders, C. K. (2010). *Applied Missing Data Analysis*. New York, NY: Guilford Press.
- Fernandez, A., Howse, E., Rubio-Valera, M., Thorncraft, K., Noone, J., Luu, X., et al. (2016). Setting-based interventions to promote mental health at the university: A systematic review. *Int. J. Public Health* 61, 797–807. doi: 10.1007/s00038-016-0846-4
- Giglberger, M., Peter, H., Kraus, E., Kreuzpointner, L., Zänkert, S., Henze, G.-I., et al. (2022). Daily life stress and the cortisol awakening response over a 13-months stress period—Findings from the LawSTRESS project. *Psychoneuroendocrinology* 2022, 105771. doi: 10.1016/j.psyneuen.2022.105771
- Heidebach, M. (2022). “Didaktik der Examensvorbereitung [Didactics of exam preparation],” in *Rechtswissenschaft lehren - Handbuch der juristischen Fachdidaktik*, ed J. Krüper (Tübingen: Mohr Siebeck), 1147–1179.
- Holm-Hadulla, R. M., and Hofmann, F.-H. (2007). *Lebens- und Studienzufriedenheitsskala [Satisfaction With Life and Studies Scale]*. Berlin: Deutsches Studentenwerk.
- Holm-Hadulla, R. M., Hofmann, F.-H., Sperth, M., and Funke, J. (2009). Psychische Beschwerden und Störungen von Studierenden. Vergleich von Feldstichproben mit Klienten und Patienten einer psychotherapeutischen Beratungsstelle [Psychological complaints and mental disorders of students. Comparison of field study samples with clients and patients of a psychotherapeutic counseling center]. *Psychotherapeut* 54, 346–356. doi: 10.1007/s00278-009-0693-3
- Hu, L. T., and Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Struct. Eq. Model.* 6, 1–55. doi: 10.1080/10705519909540118
- Karasek, R. (1979). Job demands, job decision latitude, and mental strain: Implications for job redesign. *Admin. Sci. Quart.* 24, 285–308. doi: 10.2307/2392498
- Karasek, R. (1985). *Job Content Questionnaire and User's Guide*. Lowell: University of Massachusetts, Lowell, Department of Work Environment.
- Karasek, R., Brisson, C., Kawakami, N., Houtman, I., Bongers, P., and Amick, B. (1998). The job content questionnaire (JCQ): An instrument for internationally comparative assessments of psychosocial job characteristics. *J. Occup. Health Psychol.* 3, 322–355. doi: 10.1037/1076-8998.3.4.322
- Karasek, R., and Theorell, T. (1990). *Healthy Work: Stress, Productivity, and the Reconstruction of Working Life*. New York, NY: Basic Books.
- Lai, K., and Green, S. B. (2016). The problem with having two watches: Assessment of fit when RMSEA and CFI disagree. *Multivar. Behav. Res.* 51, 220–239. doi: 10.1080/00273171.2015.1134306
- Lazarus, R. S., and Folkman, S. (1984). *Stress, Appraisal, and Coping*. New York, NY: Springer Publishing Company.
- Lobinger, T. (2016). “Verbesserungen in der juristischen Examensvorbereitung: Das Heidelberger Modell (HeidelPräp!) [Improvements in legal exam preparation: The Heidelberg Model (HeidelPräp!)],” in *Handbuch Qualität in Studium und Lehre*, eds J. Kohler, P. Pohlenz, and U. Schmidt (Berlin: DUZ Verlags- und Medienhaus GmbH), 115–128.
- Lyndon, M. P., Strom, J. M., Alyami, H. M., Yu, T.-C., Wilson, N. C., Singh, P. P., et al. (2014). The relationship between academic assessment and psychological distress among medical students: A systematic review. *Perspect. Med. Educ.* 3, 405–418. doi: 10.1007/S40037-014-0148-6
- Multrus, F., Majer, S., Bargel, T., and Schmidt, M. (2017). *Studiensituation und studentische Orientierungen. 13. Studierenden survey an Universitäten und Fachhochschulen [Study Situation and Student Orientation. 13th Student Survey at Universities and Universities of Applied Sciences]*. Bonn; Berlin: BMBF.
- Muthén, L. K., and Muthén, B. O. (2013). *Mplus Version 7.11 [Computer Software]*. Los Angeles, CA: Muthén & Muthén.
- Rabkow, N., Pukas, L., Sapalidis, A., Ehring, E., Keuch, L., Rehnisch, C., et al. (2020). Facing the truth—A report on the mental health situation of German law students. *Int. J. Law Psychiatry* 71, 101599. doi: 10.1016/j.jilp.2020.101599
- Rammstedt, B., and John, O. P. (2007). Measuring personality in one minute or less: A 10-item short version of the Big Five Inventory in English and German. *J. Res. Personal.* 41, 203–212. doi: 10.1016/j.jrp.2006.02.001
- Reschke, K., and Mätzchen, F. (2020). *Leipziger Kurzfragebogen für Chronischen Stress LKCS. Berichte aus der Psychologie*. Dürren: Shaker Verlag.
- Reschke, K., and Schröder, H. (2010). *Optimistisch den Stress meistern: Ein Programm für Gesundheitsförderung, Therapie und Rehabilitation [Mastering Stress Optimistically: A Program for Health Promotion, Therapy, and Rehabilitation]*. Tübingen: DGVt-Verlag.
- Reschke, K., and Schröder, H. (2016). Der Leipziger Kurzfragebogen Chronischer Stress [The Leipzig short questionnaire chronic stress]. *Verhaltenstherapie Psychosoziale Praxis* 48, 621–642.
- Ribeiro, I. J. S., Pereira, R., Freire, I. V., de Oliveira, B. G., Casotti, C. A., and Boery, E. N. (2018). Stress and quality of life among university students: A systematic literature review. *Health Prof. Educ.* 4, 70–77. doi: 10.1016/j.hpe.2017.03.002
- Robins, T., Roberts, R., and Sarris, A. (2015). Burnout and engagement in health profession students: The relationships between study demands, study resources and personal resources. *Austral. J. Org. Psychol.* 8, E1. doi: 10.1017/orp.2014.7
- Robotham, D., and Julian, C. (2006). Stress and the higher education student: A critical review of the literature. *J. Further High. Educ.* 30, 107–117. doi: 10.1080/03098770600617513
- Sanders, A., and Dauner-Lieb, B. (2013). Lernlust statt Examensfrust: Strategien und Tipps erfolgreicher Absolventen [Desire to learn instead of exam frustration: Strategies and tips from successful graduates]. *Juristische Schulung* 4, 380–384.
- Schafer, J. L., and Graham, J. W. (2002). Missing data: Our view of the state of the art. *Psychol. Methods* 7, 147–177. doi: 10.1037/1082-989X.7.2.147
- Schmidt, L. I., Scheiter, F., Neubauer, A., and Sieverding, M. (2018). Anforderungen, Entscheidungsfreiräume und Stress im Studium: Erste Befunde zu Reliabilität und Validität eines Fragebogens zu strukturellen Belastungen und Ressourcen (StrukStud) in Anlehnung an den Job Content Questionnaire [Demands, decision latitude, and stress among university students: Findings on reliability and validity of a questionnaire on structural conditions (StrukStud) based on the job content questionnaire]. *Diagnostica* 65, 63–74. doi: 10.1026/0012-1924/a000213
- Schmidt, L. I., Sieverding, M., Scheiter, F., and Obergfell, J. (2015). Predicting and explaining students' stress with the demand-control model: Does neuroticism also matter? *Educ. Psychol.* 35, 449–465. doi: 10.1080/01443410.2013.857010
- Sieverding, M., Schmidt, L. I., Obergfell, J., and Scheiter, F. (2013). Stress und Studienzufriedenheit bei Bachelor- und Diplomstudierenden im Vergleich: Eine Erklärung unter Anwendung des Demand-Control-Modells [Study-related stress and satisfaction among bachelor and diploma students: An explanation with the demand-control model]. *Psychologische Rundschau* 64, 94–100. doi: 10.1026/0033-3042/a000152
- Ullman, J. B. (2007). “Structural equation modeling,” in *Using Multivariate Statistics*, eds B. G. Tabachnick and L. S. Fidell (Boston, MA: Allyn & Bacon/Pearson Education), 676–780.
- Upsher, R., Nobili, A., Hughes, G., and Byrom, N. (2022). A systematic review of interventions embedded in curriculum to improve university student wellbeing. *Educ. Res. Rev.* 37, 100464. doi: 10.1016/j.edurev.2022.100464
- Weik, U., and Deinzer, R. (2010). Alterations of postawakening cortisol parameters during a prolonged stress period: Results of a prospective controlled study. *Hormon. Behav.* 58, 405–409. doi: 10.1016/j.yhbeh.2010.06.001
- West, S. G., Taylor, A. B., and Wu, W. (2012). “Model fit and model selection in structural equation modeling,” in *Handbook of Structural Equation Modeling*, ed R. H. Hoyle (The Guilford Press), 209–231.
- Worsley, J. D., Pennington, A., and Corcoran, R. (2022). Supporting mental health and wellbeing of university and college students: A systematic review of review-level evidence of interventions. *PLoS ONE* 17, e0266725. doi: 10.1371/journal.pone.0266725
- Zunhammer, M., Eberle, H., Eichhammer, P., and Busch, V. (2013). Somatic symptoms evoked by exam stress in university students: The role of alexithymia, neuroticism, anxiety and depression. *PLoS ONE* 8, e84911. doi: 10.1371/journal.pone.0084911



OPEN ACCESS

EDITED BY

Ramona Simut,
University of Oradea, Romania

REVIEWED BY

Jolita Greblikaite,
Vytautas Magnus University, Lithuania
Qi Mingde,
Guangdong University of Technology, China

*CORRESPONDENCE

Lucía Rodríguez-Aceves
✉ lucia_rodriguez@tec.mx

RECEIVED 27 September 2022

ACCEPTED 22 May 2023

PUBLISHED 14 June 2023

CITATION

Silveyra-León G, Rodríguez-Aceves L and
Baños-Monroy VI (2023) Do entrepreneurship
challenges raise student's entrepreneurial
competencies and intention?
Front. Educ. 8:1055453.
doi: 10.3389/feduc.2023.1055453

COPYRIGHT

© 2023 Silveyra-León, Rodríguez-Aceves and
Baños-Monroy. This is an open-access article
distributed under the terms of the [Creative
Commons Attribution License \(CC BY\)](#). The
use, distribution or reproduction in other
forums is permitted, provided the original
author(s) and the copyright owner(s) are
credited and that the original publication in this
journal is cited, in accordance with accepted
academic practice. No use, distribution or
reproduction is permitted which does not
comply with these terms.

Do entrepreneurship challenges raise student's entrepreneurial competencies and intention?

Geraldina Silveyra-León¹, Lucía Rodríguez-Aceves^{2*} and
Verónica I. Baños-Monroy³

¹Entrepreneurship Institute (IEEGL), Tecnológico de Monterrey, Monterrey, Mexico, ²Entrepreneurship Department, School of Business, Tecnológico de Monterrey, Monterrey, Mexico, ³Management and leadership Department, School of Business, Tecnológico de Monterrey, Monterrey, Mexico

Motivated by the question on what content and which pedagogical methodologies are effective in teaching entrepreneurship, this research tested whether entrepreneurial intention and entrepreneurial competencies changed after undergraduates attended an entrepreneurship challenge (ECH) experience. This pedagogical experience was carefully designed as a 5-week in-class education and a 1-week boot camp-type intensive activity. The research design was an empirical, survey-based pre- and post-study on a sample of 525 freshmen. Results showed an increase in *entrepreneurial intention* and in the entrepreneurial competencies measured (*opportunity identification, evaluation and exploitation, and resources procurement*). This research contributes to entrepreneurship education through the design and measurement of an effective program based on a previous framework for entrepreneurship courses and aligned with the education-through-entrepreneurship approach.

KEYWORDS

entrepreneurial intention, entrepreneurship education, entrepreneurship challenge, entrepreneurship competencies, entrepreneurship education program design, higher education, México

1. Introduction

In past decades, entrepreneurship education (EE) has attracted the attention of governments, institutions, individual scholars, and universities worldwide because it provides students with the tools necessary to initiate a new business (Balan et al., 2018; Kozlinska et al., 2020). EE is highly relevant under two assumptions: First, entrepreneurs who create an enterprise within a university environment have a more significant impact on their ecosystem's economic development (von Graevenitz et al., 2010), and they perform much better than others (Godsey and Sebor, 2010) because such institutions provide entrepreneurs with skills, attitudes, and knowledge to raise their alertness and abilities towards business opportunities (Piperopoulos and Dimov, 2015). Indeed, research has established that EE plays a fundamental role in developing more and better entrepreneurs (Karimi et al., 2014). The second assumption affirms that entrepreneurs can be nurtured. As far as we know, however, no entrepreneurial gene exists—no one is simply born an entrepreneur (Neck and Greene, 2011).

Although scholars concur that entrepreneurship can be taught, questions remain about content and appropriate pedagogy (Ramsgaard and Christensen, 2016; Balan et al., 2018). According to Ahmad et al. (2018), educators in entrepreneurship are still struggling to find a fit between instructional objectives and suitable teaching techniques. Besides that, EE faces another challenge: measurement of its effect and impact. The impact is frequently measured by students'

increased motivation or entrepreneurial intention after an EE course since it represents one of EE's few measurable outcomes (Fitzsimmons and Douglas, 2011; Nabi et al., 2017). However, another line of thought establishes that EE's impact can also be measured through competency development (Sánchez, 2013).

Along the same line, previous research has provided evidence that through EE, entrepreneurship competencies can be developed (Pittaway and Cope, 2007; Ghina, 2015; Silveyra et al., 2021), and entrepreneurial activity can be enhanced (Rasmussen and Sørheim, 2006; Bagheri and Pihie, 2011). What is accomplished through EE should be aligned with course design, considering its objective, pedagogical approach, and content, among other factors (Fayolle and Gailly, 2008; Gedeon, 2014). Systematic reviews on EE courses worldwide have identified four approaches: about, for, in, and through entrepreneurship (Edwards-schachter et al., 2015). Each includes different pedagogical methodologies and approaches to reach EE objectives.

Although a wide variety of pedagogical methodologies have been used in the entrepreneurship domain (Solomon, 2007; Neck and Greene, 2011), one of the most frequently applied is experiential learning (Fayolle, 2013). However, in spite of its intuitive appropriateness and the encouragement among leading scholars to use it (Neck and Greene, 2011), there is a lack of evidence to support the belief that experiential teaching methods have a greater impact on students' learning than traditional lecture-based teaching methods (Kozlinska et al., 2020). Consequently, due to the fact that more and more entrepreneurship education courses and programs are moving towards experiential teaching methods, it is important to investigate whether this teaching style leads to better student competencies and entrepreneurship intention, which are the desired outcomes of educational practice (Silveyra et al., 2021).

Therefore, the aim of this paper is to examine the relationship between experiential pedagogy and undergraduate student's entrepreneurship intention and competencies (opportunity identification, evaluation, exploitation and resources procurement). On the one hand, entrepreneurial intention has been used to assess the effectiveness of entrepreneurship programs (Nabi et al., 2017; Kozlinska et al., 2020). On the other hand, the phenomenon of entrepreneurship necessarily involves the dynamic interplay of opportunities and resources (Clough et al., 2019).

The main contribution of this paper is the design of an Entrepreneurship Challenge (ECH) and the measurement of its effectiveness. The ECH's design includes pedagogies aligned to objectives for each of its phases. In general, the ECH takes the form of a five-week in-class educational format followed by a full-week immersion (boot camp-type training). Importantly, the ECH design is based on the framework proposed by Gedeon (2014) for modeling entrepreneurship programmes and is aligned with the education-through-entrepreneurship approach (Edwards-schachter et al., 2015; Piperopoulos and Dimov, 2015).

The study follows a quantitative empirical research design, based on a two wave data collection (pre-ECH and post-ECH) using a paper based questionnaire. The analysis consisted of a paired sample t-test of the variables of interest (entrepreneurial intention and entrepreneurial competencies) to identify changes (if any). Findings showed positive and significant differences for all the variables, being

entrepreneurial intention the highest increase and resources procurement the highest mean.

This paper is structured as follows: The first section contains a literature review along three lines of thought: (1) EE, (2) entrepreneurial intention, and (3) entrepreneurial competencies. The second section includes a detailed description of ECH's design. The third section describes the research method and its results. Finally, a discussion of results is presented, along with conclusions.

2. Background

2.1. Entrepreneurship education

Sufficient evidence exists that entrepreneurship can be taught, or at least encouraged, through education (Solomon, 2007). Therefore, EE can be considered a key instrument for fostering entrepreneurial attitudes, intentions, and competencies (Karimi et al., 2016). Even so, several researchers have established that EE remains in its early stages because no standard theoretical framework or best practice for educating or fostering entrepreneurs has gained consensus (Balan et al., 2018; Hatt, 2018). Previous literature reviews on EE programs and courses reveal various objectives, philosophies, content, pedagogies, and results sought (Gedeon, 2014). This has impacted scientific research on EE, given that lack of theoretical frameworks for a course and program design leads to ambiguity and imprecision (Fayolle and Gailly, 2008).

Therefore, scholarly discussion has shifted from whether entrepreneurship can be taught to what content EE should deliver, but most importantly, how content should be delivered to reach EE objectives (Ahmad et al., 2018). The educational focus is now on pedagogy—which methods are the most efficient for fostering an entrepreneurial mindset, developing entrepreneurial competencies, or increasing entrepreneurial action, among others. However, a valid pathway has been developed to design programs according to objectives, i.e., entrepreneurship about, for, in, and through (Smith et al., 2006). Table 1 summarises how EE pedagogies, audience, and content should be aligned with objectives. Although previous research reveals that EE has used a wide variety of pedagogical methodologies (Solomon, 2007; Neck and Greene, 2011), for the most part, entrepreneurial education has embraced the constructivist approach, manifested through experiential learning pedagogies (Corbett, 2005; Fayolle, 2013; Lackéus, 2014).

As mentioned previously, another challenge EE faces is the measurement of its impact or efficiency, but Jack and Anderson (1998) have established a framework to evaluate EE's impact. This framework (Table 2) highlights the importance of following up with participants after course completion (Henry et al., 2005). The theoretical framework also serves as justification for how, in this paper, measurements are made pre and post-entrepreneurship experience, both students' perceptions of their intentions and their entrepreneurship competencies. Notably, measurement does not suggest a causal effect of entrepreneurship competencies on entrepreneurial intention, only a comparison to identify differences (if any). The following section offers a discussion on entrepreneurial intention.

TABLE 1 Entrepreneurship and education pedagogies.

EE objective	Learning process	Key dimensions of the teaching model	Concepts and relevant theories
Education about entrepreneurship	Learn to be an academic	-Academic conception of entrepreneurship	-Entrepreneurship as a research area
		-Focus on the theoretical dimension	-Theories for teaching and doing research in the field
		-Teaching educational model	
		-Discussion in the classroom of research topics	
		-Main audience: PhD students, professors, and researchers	
Education for entrepreneurship	Learn to be a business creator	-Entrepreneurship as a specific concept and professional situation (independent entrepreneur, creation of new ventures, corporate entrepreneurship, etc.)	-Theories of the entrepreneurial process
		-Focus on the professional / practical dimension (knowing what, how and who)	-Learning by doing / creating
		-Pedagogies of learning-by-doing	-Learning failure
		-Acquisition of skills, practical knowledge, techniques to act and be successful as an entrepreneur	-Limited rationality
		-Development of entrepreneurial skills is expected	-Effectuation
		-Main audience: potential entrepreneurs who work or have a specific entrepreneurial project	-Entrepreneurial cognition (heuristics, risk perception, etc.)
			-Business management and growth
Education in entrepreneurship	Learn skills for growth of an existing business	-Management training for established entrepreneurs focused on ensuring growth and development of the business	-Skills for solving problems
		-Development programs for management and training for growth, as well as specific courses on product development and marketing, among others	-Improvement and update of business management skills
		-Courses aimed at helping individuals or groups of individuals adopt an entrepreneurial approach, regardless of the type of organisation for which they work	
Education through entrepreneurship	Learn to become an entrepreneurial person	-Entrepreneurship as a general and wide concept.	-Entrepreneurship intention
		-Focus on the dimension of entrepreneurial spirit ('know why' and 'know when'). Changes are expected in attitudes, perceptions, and intentions towards entrepreneurship	-Entrepreneurial Event Model (Shapero and Sokol, 1982)
			-Theory of Planned Behavior (Ajzen, 1991)
		-Great diversity of audiences: students in business and non-business areas	-Entrepreneurial self-efficacy
		-High importance of consolidated entrepreneurs as role models in the classroom	-Entrepreneurial orientation (applied at the individual level)

Own elaboration based on [Henry et al. \(2005\)](#), [Fayolle and Gailly \(2008\)](#), and [Piperopoulos and Dimov \(2015\)](#).

2.2. Entrepreneurial intention

As mentioned, intention models have been widely used in studying entrepreneurship phenomena, partly because they provide information on how individuals process information, make decisions, and subsequently perform ([Liñán and Fayolle, 2015](#)). Adequate evidence, both theoretical and empirical, shows that intentions best predict any planned behavior ([Zampetakis and Moustakis, 2006](#);

[Liñán and Chen, 2009](#); [Liñán et al., 2013](#); [Liñán and Fayolle, 2015](#)). Currently, entrepreneurial intention is a consolidated research area within the field of entrepreneurship ([Fayolle and Liñán, 2014](#)). Yet, it still offers opportunities for studying background motivation or specific variables' explanatory capacity when elucidating intention in specific scenarios ([Liñán and Fayolle, 2015](#)).

In the specific field of entrepreneurship, the Theory of Planned Behavior (TPB) has been a framework for exploring individuals'

attitudes toward entrepreneurship (Liñán and Chen, 2009) since it helps explain the complexity and underlying cognitive processes behind new venture creation (Liñán et al., 2013). TPB is a parsimonious, well-grounded theory that has verified robust behavior predictions (Krueger and Carsrud, 1993). In fact, several recent studies have demonstrated validity of this theory in different cultural settings (Nabi et al., 2017; Fragoso et al., 2020). According to the TPB, three independent factors determine the intention of a behavior: (a) attitude towards the behavior, (b) social norms, and (c) perceived behavioral control (Ajzen, 1991).

Due to assessing the effectiveness of entrepreneurship programs has primarily focused on measuring the intention to become an entrepreneur and the factors that influence it (Kozlinska et al., 2020), the following hypothesis is proposed:

H1: The entrepreneurship challenge (ECH) increases student's entrepreneurial intention.

2.3. Entrepreneurial competencies

Over the past few years, the competency-based approach has become a standard framework for studying entrepreneurs' characteristics and actions (Man et al., 2002; Rasmussen and Sørheim, 2006). But because competencies prepare students for challenges in their professional lives (Bowden, 2004), one problem in acquiring entrepreneurship competencies is that, unlike other professions, entrepreneurs' responsibilities, activities, or duties have not been clearly defined (Baron, 2007). Therefore, formal education for developing entrepreneurship competencies might not be as clear in their pedagogic designs as in other professions. Thus, previous research efforts have resulted in a wide variety of proposed frameworks for entrepreneurship competencies (Onstenk, 2003; Wu, 2009; Mitchelmore and Rowley, 2010; Morris et al., 2013; Dimitratos et al., 2014; Tehseen and Ramayah, 2015). These could serve as starting points for definitions of competencies addressed through EE, given that the competencies entrepreneurs need to create successful businesses are many, but, at the same time, changing in importance and scope according to each stage of the entrepreneurial process (Baron, 2007).

According to some researchers, competencies developed through any entrepreneurship intervention should closely relate to its objectives (Fayolle and Gailly, 2008; Gedeon, 2014). Here, the ECH aims to develop entrepreneurial competencies while increasing students' entrepreneurship intention. The ECH draws from the assumption that an entrepreneurial individual is the one who identifies, evaluates and exploits opportunities (Lackéus, 2014) and can be fostered through the education (Lanero et al., 2011) of young students. This objective is closely related to what Shane and Venkataraman (2000) defined as the core of entrepreneurship: the identification, evaluation and exploitation of opportunities regardless of the resources an individual currently possesses.

Therefore, in this educational experience design, four competencies were measured: (1) opportunity identification, (2) opportunity evaluation, (3) opportunity exploitation and (4) resources procurement because they can be developed through an education program and they are relevant to the development of an

entrepreneurial intention and action (Chandler and Jansen, 1992; Man et al., 2002; Man and Lau, 2005; Wu, 2009; Mitchelmore and Rowley, 2010, 2013; Rasmussen et al., 2011; Chell, 2013; Morris et al., 2013).

According to the literature, opportunity identification is the ability to look at the habitual and unusual, to observe the ordinary and the extraordinary (Volery et al., 2013). That is, opportunity identification concerns the perception of changing conditions or unknown possibilities in an environment that represents potential sources of profit (Morris et al., 2013). In other words, the ability to identify opportunities lies at the heart of entrepreneurship (Shane and Venkataraman, 2000; Davidsson, 2015; Karimi et al., 2016). The second competency, opportunity evaluation, refers to the ability to assess the structural content of opportunities to accurately determine their attractiveness (Morris et al., 2013). This is to estimate the potential viability of the opportunity. On the other hand, the third competency, exploitation of opportunities, unlike the previous two, refers to the search for feedback, continuously incorporating new information and adapting the initial idea, in such a way that the original idea becomes an opportunity (Volery et al., 2013). Exploitation of opportunities, implies the development of market opportunities through various means (Man et al., 2002), as well as the mobilisation and recombination of a variety of resources, such as financial capital, human capital and social capital. The phenomenon of entrepreneurship necessarily involves the dynamic interplay of opportunities and resources (Clough et al., 2019). Thus, the fourth competency is resources procurement, which relates to skills necessary to access resources not necessarily owned or controlled to accomplish the implementation of previously identified opportunities (Hayton and Kelley, 2006; Morris et al., 2013). This means acquiring and developing the resources necessary to start and operate a company (Mitchelmore and Rowley, 2010).

Previous research has found that competencies prepare individuals to act as starting a venture (Izquierdo et al., 2005). This is because the competencies acquired through education increase the perception of individuals of their ability to carry out a particular activity, such as creating a company (Sánchez, 2013), potentially increasing entrepreneurial activity (Izquierdo et al., 2005). Consequently, those individuals with a higher level of certain competencies feel better able to start a company, which indicates a connection between competencies and the perceived control of creating a new company (Murugesan and Dominic, 2014). Therefore, the following hypotheses is proposed:

H2: The entrepreneurship challenge (ECH) increases student's entrepreneurial competencies related to (a) opportunity identification, (b) opportunity evaluation, (c) opportunity exploitation and (d) resources procurement.

3. Method

3.1. Entrepreneurship challenge (ECH) overview and purpose

The ECH's purpose was to provide all freshmen students with a first entrepreneurial experience through which they developed

TABLE 2 Theoretical framework to evaluate an entrepreneurship education course.

Period after completed a course	Measurement of impact of entrepreneurship education
More than 10 years ago	Contribution to society and economy
	Performance of the venture created
	Professional satisfaction
	Self-actualisation and psychological success
3 to 10 years after	Survival and reputation of the venture created
	Change in reputation and innovation level of the venture established
0 to 5 years after	Number and type of venture created
	Mergers and acquisitions
	Entrepreneurial positions obtained
	Entrepreneurial positions searched
Measures pre and post the course	Intentions to undertake a behavior
	Knowledge acquired
	Perceptions of learning and competencies acquired
Current and on-going measures	Student enrolment
	Number and type of courses offered
	Interest in entrepreneurship
	Knowledge in the field

Adapted from Henry et al. (2005).

entrepreneurial competencies by a) creating economic value with limited resources, b) within a limited period of time, c) through seed capital provided by the university.

Students experienced the ECH in teams of five members. Each team had a mentor who provided guidance and advice. At the beginning of the ECH, each team received approximately 120 USD of seed capital, which allowed them to begin operations and generate profits. When the ECH ended, teams returned the seed capital to the university and, through a crowdfunding platform, allocated their profits to a non-profit organisation whose social cause was attractive to the team members.

Using methodologies proposed by Fayolle and Gailly (2008) and Gedeon (2014), the ECH was designed to develop entrepreneurial competencies using an action-based educational approach, emphasising education through entrepreneurship. Such an approach allowed students to understand “what” and “who” is important when attempting to act entrepreneurially (Williams Middleton and Donnellon, 2014), which refers to ‘know why’ (Rae and Carswell, 2001). The ECH was divided into three phases: preparation, execution and reflection (see Table 3).

1,108 freshmen students participated in the ECH, which took place in 2017. 32 teachers were involved as mentors, each supporting between 20 to 50 students. Additionally, 12 staff members were responsible for support and logistics activities. The total amount of seed capital allocated to the ECH was 24,000 USD. Profits generated by the ECH participants totaled 30,000 USD.

In the following sections, each phase is more specifically described.

3.1.1. Preparation phase

During the preparation stage (Table 3), students received an introduction to the ECH, through which participants became acquainted with entrepreneurship competencies and received

instructions about different activities to be performed. Before the execution stage, participants attended four sessions in a classroom with about 20 to 30 students. Because previous research has found that competencies are best acquired actively (Macosko et al., 2009), teacher-mentors used an active learning approach, becoming session facilitators, while students actively participated in their learning process.

3.1.2. Execution phase

The ECH execution phase consisted of a full immersion week which took place at the end of September. Because regular classes were suspended, students focused only on the activities of the challenge. During this phase, students experienced various stimuli to support their learning process. For instance, talks with role models, whom previous research has found to influence individuals’ intention towards entrepreneurship (Kolvereid, 1996; Godsey and Sebor, 2010; Joensuu-Salo et al., 2015), workshops on resilience and failure that allowed students to experience and talk about these concepts (Pittaway and Cope, 2007; Fayolle and Gailly, 2008), visits to co-working spaces to interact with the local entrepreneurial ecosystem (Rae and Carswell, 2001), and, finally, a peer-to-peer evaluation that encouraged learning among students (Williams Middleton and Donnellon, 2014). Through this stage, students had mentors who, according to Ahmad et al. (2018), facilitated personal and professional growth by sharing insights and knowledge. See Table 4 for a detailed agenda.

3.1.3. Reflection stage

In the ECH’s final stage, the different experiences, including successes and failures, capitalised on learning. According to previous research, through reflection, entrepreneurs learn to inquire into the meanings of their past experiences and social interactions (Holcomb et al., 2009). For this reason, students wrote a personal essay reflecting

on their individual ECH experiences from beginning to end. Importantly, reflection allowed entrepreneurs not only to assimilate, reframe and restructure their understanding and acquired knowledge from various events but also to apply learning outcomes to recognize required personal skills and actions to predict and/or prevent potential crises and challenges while creating a company (Cope and Watts, 2006; Holcomb et al., 2009).

3.2. Research design

To test the proposed hypotheses, the research employed a quantitative empirical approach and used a two-wave data collection method (pre-ECH and post-ECH) using a paper based questionnaire. The analysis consisted of a paired sample t-test of the variables of interest (entrepreneurial intention and entrepreneurial competencies) to determine any differences. Due to the research purpose, the study was not designed as an experiment. Thus, causality among the variables of study is not assumed.

3.2.1. Sample and data collection

ECH participants consisted of 1,108 freshmen students, enrolled in 35 academic programs at undergrad level. Data was collected at the beginning of the ECH (T0) and at the end of it 6 weeks later (T1). In both waves, a paper based questionnaire was applied within a classroom, simultaneously in all groups of students, and supervised by a professor. Students did not receive credit for participating in the study.

At T0, 800 complete responses were obtained (response rate of 69%) and at T2 717 (response rate of 62%). The two surveys (T0 and T1) had 525 matching and complete responses, representing 45% of the total ECH enrolment. In the final sample of 525 students, 285 were male (54.3%) and 240 female (45.7%), with ages from 16 to 23 years (mean of 18.3).

3.2.2. Measures

To operationalize the variables, previous scales with adequate construct validity and reliability were used. All items (aside from demographic characteristics) were measured using a 7-point Likert scale ranging from 1 representing ‘strongly disagree’ to 7 representing ‘strongly agree.’ These items and the sources from which they were adopted are summarised in [Appendix 1](#).

Entrepreneurial intention was a pure intention measure, assessed using a scale adapted from [Liñán and Chen \(2009\)](#) and used previously by other scholars ([Chen et al., 1998](#)). Opportunity identification, opportunity evaluation and evaluation exploitation were measured using a scale adapted from [Chandler and Jansen \(1992\)](#), [Anna et al. \(2000\)](#), and [Shane and Venkataraman \(2000\)](#). These scales have been used in various previous studies ([Baum et al., 2001](#); [Man and Lau, 2005](#); [Ahmad et al., 2010](#)). Resources procurement was measured by a scale adapted from [Winborg and Landstrom \(2001\)](#). This scale was previously used by [Politis et al. \(2010\)](#) and [Morris et al. \(2013\)](#), who developed further insights into the most critical competencies for entrepreneurial success.

3.2.3. Measurement model

Data was analysed using partial least squares with the software SmartPLS 3.0 ([Ringle et al., 2005](#)). The measurement properties of the scales were tested to ensure one-dimensionality, discriminant and convergent validity (see [Table 5](#)). For reliability, all the constructs had the Cronbach’s and composite reliability (CR) values well above 0.70, as recommended by [Fornell and Larcker \(1981\)](#) and [Nunnally \(1975\)](#). Moreover all the items met the 0.50 significance-loading threshold ([Carmines and Zeller, 1979](#); [Hair et al., 2019](#)), and all the constructs had average variance extracted (AVE) above 0.50 ([Hair et al., 2017](#)). In sum, evidence suggests the presence of convergent validity.

To assess the distinctiveness of the constructs, the Fornell-Larcker criterion was used ([Fornell and Larcker, 1981](#)). [Table 6](#) suggests that the values along the diagonal for each construct are greater than any

TABLE 3 Teaching model framework for ECH.

Stages	Preparation	Execution	Reflection
Objective(s)	Introduce freshmen into the ECH and prepare them for the execution phase	Develop entrepreneurial competencies through the ECH	Raise awareness of the experience and the acquisition of entrepreneurial competencies
Duration	4 weekly classroom sessions	1 week of full immersion. Mixed sessions: auditorium setting and the real world	1 session classroom
Group size	39 groups	3 auditorium	39 groups
	20–30 students per group	350 students per auditorium	20–30 students per group
Content	Session 1. Introduction and Team Building	Day 1. Conference: Role models	Resilience
	Session 2. Opportunity identification	Day 2. Workshop: Resilience	Feedback
	Session 3. Ideation and concept validation	Day 3. Hands on: Execution of the project and visit co-working spaces within the city	Personal essay
	Session 4. Working plan and pitch	Day 4. Plenary session: Failure as part of the entrepreneurial process	
		Day 5. Peer evaluation: pitch results	
Pedagogy	Active learning	Direct experiential learning	Reflective learning
		Challenge-based learning	

Own elaboration based on [Fayolle and Gailly \(2008\)](#) and [Gedeon \(2014\)](#).

values to their left in the same row. In addition, the cross loadings analysis showed that the items had higher loadings with their associated constructs, demonstrating the existence of discriminant validity (Barclay et al., 1995; Martínez Ávila and Fierro Moreno, 2018).

To test for common method bias (CMB) the measured latent marker variable (MLMV) approach was used (Lindell and Whitney, 2001; Chin et al., 2013). In the survey used to collect data, other variables were included. In specific, risk perception, which has no nomological relationship with the rest of measures. Thus, it was used as the marker variable. Table 7 shows the path coefficients without the marker variable in the model, with the marker variable and the differences. Because the differences for both, T0 and T1 are significantly low, it is suggested the lack of CMB (Lindell and Whitney, 2001; Chin et al., 2013). It is noteworthy that in the research design no causality between the variables was assumed. However, the MLMV test in SmartPLS, requires the comparison of the paths.

3.2.4. Results

Table 8 shows the sample's descriptive statistics and the variables' correlations. Means ranged from 4.6 to 6.03. Correlations were all positive and significant. A multicollinearity analysis was performed by using the variance inflation factor (VIF) (Diamantopoulos and Siguaw, 2006; Hair et al., 2019). As recommended (Hair et al., 2019), all values ranged from 1.2 to 4.5, which are less than the cutoff value of 5, suggesting the absence of collinearity issues.

The paired samples t-test results showed positive and significant differences for all of the constructs. Entrepreneurial intention increased 11.1%, opportunity identification 5.1%, opportunity evaluation 10.7%, opportunity exploitation 7.6% and resources procurement 7.1% (see Table 9). The highest mean in T0 (5.63) and T1 (6.03) corresponded to resources procurement (see Table 9).

4. Discussion and conclusion

This research explored pre-existing perceptions and attitudes towards entrepreneurial competencies and entrepreneurship intention (T0) and after participating in an entrepreneurship challenge (T1). Motivated by the question of what (contents) and how (pedagogy) entrepreneurship should be taught (Pittaway and Cope, 2007; Ramsgaard and Christensen, 2016; Balan et al., 2018), this research explored how a carefully designed entrepreneurial challenge was used to teach entrepreneurship and to influence the entrepreneurial intention and entrepreneurial competencies of 525 undergrad students.

Findings provide evidence that those 5 weeks of learning, while at the same time actively *doing* entrepreneurship, contributed to students considering starting their businesses at some point during their trajectory at the university, thus increasing their intention towards entrepreneurship. Consequently, hypothesis 1 is not rejected.

TABLE 4 ECH execution stage agenda.

Schedule	Monday	Tuesday	Wednesday	Thursday	Friday	Schedule	
8:00–8:30	Mentoring (<i>stages 1, 2, 3 and 4</i>)	Mentoring (<i>stages 1, 2, 3 and 4</i>)	Tour around co-working places (throughout the city)	Mentoring (<i>stage 1, 2, 3 and 4</i>)	Check-in (attendance)	8:00–8:30	
8:30–9:00	Check-in (attendance)		Execution outside Campus (material acquisition, production, sales)		Team back (Deliveries preparation)	8:30–9:00	
9:00–9:30	Welcoming (<i>stages 1, 2, 3 and 4</i>)	Check-in (attendance)		Check-in (attendance)	Mentoring (<i>plenary stage</i>)	9:00–9:30	
9:30–10:00	Social Projects	Resilience Activity (<i>stages 1, 2, 3 and 4</i>)		Failure sharing activity (<i>stages 1, 2, 3 and 4</i>)		9:30–10:00	
10:00–10:30	Presentation (<i>stages 1, 2, 3 and 4</i>)					10:00–10:30	
10:30–11:00	Role Model Conference				Fast pitches (Peer evaluation activity) (<i>plenary stage</i>)	10:30–11:00	
11:00–11:30	Check-out (attendance) (<i>stages 1, 2, 3 and 4</i>)	Execution outside Campus (material acquisition, production, sales)		Execution outside Campus (material acquisition, production, sales)		11:00–11:30	
11:30–12:00	Execution outside Campus (material acquisition, production, sales)					Exit survey	11:30–12:00
12:00–12:30						Final (Pitch competition) (<i>plenary stage</i>)	12:00–12:30
12:30–13:00							12:30–13:00
13:00–17:00						Closure	13:00–17:00
17:00–17:30	Team back	Team back	Team back	Team back		17:00–17:30	
17:30–18:00	ECH Deliverables	ECH Deliverables	ECH Deliverables (via Black Board)	ECH Deliverables		17:30–18:00	
18:00–18:30	(via Black Board)	(via Black Board)		(via Black Board)		18:00–18:30	

Own elaboration.

TABLE 5 Means, standard deviations and correlations.

		Mean	SD	1	2	3	4	5	6	7	8	9	10
1	Entrepreneurial intention (t0)	4.62	1.52	1									
2	Opportunity identification (t0)	5.36	1.10	0.480**	1								
3	Opportunity evaluation (t0)	5.07	1.21	0.477**	0.746**	1							
4	Opportunity exploitation (t0)	5.23	1.18	0.501**	0.813**	0.752**	1						
5	Resources procurement (t0)	5.63	0.91	0.337**	0.560**	0.516**	0.539**	1					
6	Entrepreneurial intention (t1)	5.13	1.59	0.577**	0.342**	0.384**	0.371**	0.275**	1				
7	Opportunity identification (t1)	5.63	1.08	0.445**	0.546**	0.456**	0.509**	0.405**	0.596**	1			
8	Opportunity evaluation (t1)	5.61	1.06	0.431**	0.507**	0.536**	0.491**	0.392**	0.564**	0.772**	1		
9	Opportunity exploitation (t1)	5.63	1.11	0.463**	0.543**	0.505**	0.552**	0.377**	0.614**	0.815**	0.828**	1	
10	Resources procurement (t1)	6.03	0.83	0.363**	0.409**	0.392**	0.418**	0.498**	0.447**	0.594**	0.656**	0.624**	1

a. $N = 525$; b. ** $p < 0.01$, c. * $p < 0.05$.

TABLE 6 Indicators loadings, convergent validity, and reliability test.

Latent variable	Items	Standardized loading		Cronbach α		Composite reliability		Average variance extracted	
		T0	T1	T0	T1	T0	T1	T0	T1
Entrepreneurial intention	IE01	0.851	0.894	0.832	0.892	0.889	0.926	0.669	0.759
	IE02	0.719	0.786						
	IE03	0.895	0.929						
	IE04	0.795	0.869						
Opportunity identification	OPID01	0.838	0.866	0.883	0.913	0.918	0.939	0.738	0.794
	OPID02	0.847	0.909						
	OPID03	0.887	0.923						
	OPID04	0.863	0.865						
Opportunity evaluation	OPEV01	0.885	0.871	0.9	0.894	0.93	0.926	0.77	0.759
	OPEV02	0.864	0.873						
	OPEV03	0.887	0.876						
	OPEV04	0.873	0.865						
Opportunity exploitation	OPEX01	0.848	0.865	0.89	0.907	0.924	0.935	0.751	0.781
	OPEX02	0.875	0.894						
	OPEX03	0.873	0.888						
	OPEX04	0.872	0.889						
Resources procurement	RL1	0.722	0.795	0.74	0.803	0.834	0.87	0.56	0.627
	RL2	0.639	0.72						
	RL3	0.813	0.836						
	RL4	0.805	0.81						

Cronbach's α ; CR = Composite reliability; for all measurement items, five-point Likert scales were used (i.e., 1 strongly disagree, 5 strongly agree).

TABLE 7 Discriminant validity using Fornell-Larcker Criterion.

T0		1	2	3	4	5
1	Entrepreneurial intention (t0)	0.818				
2	Opportunity identification (t0)	0.478	0.877			
3	Opportunity evaluation (t0)	0.501	0.756	0.867		
4	Opportunity exploitation (t0)	0.489	0.764	0.816	0.859	
5	Resources procurement (t0)	0.348	0.53	0.553	0.577	0.748
T1		1	2	3	4	5
1	Entrepreneurial intention (t1)	0.871				
2	Opportunity identification (t1)	0.567	0.871			
3	Opportunity evaluation (t1)	0.614	0.832	0.884		
4	Opportunity exploitation (t1)	0.599	0.78	0.818	0.891	
5	Resources procurement (t1)	0.461	0.672	0.64	0.613	0.792

The values along the diagonal for each construct are greater than any values to their left in the same row.

TABLE 8 Common method bias test, [Lindell and Whitney \(2001\)](#) marker variable approach.

Relationship	T0			T1		
	Without marker	With marker	Difference	Without marker	With marker	Difference
Opportunity identification – Entrepreneurial Intention	0.148	0.147	–0.001	0.254	0.246	–0.008
Opportunity evaluation – Entrepreneurial intention	0.168	0.174	0.006	0.075	0.038	–0.037
Opportunity exploitation – Entrepreneurial intention	0.227	0.235	0.008	0.306	0.269	–0.037
Resources procurement – Entrepreneurial intention	0.048	0.046	–0.002	0.059	0.051	–0.008
R Square	0.832	0.832	0.000	0.892	0.892	0.000

Own elaboration.

TABLE 9 Results for Pretest and Post-test differences.

	T0 mean	T1 mean	Difference	Percentage	T-statistics	Significance
Entrepreneurial intention	4.62	5.13	0.51	11.1%	–8.22	0.000
Opportunity identification	5.36	5.63	0.28	5.1%	–6.06	0.000
Opportunity evaluation	5.07	5.61	0.54	10.7%	–11.31	0.000
Opportunity exploitation	5.23	5.63	0.40	7.6%	–8.42	0.000
Resources procurement	5.63	6.03	0.40	7.1%	–10.45	0.000

Regarding the second hypothesis related to the development of entrepreneurial competencies as a measure of EE experience, previous research establishes that entrepreneurship can be taught ([Kuratko, 2005](#); [Hindle, 2007](#); [Solomon, 2007](#); [Neck and Greene, 2011](#); [Sánchez, 2011, 2013](#)), and one outcome of the program could be the development of specific competencies ([Martin et al., 2013](#)). Results obtained through this research design showed an increase in the entrepreneurial competencies (opportunity identification, evaluation, exploitation and resources procurement) after the ECH experience. Neither, therefore, is the second hypothesis rejected. Entrepreneurship competencies include a person's underlying characteristics (personality traits, attitudes, social roles, self-image) and attributes

acquired through education (skills, knowledge, experiences) ([Man and Lau, 2005](#)). Previous research provides evidence that the latter can be modified in the short term through interventions ([Bird, 1995](#); [Man et al., 2002](#); [Ghina, 2015](#)) such as the ECH.

This research contributes to EE through the design and measurement of an entrepreneurship challenge based on a previously proposed framework for entrepreneurship courses ([Fayolle et al., 2006](#); [Gedeon, 2014](#)) and aligned with education through the entrepreneurship approach ([Edwards-schachter et al., 2015](#); [Piperopoulos and Dimov, 2015](#)). By using various pedagogical methodologies, the ECH's experiential learning allowed students to generate new meaning to entrepreneurship, which could lead them to

a change in thinking and behavior (Fayolle and Gailly, 2008). Therefore, this research provides evidence that the ECH fulfilled its objective of increasing students' perceptions and attitudes towards entrepreneurial competencies (opportunity identification, evaluation, exploitation and resources procurement) and entrepreneurial intention. In addition, this study supports the assumption that experiential learning is one of the best ways to teach entrepreneurship (Neck and Greene, 2011; Kozlinska et al., 2020).

Our study concludes that education practitioners should be encouraged to measure their programs' impact on student populations to advance the field and better understand EE's effects. This could allow space to focus on attributes of programs more useful for increasing entrepreneurial activity and mindset. Therefore, if universities, governments, business incubators, and other stakeholders from the entrepreneurial ecosystem want to encourage entrepreneurial activity, they should consider previously proven frameworks when designing interventions. Consequently, we contribute to the existing literature by highlighting with evidence the importance of aligning the intervention's objectives with the pedagogy applied and its measurement.

This research has some limitations. First, the sample, context, and results are based on a private university with an excellent reputation for developing entrepreneurial activity and spirit. In this scenario, many students might be biased not about the ECH but about the university, meaning their entrepreneurial intention or entrepreneurial competencies could easily be triggered. Another limitation is a possible source of bias related to the students' teams and mentors that can be present in the sample and results; therefore, it would be desirable to control for such variables in future studies.

Future research can implement the ECH design in other academic institutions in Mexico or overseas. The richness of possible comparisons among databases could allow improvement of the ECH pedagogical approach and design, thereby increasing the impact on student's entrepreneurial intention and competencies. Further research should be conducted regarding competencies suitable for each stage of the entrepreneurship process. Another possible line of future research is analysing age and gender and their relationship with competencies and entrepreneurial intention development using our sample. Studies have been conducted about this relationship in other countries like Germany (Oehler et al., 2015) and revealed that women

students were less prone to start a business at the end of their universities than men. In this vein, significant differences in students' interest in business founding were found regarding age, gender, and field of study in an Austrian sample (Schwarz et al., 2009).

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Acknowledgments

We acknowledge the support of Vice-presidency of Tecnológico de Monterrey, for covering the APC of this paper.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

- Ahmad, N. H., Ramayah, T., Wilson, C., and Kummerow, L. (2010). Is entrepreneurial competency and business success relationship contingent upon business environment? *Int. J. Entrep. Behav. Res.* 16, 182–203. doi: 10.1108/13552551011042780
- Ahmad, N. H., Suseno, Y., Seet, P., and Susomrith, P. (2018). "Entrepreneurial competencies and firm performance in emerging economies: A study of women entrepreneurs in Malaysia entrepreneurial competencies and firm performance in emerging economies: A Study of Women Entrepreneurs in Malaysia" in *Knowledge, Learning and Innovation. Contributions to Management Science*. eds. V. Ratten, V. Braga and C. Marques (Cham: Springer), 4–26.
- Ajzen, I. (1991). The theory of planned behavior. *Organ. Behav. Hum. Decis. Process.* 50, 179–211. doi: 10.1016/0749-5978(91)90020-T
- Anna, A. L., Chandler, G. N., Jansen, E., and Mero, N. P. (2000). Women business owners in traditional and non-traditional industries. *Journal of Business venturing* 15, 279–303. doi: 10.1016/S0883-9026(98)00012-3
- Bagheri, A., and Pihie, Z. A. L. (2011). Competencies enabling university students to successfully lead entrepreneurial projects and activities. International Conference on Social Science and Humanity, 5, 454–458. Available at: <http://www.ipedr.com/vol5/no1/97-H10008.pdf>
- Balan, P., Maritz, A., and Mckinlay, M. (2018). A structured method for innovating in entrepreneurship pedagogies. *Educ. Train.* 60, 819–840. doi: 10.1108/ET-05-2017-0064
- Barclay, D., Higgins, C., and Thomson, R. (1995). The partial least squares (PLS) approach to causal modelling: personal computer adoption and use as an illustration. *Stud. Technol.* 2, 285–309.
- Baron, R. A. (2007). Behavioural and cognitive factors in entrepreneurship: entrepreneurs as the active element in new venture creation. *Strateg. Entrep. J.* 1, 167–182. doi: 10.1002/sej
- Baum, J. R., Locke, E. A., and Smith, K. E. N. G. (2001). A multidimensional model of venture growth. *Acad. Manag. J.* 44, 292–303. doi: 10.2307/3069456
- Bird, B. (1995). "Toward a theory of entrepreneurial competency" in *Seminal Ideas for the Next Twenty-Five Years of Advances (Advances in Entrepreneurship, Firm Emergence and Growth, Vol. 21)*. eds. J. A. Katz and A. C. Corbet (Bingley: Emerald Publishing Limited), 51–72.
- Bowden, J. A. (2004). *Competency-based learning. In Connotative learning: The Trainer's guide to learning theories and their practical application to training design.* Kendall Hunt Publishing; Dubuque, Iowa

- Carmines, E. G., and Zeller, R. A. (1979). *Reliability and validity assessment*. Sage publications. Thousand Oaks, CA
- Chandler, G. N., and Jansen, E. (1992). The founder's self-assessed competence and venture performance. *J. Bus. Ventur.* 7, 223–236. doi: 10.1016/0883-9026(92)90028-P
- Chell, E. (2013). Review of skill and the entrepreneurial process. *Int. J. Entrepreneurial Behav. Res.* 19, 6–31. doi: 10.1108/13552551311299233
- Chen, C. C., Greene, P. G., and Crick, A. (1998). Does entrepreneurial self-efficacy distinguish entrepreneurs from managers? *J. Bus. Ventur.* 13, 295–316. doi: 10.1016/S0883-9026(97)00029-3
- Chin, W. W., Thatcher, J. B., Wright, R. T., and Steel, D. (2013). "Controlling for common method variance in PLS analysis: the measured latent marker variable approach" in *New perspectives in partial least squares and related methods* (New York: Springer), 231–239.
- Clough, D. R., Fang, T. P., Vissa, B., and Wu, A. (2019). Turning lead into gold: how do entrepreneurs mobilize resources to exploit opportunities? *Acad. Manag. Ann.* 13, 240–271. doi: 10.5465/annals.2016.0132
- Cope, J., and Watts, G. (2006). *Learning by doing. Nursing Standard: Official Newspaper of the Royal College of Nursing*, 20, 61. RCN Publishing: Lancashire, England
- Corbett, A. C. (2005). Experiential learning within the process of opportunity identification and exploitation. *Entrep. Theory Pract.* 29, 473–491. doi: 10.1111/j.1540-6520.2005.00094.x
- Davidsson, P. (2015). Entrepreneurial opportunities and the entrepreneurship nexus: A re-conceptualization. *J. Bus. Ventur.* 30, 674–695. doi: 10.1016/j.jbusvent.2015.01.002
- Diamantopoulos, A., and Siguaw, J. A. (2006). Formative versus reflective indicators in organisational measure development: A comparison and empirical illustration. *Br. J. Manag.* 17, 263–282. doi: 10.1111/j.1467-8551.2006.00500.x
- Dimitratos, P., Liouka, I., and Young, S. (2014). A missing operationalization: entrepreneurial competencies in multinational enterprise subsidiaries. *Long Range Plan.* 47, 64–75. doi: 10.1016/j.lrp.2013.10.004
- Edwards-schachter, M., García-granero, A., Sánchez-barrioluengo, M., Quesada-pineda, H., and Amara, N. (2015). Disentangling competences: interrelationships on creativity, innovation and entrepreneurship. *Think. Skills Creat.* 16, 27–39. doi: 10.1016/j.tsc.2014.11.006
- Fayolle, A. (2013). Personal views on the future of entrepreneurship education. *Entrepreneurship Reg. Dev.* 25, 692–701. doi: 10.1080/08985626.2013.821318
- Fayolle, A., and Gailly, B. (2008). From craft to science teaching models and learning processes in entrepreneurship education. *J. Eur. Ind. Train.* 32, 569–593. doi: 10.1108/03090590810899838
- Fayolle, A., Gailly, B., and Lassas-Clerc, N. (2006). Assessing the impact of entrepreneurship education programmes: a new methodology. *J. Eur. Ind. Train.* 30, 701–720. doi: 10.1108/03090590610715022
- Fayolle, A., and Liñán, F. (2014). The future of research on entrepreneurial intentions. *J. Bus. Res.* 67, 663–666. doi: 10.1016/j.jbusres.2013.11.024
- Fitzsimmons, J. R., and Douglas, E. J. (2011). Interaction between feasibility and desirability in the formation of entrepreneurial intentions. *J. Bus. Ventur.* 26, 431–440. doi: 10.1016/j.jbusvent.2010.01.001
- Fornell, C., and Larcker, D. F. (1981). Structural equation models with unobservable variables and measurement error: algebra and statistics. *J. Mark. Res.* 18, 382–388. doi: 10.1177/002224378101800313
- Fragoso, R., Rocha-Junior, W., and Xavier, A. (2020). Determinant factors of entrepreneurial intention among university students in Brazil and Portugal. *Journal of Small Business and Entrepreneurship*, 32, 33–57. doi: 10.1080/08276331.2018.1551459
- Gedeon, S. (2014). Application of best practices in university entrepreneurship education. *Eur. J. Train. Dev.* 38, 231–253. doi: 10.1108/EJTD-05-2013-0058
- Ghina, A. (2015). Building a systematic framework for entrepreneurship education. *J. Entrep. Educ.* 18, 73–99.
- Godsey, M. L., and Sebor, T. C. (2010). Entrepreneur role models and high school entrepreneurship career choice: results of a field experiment. *Small Bus. Inst. J.* 5, 83–125.
- Hair, J. F. Jr., Matthews, L. M., Matthews, R. L., and Sarstedt, M. (2017). PLS-SEM or CB-SEM: updated guidelines on which method to use. *Int. J. Multivariate Data Analysis* 1, 107–123. doi: 10.1504/IJMDA.2017.087624
- Hair, J. F., Risher, J. J., Sarstedt, M., and Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *Eur. Bus. Rev.* 31, 2–24. doi: 10.1108/EBR-11-2018-0203
- Hatt, L. (2018). Threshold concepts in entrepreneurship – the entrepreneurs' perspective. *Education + Training* 60, 155–167. doi: 10.1108/ET-08-2017-0119
- Hayton, J. C., and Kelley, D. J. (2006). A competency-based framework for promoting corporate entrepreneurship. *Hum. Resour. Manag.* 45, 407–427. doi: 10.1002/hrm.20118
- Henry, C., Hill, F., and Leitch, C. (2005). Entrepreneurship education and training: can entrepreneurship be taught? Part II. *Education + Training* 47, 158–169. doi: 10.1108/00400910510592211
- Hindle, K. (2007). "Teaching entrepreneurship at university: from the wrong building to the right philosophy" in *Handbook of Research in Entrepreneurship Education: A General Perspective*. ed. A. Fayolle (Cheltenham: Edward Elgar Publishing), 104–126.
- Holcomb, T. R., Ireland, R. D., Holmes, R. M., and Hitt, M. A. (2009). Architecture of entrepreneurial learning: exploring the link among heuristics, knowledge, and action. *Entrep. Theory Pract.* 33, 167–192. doi: 10.1111/j.1540-6520.2008.00285.x
- Izquierdo, E., Deschoolmeester, D., and Salazar, D. (2005). The importance of competencies for entrepreneurship: A view from entrepreneurs and scholars' perspective. Present at IntEnt Conference in Reino Unido, 1–13. Available at: http://www.espaee.espol.edu.ec/images/documentos/publicaciones/documentos_trabajo/entrepreneurship/Importance.pdf
- Jack, S. L., and Anderson, A. R. (1998). Entrepreneurship education within the condition of entrepreneurship. Proceedings of the Conference on Enterprise and Learning, 13–28.
- Joensuu-Salo, S., Varamäki, E., and Viljamaa, A. (2015). What makes a student start a firm? Beyond intentions – what makes a student start a firm? *Education + Training* 57, 853–873. doi: 10.1108/ET-11-2014-0142
- Karimi, S., Biemans, H. J. A., Lans, T., Chizari, M., and Mulder, M. (2014). Effects of role models and gender on students' entrepreneurial intentions Saeid. *Eur. J. Train. Dev.* 38, 694–727. doi: 10.1108/EJTD-03-2013-0036
- Karimi, S., Biemans, H. J. A., Lans, T., Chizari, M., and Mulder, M. (2016). The impact of entrepreneurship education: A study of Iranian students' entrepreneurial intentions and opportunity identification. *J. Small Bus. Manag.* 54, 187–209. doi: 10.1111/jsbm.12137
- Kolvereid, L. (1996). Prediction of employment status choice intentions. *Entrep. Theory Pract.* 21, 47–58. doi: 10.1177/104225879602100104
- Kozlinska, I., Rebmann, A., and Mets, T. (2020). Entrepreneurial competencies and employment status of business graduates: the role of experiential entrepreneurship pedagogy. *J. Small Bus. Entrepreneurship*, 32, 1–38. doi: 10.1080/08276331.2020.1821159
- Krueger, N. F., and Carsrud, A. L. (1993). Entrepreneurial intentions: applying the theory of planned behaviour. *Entrepreneurship Reg. Dev.* 5, 315–330. doi: 10.1080/08985629300000020
- Kuratko, D. F. (2005). The emergence of entrepreneurship education: development, trends, and challenges. *Entrep. Theory Pract.* 29, 577–597. doi: 10.1111/j.1540-6520.2005.00099.x
- Lackéus, M. (2014). An emotion based approach to assessing entrepreneurial education. *Int. J. Manag. Educ.* 12, 374–396. doi: 10.1016/j.ijme.2014.06.005
- Lanero, A., Vázquez, J. L., Gutiérrez, P., and García, M. P. (2011). The impact of entrepreneurship education in European universities: an intention-based approach analyzed in the Spanish area. *Int. Rev. Public Nonprofit Mark.* 8, 111–130. doi: 10.1007/s12208-011-0067-8
- Liñán, F., and Chen, Y.-W. (2009). Development and cross-cultural application of a specific instrument to measure entrepreneurial intentions. *Entrep. Theory Pract.* 33, 593–617. Available at: <http://onlinelibrary.wiley.com/doi/10.1111/j.1540-6520.2009.00318.x/full>
- Liñán, F., and Fayolle, A. (2015). A systematic literature review on entrepreneurial intentions: citation, thematic analyses, and research agenda. *Int. Entrep. Manag. J.* 11, 907–933. doi: 10.1007/s11365-015-0356-5
- Liñán, F., Nabi, G., and Krueger, N. (2013). British and Spanish entrepreneurial intentions: A comparative study. *Revista de Economía Mundial* 33, 73–103. doi: 10.1227/01.NEU.0000297044.82035.57
- Lindell, M. K., and Whitney, D. J. (2001). Accounting for common method variance in cross-sectional research designs. *J. Appl. Psychol.* 86, 114–121. doi: 10.1037/0021-9010.86.1.114
- Macosko, J. C., Johnson, A. D., and Yocum, S. M. (2009). Teaching entrepreneurship through science-oriented teams and projects: three case studies. Available at: https://econpapers.repec.org/RePEc:elg:eechap:12826_9
- Man, T. W. Y., and Lau, T. (2005). The context of entrepreneurship in Hong Kong. *J. Small Bus. Enterp. Dev.* 12, 464–481. doi: 10.1108/14626000510628162
- Man, T. W. Y., Lau, T., and Chan, K. F. (2002). The competitiveness of small and medium enterprises A conceptualization with focus on entrepreneurial competencies. *J. Bus. Ventur.* 17, 123–142. doi: 10.1016/S0883-9026(00)00058-6
- Martin, B. C., McNally, J. J., and Kay, M. J. (2013). Examining the formation of human capital in entrepreneurship: A meta-analysis of entrepreneurship education outcomes. *J. Bus. Ventur.* 28, 211–224. doi: 10.1016/j.jbusvent.2012.03.002
- Martínez Ávila, M., and Fierro Moreno, E. (2018). Aplicación de la técnica PLS-SEM en la gestión del conocimiento: un enfoque técnico práctico. *RIDE. Rev. Iberoam. Investig. Desarro.* 8, 130–164. doi: 10.23913/ride.v8i16.336
- Mitchelmore, S., and Rowley, J. (2010). Entrepreneurial competencies: a literature review and development agenda. *Int. J. Entrepreneurial Behav. Res.* 16, 92–111. doi: 10.1108/13552551011026995
- Mitchelmore, S., and Rowley, J. (2013). Entrepreneurial competencies of women entrepreneurs pursuing business growth. *J. Small Bus. Enterp. Dev.* 20, 125–142. doi: 10.1108/14626001311298448
- Morris, M. H., Webb, J. W., Fu, J., and Singhal, S. (2013). A competency-based perspective on entrepreneurship education: conceptual and empirical insights. *J. Small Bus. Manag.* 51, 352–369. doi: 10.1111/jsbm.12023

- Murugesan, R., and Dominic, P. D. D. (2014). Socio, economic and psychological determinants of entrepreneurial intentions: A structural equation model. *Glob. Bus. Econ. Rev.* 16, 396–415. doi: 10.1504/GBER.2014.065363
- Nabi, G., Liñan, F., Krueger, N., Fayolle, A., and Walmsley, A. (2017). The impact of entrepreneurship education in higher education: A systematic review and research agenda. *Acad. Manag. Learn. Edu.* 16, 277–299. doi: 10.5465/amle.2015.0026
- Neck, H. M., and Greene, P. G. (2011). Entrepreneurship education: known worlds and new Frontiers. *J. Small Bus. Manag.* 49, 55–70. doi: 10.1111/j.1540-627X.2010.00314.x
- Nunnally, J. C. (1975). Psychometric theory—25 years ago and now. *Educ. Res.* 4, 7–21. doi: 10.3102/0013189X004010007
- Oehler, A., Höffer, A., and Schalkowski, H. (2015). Entrepreneurial education and knowledge: empirical evidence on a sample of German undergraduate students. *J. Technol. Transfer* 40, 536–557. doi: 10.1007/s10961-014-9350-2
- Onstenk, J. (2003). Entrepreneurship and vocational education. *Eur. Educ. Res. J.* 2, 74–89. doi: 10.2304/eej.2003.2.1.12
- Piperopoulos, P., and Dimov, D. (2015). Burst bubbles or build steam? Entrepreneurship education, entrepreneurial self-efficacy, and entrepreneurial intentions. *J. Small Bus. Manag.* 53, 970–985. doi: 10.1111/jsbm.12116
- Pittaway, L., and Cope, J. (2007). Entrepreneurship education: a systematic review of the evidence. *Int. Small Bus. J.* 25, 479–510. doi: 10.1177/0266242607080656
- Politis, D., Winborg, J., and Dahlstrand, A. L. (2010). Exploring the resource logic of student entrepreneurs. *Int. Small Bus. J.* 30, 659–683. doi: 10.1177/0266242610383445
- Rae, D., and Carswell, M. (2001). Towards a conceptual understanding of entrepreneurial learning. *J. Small Bus. Enterp. Dev.* 8, 150–158. doi: 10.1108/EUM000000000006816
- Ramsgaard, M. B., and Christensen, M. E. (2016). Interplay of entrepreneurial learning forms: a case study of experiential interplay of entrepreneurial learning forms: a case study of experiential learning settings. *Innov. Educ. Teach. Int.* 55, 55–64. doi: 10.1080/14703297.2016.1228468
- Rasmussen, E., Mosey, S., and Wright, M. (2011). The evolution of entrepreneurial competencies: A longitudinal study of university spin-off venture emergence. *J. Manag. Stud.* 48, 1314–1345. doi: 10.1111/j.1467-6486.2010.00995.x
- Rasmussen, E., and Sørheim, R. (2006). Action-based entrepreneurship education. *Technovation* 26, 185–194. doi: 10.1016/j.technovation.2005.06.012
- Ringle, C. M., Wende, S., and Will, A. (2005). SmartPLS 2.0 (beta). Germany: University of Hamburg
- Sánchez, J. C. (2011). University training for entrepreneurial competencies: its impact on intention of venture creation. *Int. Entrep. Manag. J.* 7, 239–254. doi: 10.1007/s11365-010-0156-x
- Sánchez, J. C. (2013). The impact of an entrepreneurship education program on entrepreneurial competencies and intention. *J. Small Bus. Manag.* 51, 447–465. doi: 10.1111/jsbm.12025
- Schwarz, E. J., Wdowiak, M. A., Almer-Jarz, D. A., and Breitenacker, R. J. (2009). The effects of attitudes and perceived environment conditions on students' entrepreneurial intent: an Austrian perspective. *Education + Training* 51, 272–291. doi: 10.1108/00400910910964566
- Shane, S., and Venkataraman, S. (2000). The promise of entrepreneurship as a field of research. *Acad. Manag. Rev.* 25, 217–226. doi: 10.5465/amr.2000.2791611
- Shapero, A., and Sokol, L. (1982). "The social dimensions of entrepreneurship" in *Encyclopedia of entrepreneurship*, 72–90. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1497759
- Silveyra, G., Herrero, Á., and Pérez, A. (2021). Model of teachable entrepreneurship competencies (M-TEC): scale development. *Int. J. Manag. Educ.* 19:100392. doi: 10.1016/j.ijme.2020.100392
- Smith, A. J., Collins, L. A., and Hannon, P. D. (2006). Embedding new entrepreneurship programmes in UK higher education institutions: challenges and considerations. *Education + Training* 48, 555–567. doi: 10.1108/00400910610710001
- Solomon, G. (2007). An examination of entrepreneurship education in the United States. *J. Small Bus. Enterp. Dev.* 14, 168–182. doi: 10.1108/14626000710746637
- Tehseen, S., and Ramayah, T. (2015). Entrepreneurial competencies and SMEs business success: the contingent role of external integration. *Mediterr. J. Soc. Sci.* 6, 50–61. doi: 10.5901/mjss.2015.v6n1p50
- Volery, T., Müller, S., Oser, F., Naepflin, C., and del Rey, N. (2013). The impact of entrepreneurship education on human Capital at Upper-Secondary Level. *J. Small Bus. Manag.* 51, 429–446. doi: 10.1111/jsbm.12020
- von Graevenitz, G., Harhoff, D., and Weber, R. (2010). The effects of entrepreneurship education. *J. Econ. Behav. Organ.* 76, 90–112. doi: 10.1016/j.jebo.2010.02.015
- Williams Middleton, K., and Donnellon, A. (2014). Personalizing entrepreneurial learning: A pedagogy for facilitating the know why. *Entrep. Res. J.* 4, 167–204. doi: 10.1515/erj-2013-0040
- Winborg, J., and Landström, H. (2001). Financial bootstrapping in small businesses: Examining small business managers' resource acquisition behaviors. *Journal of business venturing* 16, 235–254. doi: 10.1016/S0883-9026(99)00055-5
- Wu, W. W. (2009). A competency-based model for the success of an entrepreneurial start-up. *WSEAS Trans. Bus. Econ.* 6, 279–291.
- Zampetakis, L. A., and Moustakis, V. (2006). Linking creativity with entrepreneurial intentions: A structural approach. *Int. Entrep. Manag. J.* 2, 413–428. doi: 10.1007/s11365-006-0006-z

Appendix 1

Items included in the questionnaire.

<i>Entrepreneurial Intention</i>	
I. Please indicate your agreement with the following phrases:	
	<i>1 = Completely disagree 7 = Completely agree</i>
IE01	I plan to start a new business within 5 years of completing my studies
IE02	I have already made taken some steps towards starting my own business (e.g., seeking information, discussing the idea with friends, writing a business plan)
IE03	I am sure I will start my own business within 5 years of completing my studies
IE04	It is one of my career goals to become an entrepreneur
<i>Opportunity identification, evaluation, and exploitation</i>	
II. Please indicate your agreement with the following phrases:	
	<i>1 = Completely disagree 7 = Completely agree</i>
Opportunity identification	
OPID01	I consider myself able to identify consumer needs that have not yet been met
OPID02	I consider myself able to imagine products and / or services that generate benefits for people
OPID03	I consider myself able to identify products and / or services that people want
OPID04	I consider myself able to take advantage of high-value business opportunities
Opportunity evaluation	
OPEV01	I have a gut feeling for potential opportunities
OPEV02	I can distinguish between profitable opportunities and not so profitable opportunities
OPEV03	I have a knack for telling high-value opportunities apart from low-value opportunities
OPEV04	When facing multiple opportunities, I am able to select the good ones
Opportunity exploitation	
OPEX01	I consider myself capable of generating creative business ideas
OPEX02	I consider myself capable of generating innovative products and / or services
OPEX03	I consider myself able to visualise the steps to follow to implement a business idea
OPEX04	I consider myself able to formulate and implement strategies to realise a business idea
<i>Resources procurement</i>	
IV. Please indicate your agreement with the following phrases:	
	<i>1 = Completely disagree 7 = Completely agree</i>
RL01	Mobilizing resources in unusual ways
RL02	Reducing your resource requirements (economize)
RL03	Finding ways to actually create new resources, competences, technologies
RL04	Responding to challenges and tasks by redeploying resources in different ways

Own elaboration adapted from Liñán and Chen (2009), Chandler and Jansen (1992), Anna et al. (2000), and Morris et al. (2013).



OPEN ACCESS

EDITED BY

Fengjuan Cui,
Yunnan University, China

REVIEWED BY

Layla Hasan,
University of Technology Malaysia, Malaysia
Reza Kafiipour,
Shiraz University of Medical Sciences, Iran

*CORRESPONDENCE

Yuqiao Liu
✉ Joeyliu1998@outlook.com
Weihua Luo
✉ weihua.luo@dlmu.edu.cn

RECEIVED 02 February 2023

ACCEPTED 26 June 2023

PUBLISHED 13 July 2023

CITATION

Liu Y, Luo W and Wang X (2023) Exploring the relationship between students' note-taking and interpreting quality: a case study in the Chinese context.

Front. Educ. 8:1157509.

doi: 10.3389/feduc.2023.1157509

COPYRIGHT

© 2023 Liu, Luo and Wang. This is an open-access article distributed under the terms of the [Creative Commons Attribution License \(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

Exploring the relationship between students' note-taking and interpreting quality: a case study in the Chinese context

Yuqiao Liu*, Weihua Luo* and Xiaochen Wang

School of Foreign Languages, Dalian Maritime University, Dalian, China

This paper aims to explore the relationship between note-taking and interpreting quality in consecutive interpreting. Research questions focus on three perspectives: language choice, the use of symbols and their influence on interpreting quality, and the problems in note-taking. The research design is divided into three steps: pre-interpretation preparation, consecutive interpretation, and retrospective interview. Through the empirical study, a mixed research method is adopted with the analysis of the notes and retrospective interviews with six participants whose major is translation and interpreting at a university in Northeast China. Specifically, both descriptive data analysis and correlation analysis are used for quantitative data, and thematic analysis aims to better describe qualitative data. Findings are as follows: first, students prefer to use English to take notes in English-to-Chinese consecutive interpreting, while Chinese is used more in Chinese-to-English consecutive interpreting; second, the number of symbols used is not related to the quality of interpreting; third, the following five problems are identified from the interview with student participants in students' notes: missing key information, inconsistent abbreviations, unclear logics, incomplete records of figures and the meaning of figures, and inadequate records of high-density information. The identification of language choice and problems of note-taking in interpreting practice might help teachers and students understand the problems of students' note-taking and shed light on teaching and learning consecutive interpreting.

KEYWORDS

consecutive interpreting, note-taking, interpreting quality, Gile's theory, mixed methods research

1. Introduction

Note-taking is a prompted record of the interpreter's impromptu and rapid process of managing the cues of the logic of the source language and marking the content, organization, and keywords (Gillies, 2017). The note is a kind of memory aid for interpreters, and it becomes an important carrier of the interpreting content throughout the process, prompting interpreters to convert the original auditory symbols into visual symbols (Jabaghyan, 2021). Therefore, the strength of note-taking ability is directly related to the accuracy of interpretation.

Compared to Western countries, the Chinese interpretation program is unique in terms of development history and learners (Su, 2021). First, the history of interpretation courses in China is relatively short. In contrast to Geneva, where the first senior translation institute was founded in 1941 (Chilingaryan et al., 2016), China did not launch an interpreter training program at Beijing Foreign Studies University until 1979. As a result, China lacks sufficient experience in creating interpretation courses and refining interpretation techniques. Second, in terms of the

surrounding language, as the dominant language in China becoming Mandarin, students can only practice bilingual or multilingual skills, especially translation and interpreting in colleges and universities. All of these factors motivate the author to contribute to interpreting research in China, hoping to provide some insights for current interpreting learning.

Dam (2004) stated that the choice of language in interpreters' note-taking was mainly governed by the status of the language in the interpreters' language combination, and much less by its status in the interpreting task. In order to seek evidence for or against the proposal, Szabó (2006) conducted a small-scale empirical study focusing on the language of note-taking in consecutive interpreting and revealed that interpreters with Hungarian as their A language and English B had a strong tendency to take notes in English, irrespective of the direction of interpreting, which did not fully support Dam's finding. Few pieces of research were conducted in terms of the language choice in English-Chinese consecutive interpretation. While in consideration of the importance of symbols used in interpreting, Wang et al. (2010) analyzed the notes taken by 12 college English majors and found there was no significant correlation between the features of note-taking and the quality of interpretation. Differently, Chen (2022) conducted a quantitative study from the perspective of social semiotics to present the differences between trainee interpreters and professional interpreters. However, there are seldom studies that can be found designed for postgraduates majoring in translation and interpreting when searching on the Google Scholar website. Students agree that note-taking is a major difficulty in their study and interpretation practice, with great essence for the improvement of students' interpretation (Maydosz and Raver, 2010). Therefore, it is a great necessity to study language choice, symbol use, and note problems for graduate students majoring in translation and interpreting.

The study aims to answer three research questions:

- I. What is students' language choice in note-taking for consecutive interpreting?
- II. What is the influence of symbol use on the quality of consecutive interpreting?
- III. What are the problems with the notes that affect the quality of consecutive interpreting?

The author conducted an empirical study with mixed methods, using both qualitative and quantitative research methods, particularly the analysis of the notes and interviews with six graduate students majoring in translation and interpreting at a university in Northeast China. The study is believed to benefit students and teachers. For students majoring in translation and interpreting, the study of their note-taking can help to summarize the common mistakes in note-taking and interpreting practice, helping to inform students how to improve their note-taking process and interpreting ability. For teachers, as the interpreting classes have been developed for a relatively short period of time in China, the teaching quality is relatively weak compared to other subjects. Studying the choices of language during note-taking and how the note-taking process can support interpretation and student perceptions of the problems in note-taking can help to strengthen the knowledge of students' interpretation ability, clarify the teaching orientation, and then develop a more effective teaching plan.

2. Literature review

2.1. Previous research on the relationship between note-taking and interpretation

Roza (1956) first proposed the note-taking system in 1956 with great influence across the world. Then, many books and articles on note-taking were published followed by Roza, generating a wider impact on the research area. Meanwhile, works of literature written about note-taking in consecutive interpreting boomed (e.g., Wang et al., 2013; Wang and Guo, 2015; Liu and Xu, 2017). In the beginning, experienced scholars aimed to provide suggestions and guidelines for interpreting through an introspective view of note-taking and discussion from different aspects as Matyssek (1989) proposed a system mainly based on symbols, and Roza (1956) chose to use language-dependent elements.

However, a variety of themes concerning empirical research were later done (e.g., Dai and Xu, 2007; Liu, 2010; Chen, 2022). And many scholars conducted empirical studies from different aspects and attempted to find certain interactions between note-taking and interpreting quality. In order to investigate the form of notes, Marani and Heidari Tabrizi (2017) studied the process of note-taking in Persian-English consecutive interpreting, five Iranian interpreters were interviewed and observed. The findings imply that interpreters without passing courses take notes based on their experiences irregularly rather than the rules and principles. Compared to Liu (2010)'s study, whose student participants were English majors, investigating the form of note-taking and finding that the high-score group used more symbols and clear-separation marks than those in the low-score group.

In terms of the choice and language, which sparked mounting concerns in note-taking literature (e.g., Gao, 2019), some literature suggested taking source language as a priority. It was believed that interpreters could "minimize their effort and save capacity" (Szabó, 2006, p. 131) during the phase of listening under great time pressure. For example, Hanusiak (2021) analyzed which language was preferred by students in note-taking whose mother tongue was Polish when interpreting English into Polish through a regular consecutive task, presenting that the source language was adopted primarily. However, writing the target language in notes was recommended by others because they argued it could make production much less effortful and facilitate better processing of interpretation. To hold critical thinking, González (2012) suggested that the expertise level in consecutive interpreting is the relevant factor in the language choice for interpreters.

The relationship between note-taking and interpreting performance triggered scholars' interest although there is no consistent conclusion. Orlando (2010, 2014) tried to find clear ways of evaluating the progressive acquisition of note-taking systems through digital pen technology. Based on suggestions that the accuracy of target text can be judged by examining the semantic network, Dam et al. (2005) developed assumptions regarding the characteristics of efficiency and non-efficiency in notes. Dam (2007) evaluated the hypothesis later from five qualified interpreters who translated from Spanish to Danish. The data showed evidence for the hypotheses, "the more notes, the better the target text—and vice versa," and "the more abbreviations/the fewer full words, the better the target text—and vice versa" (Dam 2007, p. 194). However, the findings of the research conducted by Cardoen (2013) are contradictory with Dam's

conclusions, which showed that fluent chunks contained fewer notes, more full words, and fewer abbreviations than disfluent chunks. The fact that Dam chose professional translators while other researchers took students as participants may help to explain why her findings were not replicated (Chen, 2017).

Through this brief review of previous research on note-taking in consecutive interpreting, we are able to find that major inconsistencies still exist despite some detected general trends, such as the use of language overweight that of symbols during note-taking. Most of the empirical studies' data is based on undergraduate students (whose interpreting abilities differ a lot), and some reviews concerning listening comprehension during interpreter training (e.g., Cerezo Herrero, 2017). It is detected that few scholars conduct research on postgraduate students majoring in translation and interpreting with the aim of figuring out the relationship between note-taking and interpreting quality. As postgraduate students play an increasingly important role in translation and interpreting education, the research aims to explore the relationship between masters' note-taking and interpreting quality in China (Man et al., 2020).

2.2. Theoretical framework

Gile (1995/2009) proposed the Effort Models (EMs), which focused on how interpreters allocate their energy to tasks such as listening, comprehension, memory, and output during the process of interpreting, and the effort model includes the Interpreting Model of Simultaneous Interpreting and the Interpreting Model of Consecutive Interpreting, and the Interpreting Model of Comprehension (Shao, 2013). In this paper, as the research focus is consecutive interpreting, we only discuss his Model of Consecutive Interpreting. The model of consecutive interpreting suggests that interpreting can be divided into two phases. The first one is listening and note-taking, which can be expressed as $\text{Interpreting} = L + N + M + C$ (L means Listening and Analysis, N means Note-taking, M means Short-term Memory operations, and C means Coordination. The second phase is Target-speech production, which can be expressed as $\text{CI} = \text{Rem} + \text{Read} + P$ (Rem means Remembering, Read means Note-reading, and P means Production).

In the first phase, the effort required for listening and analysis refers to the time it takes for interpreters to hear the source language, take notes, and produce the interpretation, and the short-term memory in this phrase is negatively related to the duration of the speaking. The main difference between the two phrases of memorization is that the second one refers to the constant recall of information units from a speech by relying on long-term memory. On the face of it, the second phase seems more tedious and complex than the first, but if the notes are recorded properly, they can be a good aid to the interpreter's memory and make the interpretation of the notes easier (Gile and Chai, 2009).

In the first phase of Gile's model, $\text{Interpreting} = L + N + M + C$, if the interpreter is able to use symbols appropriately, it will greatly reduce the effort required for the N (Note-taking) part. At this phase, to balance the distribution of attention required between N and L, it is necessary to make effective notes during listening. Only when the efficiency of notes is improved and the content of notes is targeted, can more energy be allocated to M to active short memory. In the second phase, the use of symbols also makes it easier for interpreters to interpret the content of the notes and reduces the effort spent on reading. Thus, according to Gile's theory, the use of symbols in

consecutive interpreting notes reduces the amount of attention and energy allocated by the interpreter to N, M, Rem, and Read, thus better ensuring the quality of output.

Many scholars have conducted their studies by using the Effort Models. For example, Wu and Wang (2009) proposed a supplementary solution named discourse transformation to tide over the capacity gap based on the Gile's Effort Models. While, Gumul (2018) found empirical evidence for Gile's Effort Models by triangulating retrospective protocols with product analysis with 120 interpreters, clearly supporting Gile's observations about the nature of the interpreting process. To better explain the implication of the didactic construct, Gile (2021) conceived EMs as a functional didactic tool to implicate high cognitive load, analyze fundamental issues, and predict future evolution in translation and interpreting, shedding light on the frontier field.

3. Methodology

The study was conducted with six postgraduate students majoring in translation and interpreting at a university in China. Three steps were contained in this empirical study, pre-interpretation preparation, consecutive interpretation, and retrospective interviews. Throughout the study, a mixed research method was adopted. The analysis of notes was used to better represent language choice and symbol usage, and retrospective interviews with participants aimed to figure out problems in note-taking. Both quantitative data and qualitative data have been collected and analyzed, the former concerned with descriptive data analysis and correlation analysis designed for the first two research questions, while the latter contained thematic analysis for the last question.

3.1. Participants

Six participants from the School of Foreign Languages of a university in Northeast China were recruited. They were all first-year postgraduates majoring in translation and interpreting and passed the postgraduate interpreting assessment with no more than a five difference in marks. All six subjects have passed the same level of the China Accreditation Test for Translators and Interpreters (CATTI). Before the research, they had received semester-long training in basic interpretation courses, being familiar with consecutive interpreting notes and basic skills. Sim et al. (2018) suggested that for qualitative research, diversified recommendations range from 5 to 35 for grounded theory studies, and those for single-case studies from 4 to 30 subjects are feasible to help figure out. Concerning the limitation on the number of masters in translation and interpreting in the university and the effectiveness of data analysis, the author selected 6 participants in this study. The above prerequisites ensure that the subjects have comparable interpretation capabilities and reduce the impact of their capabilities on the results.

3.2. Research design

The research was conducted in a dedicated interpretation classroom, with the audio played by the teacher and the author's assistance. The empirical process was divided into three steps: pre-interpretation preparation, consecutive interpretation (including

note-taking process and interpretation), and retrospective interview. The audio recording was used in consecutive interpretation and retrospective interviews.

3.2.1. Pre-interpretation preparation

Before interpretation, the author gave each subject three blank A4 sheets of paper for writing notes. The author promised the subjects that the records of interpretation and retrospective interviews would be kept confidential and that all notes would be used in an anonymous form for the study so that privacy would not be compromised.

3.2.2. Consecutive interpretation

The author did not inform each subject of the purposes of the research, expecting each student to take notes according to their usual personal habits, thus avoiding the irrelevant factors influencing the results.

Before recording, the teacher tested the headphones and microphones of each subject and ensured the study environment was good. Subjects were informed of the topic of materials before starting, and the teacher was responsible for playing the prepared materials which are one Chinese-to-English audio and one English-to-Chinese audio. The length of the Chinese-to-English audio was 2 min and 15 s, with a speech rate of 244 words per minute, and the topic was the disadvantages of wind power. The English-to-Chinese audio was 4 min and 10 s long, with a speech speed of 109 words per minute, and the topic was how to file a police report for stolen property. Both audios were colloquial and speakers were accent-free, without jargon, and easy to understand.

Then the teacher required students to translate the materials from Chinese to English and subsequently translate from English to Chinese. There were four sections for the Chinese-English translation and six sections for translation from English to Chinese.

Subjects took notes when playing the materials and translated what they had just heard after a pause. After the completion of consecutive interpretations, the author copied six subjects' recordings to a personal USB and collected all the notes. After the data collection, the audio recordings of their translation were transcribed into text, while participants' notes were analyzed by counting their use of complete Chinese words, individual Chinese characters, English words, English abbreviations, symbols, and end marks as categorized by [Dam \(2004\)](#) and [Liu \(2010\)](#).

1. Complete Chinese words: forms of Chinese note-taking including phrases and four-character idioms, regardless of whether the strokes are complete or not.
2. Individual Chinese characters: complete or nearly complete Chinese characters occurring alone and containing Chinese radicals.
3. English words: including nouns in singular and plural forms and verbs in different tenses, whether or not spelled correctly.
4. English abbreviations: taking only their first few letters, consonants, and other word parts; initials (e.g., names of institutions, technical terms); default idiomatic abbreviations.
5. Symbols: non-linguistic forms of note including indicative symbols, graphic symbols, interdisciplinary symbols, and combinations of symbols.
6. End marks: marks to distinguish between utterances.

Considering some participants' poor hand-writing which may make no sense to researchers, therefore, the author confirmed the ambiguous contents with subjects in order to improve the accuracy of the statistics,

3.2.3. Retrospective interviews

After the completion of consecutive interpreting, the researcher conducted retrospective interviews with each of the six subjects for about 30 min. The interviews were audio recorded, and the questions included how the participants chose language when making notes, and whether there is any relationship between note-taking and their perceived interpreting quality. During the interview, the researcher pointed out each participant's misinterpretation and the words that were not interpreted. Thus, the interviewee could recall the process of making notes and the reason why they made mistakes when interpreting.

3.3. Data analysis

As discussed before, the study intends to collect both quantitative and qualitative data via conducting consecutive interpretations and retrospective interviews. Thus, various methods for data analysis were employed. Before the data analysis, it was crucial to determine participant quality of interpretation, thus enabling the author to figure out the relationship between note-taking and interpreting quality.

With an aim to evaluate the relationship between note-taking and the quality of interpretation, it is important to justify how researchers can determine the quality of interpretation. Many scholars (e.g., [Viezzi, 1993](#); [Barik, 1994](#); [Gile 1995/2009](#)) have put forward their own criteria for assessing the quality of interpretation. For example, [Kurz \(1989\)](#) put forward that interpreters should keep a sense of consistency with the original message, while [Gile \(1991\)](#) believed that interpreters should have a faithful image of the original content. As this research focuses on the relationship between note-taking and interpreting quality, scores are provided based on the accuracy of interpretation and complete conveying of key information. On this very note, the author adopts the criteria proposed by [Cai \(2003\)](#): the quality of interpretation is evaluated according to the number of information units interpreted. The information units in this study refer to the definition of the meaning unit in the Interpretivist Theory, semantic units are taken to be information units in a complete hierarchy of meaning, such as the cause in causality, time, or place in narrative structure (See [Appendix I](#)). Thus, the author intended to conduct statistical calculations to see the quantification of the interpreting quality.

To analyze quantitative data to answer the first two questions, the researcher adopted descriptive data analysis and correlation analysis. Specifically, the author used descriptive data analysis to present each participant's note form and information units, while the analysis of correlation was designed to solve the second research question, describing the relationship between different forms of note-taking and interpreting quality by using SPSS software.

To better analyze qualitative data, which helps to answer the third research question, thematic analysis was adopted in this area, including the following steps ([Braun and Clarke, 2006](#)). First, the researcher transcribed the verbal data into written forms to get familiar with the qualitative data. Then, the researcher read the

transcription several times to make initial codes after which the researcher compared and merged the initial codes. Thus, the themes that can answer my research questions can be found. After the thematic analysis, the themes that relate to my research questions are missing key information, inconsistent abbreviations, unclear logic, incomplete records of figures and the meaning of figures, and inadequate records of high-density information.

4. Findings

The author conducted a quantitative and qualitative analysis of the interpretation and interview data, including quantitative statistics on the form of notes taken by each subject, quantitative statistics on the performance of interpreters, and explored the relationship between the two through SPSS software, as well as providing insights into the findings.

4.1. Quantitative statistics in the form of notes

This research draws on [Dam \(2004\)](#), [Dai and Xu \(2007\)](#), and [Liu \(2010\)](#), classifying the forms of notes into complete Chinese words (e.g., “运行,” “来源,” “人工”), individual Chinese characters (e.g., “叶,” “撞,” “欠”), English words (e.g., point and points, take, took and taken), English abbreviations (e.g., inf for information, IMF for International Monetary Fund, LA for Los Angeles, ad for advertisement), symbols, end marks (e.g., horizontal line, diagonal, double horizontal line).

In order to facilitate the comparison between the form of notes and the quality of interpretation, the author counted each subject's usage of each type of note form as follows.

According to [Table 1](#), the use of Chinese was much more than the use of English when students make Chinese-to-English interpretation notes, with the most frequent notes being individual Chinese characters, followed by the application of symbols. English abbreviations were the least used. The frequency of using complete Chinese words was similar to that of English words, five out of six students had the habit of marking end marks in order to divide utterances, especially when the teacher played a pause in materials.

TABLE 1 Notes in Chinese to English interpretation.

Name of subject	A	B	C	D	E	F
Complete Chinese words	16	5	7	4	9	7
Individual Chinese characters	22	36	36	29	33	39
English words	9	17	8	6	3	3
English abbreviations	1	2	3	4	1	3
Symbols	12	19	11	16	18	14
End marks	18	4	4	4	4	0
Sum	78	83	69	63	68	66
The ratio of Chinese-to-English language	19:5	41:19	43:11	33:10	21:2	23:3

According to [Table 2](#), the use of English was much more than the use of Chinese when students took English-to-Chinese interpretation notes, where English words most frequently occurred, the complete Chinese words were least used, and the frequency of using individual Chinese characters and English abbreviations was similar. Compared with the process of making Chinese-English translations, all six students had the habit of making end marks when making English-Chinese translations.

4.2. Quantitative statistics on the quality of interpretation

For the assessment of interpreting quality, the author mainly adopted quantitative analysis. In the research, the Chinese-to-English interpretation consisted of 4 paragraphs, in which the author found 45 information units ([Table 3](#)) and the English-to-Chinese interpretation consisted of 6 paragraphs, in which the author found 54 information units ([Table 4](#)). Please see [Appendix I](#) for details.

4.3. Assessment of subject's interpreting quality

The score was 100 out of 100. Proportionally, each information unit in Chinese-to-English interpretation is 2.22, and each information unit in English-to-Chinese interpretation is 1.85. For students who had not interpreted the complete information accurately, they would get a score of 0. The number of information points that each participant interpreted and the final score of each subject are summarized in [Tables 5, 6](#), please see [Appendix II](#) for details.

4.4. The relationship between note-taking and interpreting quality

To further investigate the relationship between note-taking and interpreting quality, the author used SPSS statistical software to calculate the Pearson correlation between the number of symbols, the proportion of recorded languages, the total number of notes, and the quality of interpretation, respectively. The detailed results were as follows.

TABLE 2 Notes in English to Chinese interpretation.

Name of subject	A	B	C	D	E	F
Complete Chinese words	11	3	3	8	4	0
Individual Chinese characters	11	18	20	24	18	4
English words	50	38	34	41	61	47
English abbreviations	6	16	34	13	11	24
Symbols	13	18	14	11	10	19
End marks	23	7	6	7	5	4
Sum	114	100	111	104	109	98
The ratio of English-to-Chinese language	28:11	18:7	68:23	27:16	36:11	71:4

TABLE 3 Statistics of information units in the Chinese to English material.

	First paragraph	Second paragraph	Third paragraph	Fourth paragraph	Sum total
Information units	18	9	13	5	45

TABLE 4 Statistics of information units in the English to Chinese Material.

	First paragraph	Second paragraph	Third paragraph	Fourth paragraph	Fifth paragraph	Sixth paragraph	Sum total
Information units	8	11	9	9	10	7	54

TABLE 5 Coverage of information units in Chinese-to-English consecutive interpretation by each subject.

	A	B	C	D	E	F
Information units coverage in the first paragraph	16	14	16	18	15	13
Information units coverage in the second paragraph	9	9	9	9	8	8
Information units coverage in the third paragraph	13	13	13	13	12	10
Information units coverage in the fourth paragraph	5	5	5	5	4	4
Final score	95.46	91.02	95.46	99.90	86.58	77.70

TABLE 6 Coverage of information units in English-to-Chinese consecutive interpretation by each subject.

	A	B	C	D	E	F
Information units coverage in the first paragraph	5	6	7	8	6	7
Information units coverage in the second paragraph	9	8	10	11	8	9
Information units coverage in the third paragraph	7	5	7	8	5	7
Information units coverage in the fourth paragraph	5	5	6	4	5	5
Information units coverage in the fifth paragraph	5	4	7	8	3	5
Information units coverage in the sixth paragraph	5	5	5	5	5	5
Final score	66.60	61.05	77.70	81.40	59.20	70.30

Using the Pearson correlation coefficient to investigate the strength of the correlation between the quality of Chinese-to-English interpretation and the number of symbols, the data in Table 7 shows that the correlation coefficient between the quality of interpretation and the number of note symbols is -0.173 , which is close to 0, and the value of p is $0.743 > 0.05$, thus there is no correlation between the quality of interpretation and the number of symbols (Zhang and Xu, 2009).

Using the Pearson correlation coefficient to indicate the strength of the correlation between the quality of Chinese-to-English interpretation and the total number of notes, the analysis of Table 8 shows that the correlation coefficient between the quality of

TABLE 7 The correlation between the quality of Chinese-to-English interpretation and the number of symbols.

Correlation			
		Number of symbols	Quality of Chinese-to-English interpretation
Number of symbols	Pearson correlation	1	-0.173
	Sig.		0.743
	Subject	6	6
Quality of Chinese-to-English interpretation	Pearson correlation	-0.173	1
	Sig.	0.743	
	Subject	6	6

Chinese-to-English interpretation and the total number of notes is 0.102 , which is close to 0, and the value of p is $0.848 > 0.05$, thus indicating that there is no correlation between the quality of Chinese-to-English interpretation and the total number of notes.

The Pearson correlation coefficient between the quality of English-to-Chinese interpretation and the number of symbols is -0.072 , which is close to 0, and the value of p is $0.891 > 0.05$, thus there is no correlation between the two (Table 9).

From Table 10, the correlation coefficient value between the quality of English-to-Chinese interpretation and the total number of notes is -0.161 , which is close to 0, and the value of p is $0.760 > 0.05$, thus indicating that there is no correlation between the quality of English-to-Chinese interpretation and the total number of notes.

From a statistical point of view, although there was no significant correlation between the number of symbols and the quality of interpretation, all subjects affirmed the use of symbols and believed that effective usage could reduce memory load, save recording time and improve note-taking effectiveness (Jabaghyan, 2021).

4.5. Problems with note-taking

Note-taking is an important aid to consecutive interpretation, affecting the quality of the interpretation to a certain extent (Dam, 2021). By comparing the materials with the translation transcriptions of each subject and integrating the retrospective interviews, the author found that the factors affecting interpreting quality were divided into two main categories: note-related factors and non-note-related factors.

TABLE 8 The correlation between the quality of Chinese-to-English interpretation and the total number of notes.

Correlation			
		Total number of notes	Quality of Chinese-to-English interpretation
Total number of notes	Pearson correlation	1	0.102
	Sig.		0.848
	Subject	6	6
Quality of Chinese-to-English interpretation	Pearson correlation	0.102	1
	Sig.	0.848	
	Subject	6	6

TABLE 9 The correlation between the quality of English-to-Chinese interpretation and the number of symbols.

Correlation			
		Number of symbols	Quality of English-to-Chinese interpretation
Number of symbols	Pearson correlation	1	−0.072
	Sig.		0.891
	Subject	6	6
Quality of English-to-Chinese interpretation	Pearson correlation	−0.072	1
	Sig.	0.891	
	Subject	6	6

Based on the retrospective interviews with each subject, the author will focus on the problems related to note-taking, which have been categorized into five situations, namely, missing key information, inconsistent abbreviations, unclear logic, incomplete records of figures and the meaning of figures, and inadequate records of high-density information.

4.5.1. Missing key information

- 1a. Here’s how to file an accurate police report that increases the chances of getting your stuff back.
- 1b. 而如何向警方提交一个报告，这是一个非常好的机会，因为它有可能帮你寻回你丢失的物品。.
- Subject B said that he understood the word “increase” when the recording was played but did not write it down in notes, resulting in a blurred memory when translating, so he interpreted it as “it was a good opportunity” (Figure 1).
- 1c. 那么说如果我们要把风机建设在那些候鸟迁徙的必经之路上，很有可能就会对候鸟本身造成一定伤害。.
- 1d. And it will also hurt the birds and we would probably do harm to the bird itself.
- Subject E’s notes were not clear enough, only using the “if” in his notes to determine that there was a causal relationship here, but the

TABLE 10 The correlation between the quality of English-to-Chinese interpretation and the number of notes.

Correlation			
		Total number of notes	Quality of English-to-Chinese interpretation
Total number of notes	Pearson correlation	1	−0.161
	Sig.		0.760
	Subject	6	6
Quality of English-to-Chinese interpretation	Pearson correlation	−0.161	1
	Sig.	0.760	
	Subject	6	6

key information after “if” was not clearly recorded, resulting in the omission of the interpretation “build the wind turbine on the route of migratory birds” (Figure 2).

- 1e. You can write down the name of the officer you are speaking with and request that an officer be sent to your location to speak with you.
- 1f. 你要写下自己的名字来寻求帮助，并且你也可以寻求警局里的警官的帮助，你可以要求他们来到你丢东西的地方去出警。.
- Subject E only recorded “name” in his notes here, but did not record whose name he was writing down, so he mistakenly interpreted “officer’s name” as “my name” (Figure 3).
- 1g. Do not try to recover anything by yourself. These methods do work. A man in Florida retrieved his iPhone this way.
- 1h. 请你不要做任何的操作，你可以等待...这类资产跟踪服务通常是有效的，比如说佛罗里达州的警察们会用这个跟踪服务寻找丢失的iPhone手机。.

After comparing the English and Chinese texts, the author found that the student had mishandled the last sentence. The main problem was that the student had misinterpreted the subject “a man.” After comparing the student’s notes and retrospective interview, the author found that the subject was misinterpreted as “the police officers in Florida” because the student had overlooked the key information in the passage during the recording process (Figure 4).

4.5.2. Inconsistent abbreviations

- 2a. 那么最后一点我想谈的就是，风机带给我们的噪音问题。很多时候我们可能都会意识到，当我们驱车从风机下面经过的时候，我们会听到风机叶片发出巨大的声音。.
- 2b. The last problem I would like to talk is the noise of the wind turbine, because the fan blade will makes the noises. When we drive the car pass by the wind turbine, we will hear a lot of noises.
- In this case, subject A changed his words frequently and missed the interpretation “a lot of times we might have been aware of it.” At the time of the interview, the student said that she did not recognize the word “车” and her short-term memory failed, which led to difficulties in organizing language and numerous changes of phrase (Figure 5).
- 2c. If you need to make any changes or add new Information and periodically check in with law enforcement to find out if your property has been recovered.

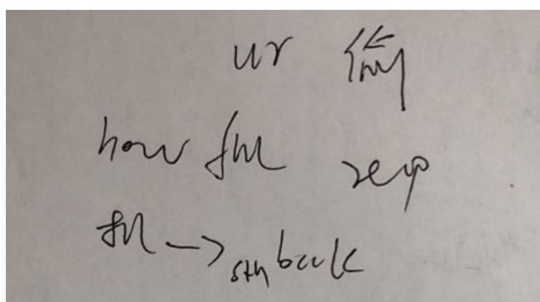


FIGURE 1
Excerpted notes of Subject B.

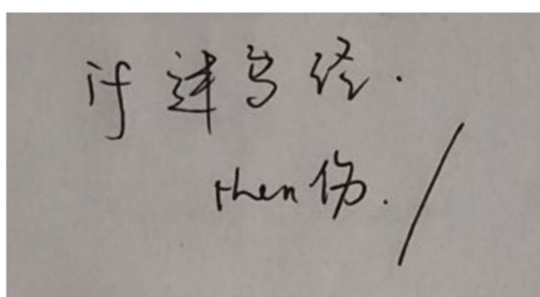


FIGURE 2
Excerpted notes of Subject E.

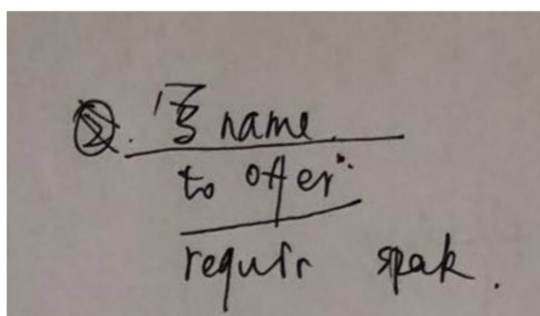


FIGURE 3
Excerpted notes of Subject E.

2d. 如果你有任何的一个对于案件的更改信息或者提供新的信息，你也可以与警察确认诉讼进程...以及什么时候你的物品可以得到返还。.

Subject A was stuck here for nearly 6 s, with a long speech interruption, and the student indicated that the messy handwriting of notes caused him not to recognize the information in time (Figure 6).

2e. Well, moving to a foreign country is one of the biggest life transitions you can ever make.

2f. 搬到一个外国国家生活肯定在你的一生中是一个最大的挑战。.

Subject C was unsure of the abbreviation for “life transition” in notes, which led to a misinterpretation of the word “life challenges” (Figure 7).

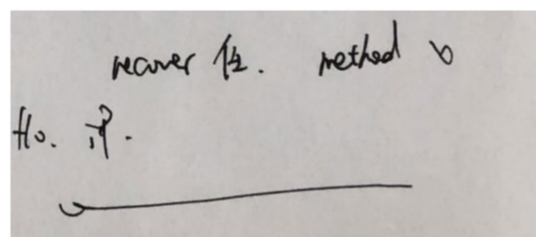


FIGURE 4
Excerpted notes of Subject D.

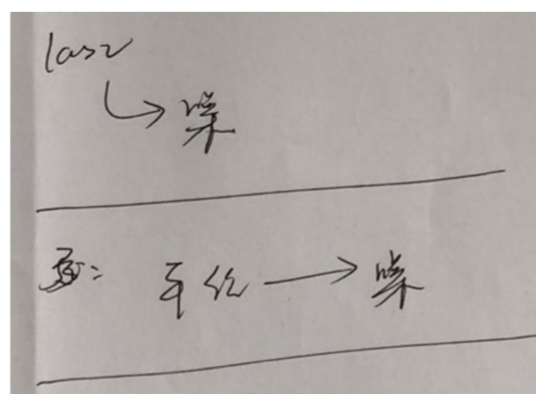


FIGURE 5
Excerpted notes of Subject A.

2g. 这样会增加鱼类的种群数量，那么也可以说，在有些情况下，风机也会给我们带来有益的生态环境的变化。.

2h. Their bases are often used by fish and it will increase the fish populations. And it can also bring the benefits of the ecological environment.

Subject E here had a long interval between the two interpretations, and the symbol of “+” in notes was mistaken for a connecting symbol, and only after a short period of reflection and organization of language did he remember that it meant “increase” (Figure 8).

2i. 那么很多风机制造厂商都致力于研发一种没有声音的风机，因为这会让风机离我们更加接近，毕竟我们每个人都不希望生活在风机旁边，而这个风机每天无时无刻都在发出着噪音。.

2j. Many draft fan factories are trying to make fan without voice. We do not want to live too near from the draft fan which make a lot of noises.

The omission of the phrase “because it would bring the wind turbine closer to us” in subject F was due to an uncertain abbreviation (Figure 9).

2k. 这样会增加鱼类的种群数量，那么也可以说，在有些情况下，风机也会给我们带来有益的生态环境的变化。.

2L. And they may increase the species and numbers for the fish... so the fan may have some advantageous situations.

The student was stuck for too long here, and after interviewing the student recalled that he hesitated because he was identifying his notes and struggling with his choice of words. Unsure of the abbreviation, the radical symbol for “改” was not recognized at first,

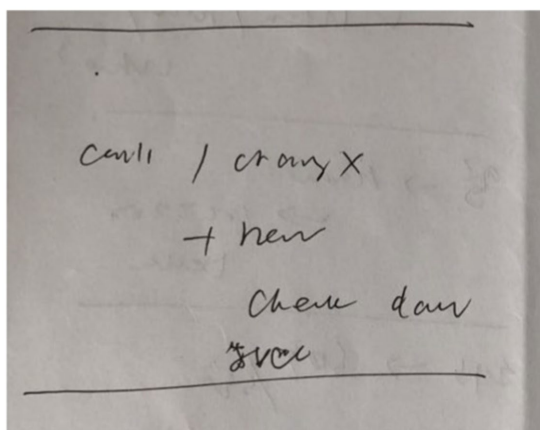


FIGURE 6
Excerpted notes of Subject A.

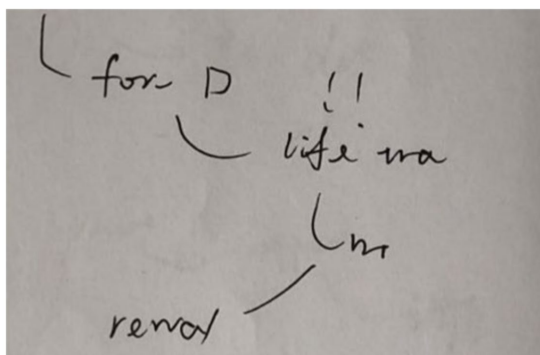


FIGURE 7
Excerpted notes of Subject C.

and it took a while to identify it. He was thinking about whether the material was “wind turbines also have a beneficial effect on the ecosystem” or “the above are the beneficial effects of wind turbines on the ecosystem.” Meanwhile, he was also considering whether to use the noun merits or the adjective advantageous for the word (Figure 10).

4.5.3. Unclear logic

3a. This is a perfectly safe neighborhood with very low crime rates, there are things that you should know in case something bad happens.

3b. 尽管大家所在的这个位置，我们所在的这个街区是一个犯罪率很低的地方，但是我还是要提醒大家，一些让你不愉快的事情还是有可能发生的。

The student omitted the phrase “in case” here because the logic of the notes was not clear, thus missing the key logical word in the passage. However, the student did a good job of interpreting “in case” by adding the word “although” as a logical word, making the interpretation coherent and well-organized as a whole (Figure 11).

3c. This is a perfectly safe neighborhood with very low crime rates, there are things that you should know in case something bad happens.

3d. 虽然我们住在一个非常安全的社区里，但是有一些东西你必须了解，因为它们影响不太好。

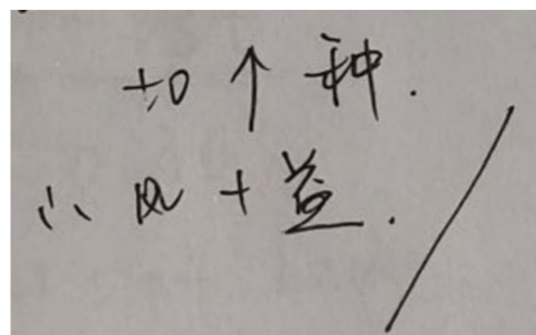


FIGURE 8
Excerpted notes of Subject E.

Subject A misinterpreted the logical “in case” in this passage, and Subject B made the same mistake here. Both students reported that the high density of information here led to logical confusion in note-taking and a failure to organize the language (Figure 12).

3e. 这是因为风机叶片在旋转的时候，会和空气发生摩擦。而这种摩擦，就是声音的来源。

3f. So that is because most of the wind power plants..ummm... when they are rotating, it would rap the air and produce noise by the rap of the air.

Subject D, who appeared to have changed his tone here, indicated in the interview that the intonation part was being adjusted to the logic of the interpretation based on his notes (Figure 13).

3g. Firstly, always act fast. As soon as you find your properties are stolen, call your local police department or sheriff’s office immediately.

3h. 第一点，你需要尽可能早的去警局报案，也就是说你要第一时间联系所在的警察局或者是警察站。

Subject D thought that “as soon as” was not the focus here, but in fact, the omission of the conjunction led directly to the incomplete interpretation of the entire temporal clause (Figure 14).

4.5.4. Incomplete records of figures and the meaning of figures

4a. You can request a copy of your police report. There may be a small fee for this document, and it could take a week to 10 days to receive it by mail.

4b. 同时你也可以向警官要你这个案件的复印件，你可以要这个案件的报告细节，它可能会花一周或者十几天。

The student omitted to interpret “small fee” and incorrectly translated “10 days” as “more than 10 days.” The student said that he had heard “small fee” when listening to the material, but had written only the word “small” in his notes, so he forgot to interpret “fee” and mistranslated it as “small details.” In “take a week to 10 days,” the student said that he was influenced by the previous paragraph and did not grasp the information, which led to an incomplete recording of the numbers and their collocation, resulting in a misinterpretation (Figure 15).

4.5.5. Inadequate records of high-density information

5a. You could take photographs and video of your valuables, write down detailed descriptions such as serial numbers, brand, model number, etc. And store the information in a safe place.

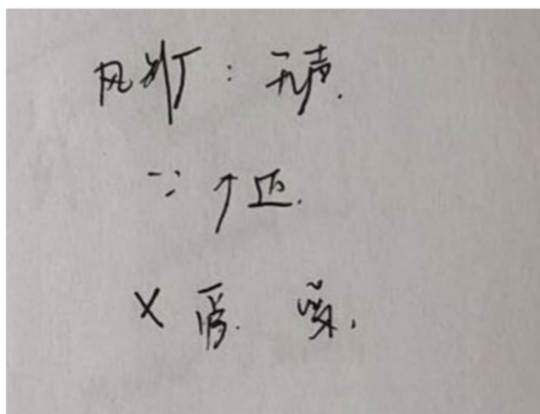


FIGURE 9
Excerpted notes of Subject F.

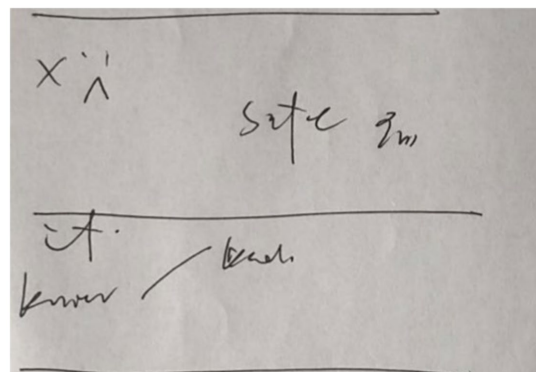


FIGURE 12
Excerpted notes of Subject B.

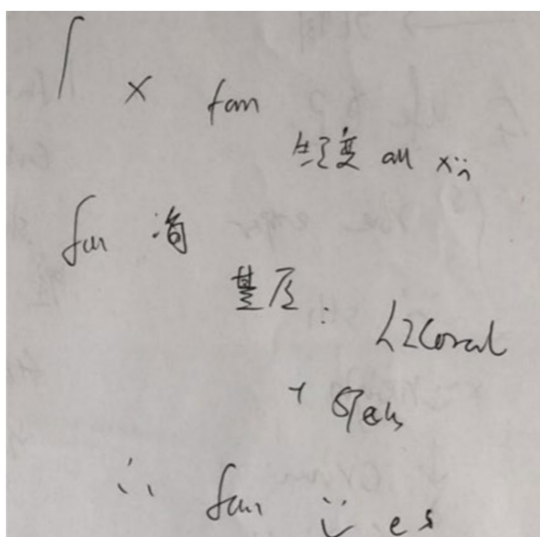


FIGURE 10
Excerpted notes of Subject B.

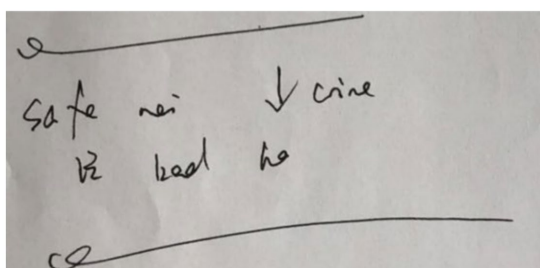


FIGURE 11
Excerpted notes of Subject D.

5b. 我们需要准备一些相关的东西，比如说拍照、录像以及相关的信息，它的品牌以及相关的追溯码，你可以把这些信息放在一个安全的地方。.

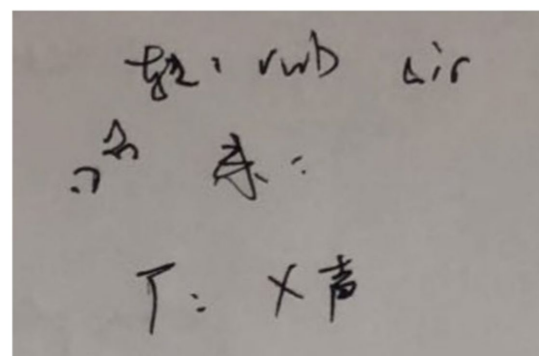


FIGURE 13
Excerpted notes of Subject D.

The student omitted to translate “serial number” and “model number” here because there were three parallel noun components in the passage and the density of information here made the record incomplete. The student has chosen to translate generally here, and it would have been wise to summarize them in general terms.

Subjects C and E were similarly generalized and vague here due to the number of juxtaposed nouns (Figure 16).

5c. If you have photographs of the stolen property, offer them to the investigating officer, ask for your case number and write it down.

5d. 其中的一些照片，或者是一些比较有价值的东西，一些信息都要向警方提供出来。然后你要写下一些电话号码，以便随时联系。.

Here the student misinterpreted “ask for case number,” saying that he had only written down “number” in his notes and did not respond immediately to the meaning of “case number,” thus causing the interpretation to stall and be mistranslated as “write down the number” (Figure 17).

Overall, according to the thematic analysis of qualitative data, the above five problems related to note-taking were figured out, including missing key information, inconsistent abbreviations, unclear logic, incomplete records of figures and the meaning of figures, and inadequate records of high-density information.

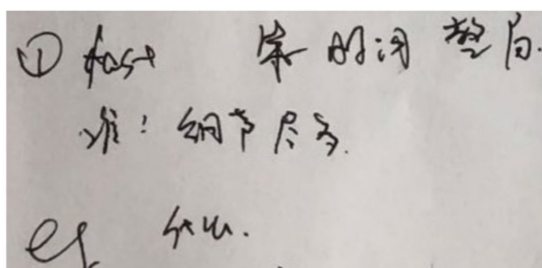


FIGURE 14
Excerpted notes of Subject D.

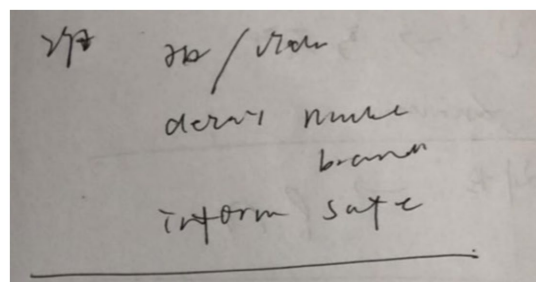


FIGURE 16
Excerpted notes of Subject A.

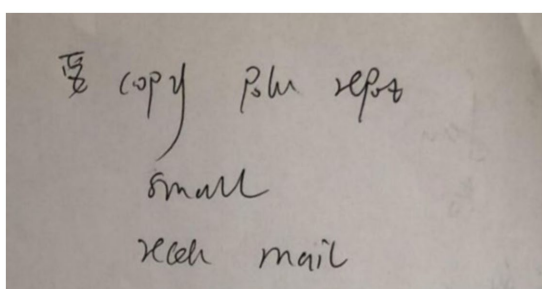


FIGURE 15
Excerpted notes of Subject B.

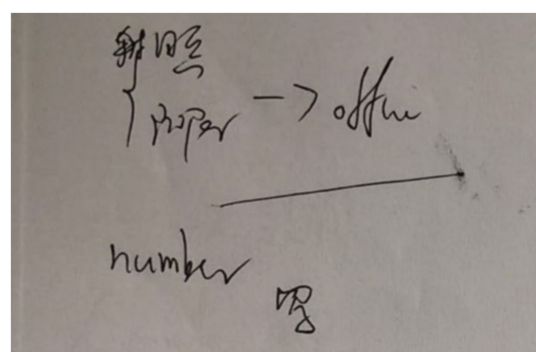


FIGURE 17
Excerpted notes of Subject B.

5. Discussion

This chapter discusses and focuses on three research problems including language choice, the use of symbols and their influence on interpreting quality, and the problems in note-taking by analyzing both quantitative and qualitative data and making effective suggestions for improving the interpreting quality.

5.1. Tendency of the language of students' notes

According to the statistical data in the form of notes, the ratio of Chinese-to-English language recorded by students in consecutive interpreting was higher than 3, with the highest value reaching 10.5, which meant that the six subjects were more inclined to use Chinese in note-taking.

In Chinese-to-English interpretation, the lowest ratio was 1.69 and the highest was 17.75, and the lowest ratio was recorded by the highest scorer, who said that he preferred to use the target language to take notes in order to reduce the short-term memory burden, which is in line with [Gile \(1995/2009\)](#), believing that taking notes in target language helps to reduce the attention and energy thus better ensuring the quality of output.

As a result, the students tended to write in Chinese through Chinese-to-English consecutive interpreting and write in English through English-to-Chinese consecutive interpreting. This is contradictory to Dam's study [Dam \(2004\)](#) which found that student

students wrote between 74 and 87% of their notes in the target language. The reasons for the different conclusions may be, first, the subjects of Dam's research were all professional conference interpreters with extensive experience and competence, and second, the sample size of his study was only four people, which also contained a small sample. Another trend mentioned in retrospective interviews was that when students understood the materials, they were more inclined to take notes in the target language. If they did not or when the information was intensive and time was tight, they would choose to take notes in the source language. This finding is supported by [González \(2012\)](#) study, articulating that students tended to use the source language as the dominant language in their notes, however, as the subjects' level of expertise increased, they preferred the target language during note-taking.

5.2. The relationship between the use of symbols and the quality of interpretation

Based on the correlation data described above, it was clear that there was no necessary link between interpreting quality and the use of student notation, which is in line with the study by [Wang et al. \(2010\)](#). However, [Liu \(2010\)](#) found that the use of symbols and end marks was more frequent in the high-score group with positively correlated with interpretation performance. The difference between this study and Liu's study [Liu \(2010\)](#) may be due to the fact that his study included a larger number of students with significant subgroups, whereas this study only

invited a relatively small sample size. In the retrospective interviews, students confirmed the usefulness of notation, saying that it could speed up the recording of information in consecutive interpreting, especially when the information was dense, thus improving the interpreting quality. However, there could be negative effects if the interpretation notes were not handled properly. For example, the participants said in their interviews that they sometimes tried to create new notation and it became a hindrance. Subjects also said that there were some symbols that were multi-translated and showed a wider range of meanings, so sometimes it was not as accurate as writing down the words.

From the interpretation and the retrospective interviews, all subjects agreed that the quality of interpretation was influenced by several factors and was not necessarily linked to the use of symbols. Other factors included students' listening, language organization, and short-term memory skills. Note-taking was only an aid, the first factor in interpreting quality was understanding and comprehending the materials, which has been emphasized by Gillies (2017), stating it was much more common for student interpreters to not hear something than to not understand something. Symbols should not be used forcibly, but appropriately. It was clear that although not all students favored the use of symbols, its role was unanimously recognized. Therefore, teachers should continue contributing to imparting note-taking systems in the future. In the early stages of learning to interpret, teachers could introduce students to generic and basic symbols to support their interpretation. Additionally, teachers should also clarify the relative nature of symbols and not over-rely on them. In addition, as note-taking was distinctive and personal depending on individual preferences and choices, it should be seen as an aid rather than an authority for students.

5.3. Analysis of interpreting quality issues

The author categorized the problems affecting students' interpreting quality into two main categories: note-related and non-note-related. Combined with retrospective interviews, the five problems were identified in students' notes: missing key information, inconsistent abbreviations, unclear presentation of logical relationships, incomplete records of figures and their combination, and inadequate records of high-density information.

According to statistics on the frequency of problems in the six subjects' notes, the most frequent problems in the process of note-taking were inadequate records of high-density information and inconsistent abbreviations. This showed that students' scribbles could cause difficulties in recognition and that inappropriate use of notes could increase the load on short-term memory, thus affecting the quality of interpretation. As Orlando (2010) stated, certain note-taking practices could produce incomplete and ineffective notes, contributing to students' failure to record many important points in a speech or lecture. Therefore, students should either become proficient in some common symbols or get familiar with note-taking systems. In addition, students should focus on fast and logical note-taking to improve the speed of note-taking and ensure the recognition of handwriting.

In addition, the author found in the retrospective interviews that non-note-taking problems such as short-term memory failure, misheard vocabulary, and failure to understand the materials also occurred during the listening and interpreting process. In fact, the improvement of the quality of interpretation depended on the development of short-term memory, listening comprehension, and

vocabulary. Being proficient in short-term memory and listening comprehension was of paramount importance, which has been partially supported by Cerezo Herrero (2017), describing that teaching language comprehension in Translation and Interpreting programs should mainly aim to train students in oral comprehension for interpreting, becoming the basis for the training of interpreters.

There were some students who missed or misinterpreted words such as "register" and "海上" even though they were clearly recorded in their notes. This finding was in line with the findings from Mu and Lei (1998), observing that many students neglected to understand the source language when taking notes on interpretation and just kept writing, but ended up stammering when it was time to interpret. This showed that teachers need to think about how students could learn to take notes based on analysis and comprehension, rather than just writing down whatever they heard without thinking about it.

6. Conclusion

This paper selected materials from the interpreting practice of six graduate students majoring in translation and interpreting at a university in Northeast China and explored the relationship between students' note-taking and the quality of interpreting from three perspectives: the tendency of language choice, the influence of symbol use on interpreting quality, and the problems in note-taking. Drawing on previous research, the author summarized and classified different forms of note-taking, and used a mixed method with both qualitative and quantitative analysis. A retrospective interview was conducted with each subject after the interpretation was completed to ensure the scientific validity and enhance the persuasiveness of the empirical findings. Findings were as follows: first, students prefer to use English to take notes in English-to-Chinese consecutive interpreting, while Chinese is used more in Chinese-to-English consecutive interpreting; second, the number of symbols used is not related to the quality of interpreting; third, the following five problems are identified from the interview with student participants in students' notes: missing key information, inconsistent abbreviations, unclear logics, incomplete records of figures and the meaning of figures, and inadequate records of high-density information.

The shortcomings of the study were: first, the small sample size and the variability of each individual, which made the findings contingent and open to verification. Second, the empirical study was conducted with only six students, and although the subjects scored similarly, they differed in terms of ability. It was evident that each subject's short-term memory and listening comprehension varied in this research. For example, in one case, the interpreting quality remained high despite the small number of notes taken by the subject. This was due to the fact that the student had a high level of short-term memory and listening skills and could rely on memory to assist in the interpretation. Although this was an isolated case, it did affect the results to a certain extent. In addition, although the author marked 45 and 54 information units for the Chinese-to-English and English-to-Chinese materials respectively, there was no guarantee that the difficulty of each information unit would be exactly the same, and this difference in difficulty may also lead to errors in the results. Finally, the interpretation task was conducted in a faculty classroom rather than a real interpretation scene, and to

a certain extent, it lacked more professional equipment, environment, and the intense atmosphere of live interpretation.

In conclusion, although the results of this research were consistent with the author's initial ideas, there were still shortcomings in the research process. Future studies may consider expanding the sample size to include high-level student interpreters, and collecting and analyzing student interpreters' interpreting notes from their interpreting practice and even their actual work. It is sincerely hoped that in future studies, these issues can be properly addressed so that a more comprehensive understanding of the relationship between note-taking and interpreting quality can be achieved.

Data availability statement

The original contributions presented in the study are included in the article/[Supplementary material](#), further inquiries can be directed to the corresponding authors.

Ethics statement

Ethical approval was not required for the study involving human participants in accordance with the local legislation and institutional requirements. Written informed consent to participate in this study was not required from the participants in accordance with the national legislation and the institutional requirements. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

References

- Barik, H. C. (1994). A description of various types of omissions, additions and errors of translation encountered in simultaneous interpretation. *Bridging the gap: Empirical research in simultaneous interpretation*, 3, 121–137.
- Braun, V., and Clarke, V. (2006). Using thematic analysis in psychology. *Qual. Res. Psychol.* 3, 77–101.
- Cai, X. (2003). The information unit of interpretation quality assessment. *Foreign Lang.* 5, 75–80.
- Cardoen, H. (2013). *The effect of note-taking on target-text fluency*. eds. G. N. Gabriel, Y. Khaled and T. Voinova.
- Cerezo Herrero, E. (2017). A critical review of listening comprehension in interpreter training: the case of Spanish translation and interpreting degrees. *Porta Linguarum* 28, 7–22. doi: 10.30827/Digibug.54000
- Chen, S. (2017). Note-taking in consecutive interpreting: new data from pen recording. *Trans. Interpret.* 9, 4–23. doi: 10.12807/ti.109201.2017.a02
- Chen, S. (2022). The process and product of note-taking and consecutive interpreting: empirical data from professionals and students. *Perspectives* 30, 258–274. doi: 10.1080/0907676X.2021.1909626
- Chilingaryan, K., Gorbatenko, O., and Gorbatenko, R. (2016). Training court interpreters in Germany. In *Proceedings of ADVED 2016 2nd International Conference on Advances in Education and Social Sciences* (pp. 10–12).
- Dai, W., and Xu, H. (2007). An empirical study on the characteristics of interpreters' notes in the process of Chinese-English consecutive interpreting: a case study of professionally trained interpreters and non-professional interpreters. *For. Lang. Teach. Res.* 2, 136–144+161. doi: 10.3969/j.issn.1000-0429.2007.02.009
- Dam, H. V. (2004). Interpreters' notes: on the choice of language. *Interpreting* 6, 3–17. doi: 10.1075/intp.6.1.03dam
- Dam, H. V. (2007). "What makes interpreters' notes efficient? Features of (non-) efficiency in interpreters' notes for consecutive," in *Doubts and directions in translation studies*. eds. Y. Gambier, M. Shlesinger and R. Stolze.
- Dam, H. V. (2021). From controversy to complexity: replicating research and extending the evidence on language choice in note-taking for consecutive interpreting. *Interpreting* 23, 222–244. doi: 10.1075/intp.00062.dam
- Dam, H. V., Engberg, J., and Schjoldager, A. (2005). Modelling semantic networks on source and target texts in consecutive interpreting: A contribution to the study of interpreters' notes. *Knowledge systems and translation*, 7, 227–254.
- Gao, B. (2019). Developmental patterns of language choice in English-Chinese consecutive interpreting notes - a cross-sectional study based on interpreting learners. *Chin. Trans.* 1, 83–90. doi: CNKI:SUN:ZGFY.0.2019-01-010
- Gile, D. (1991). Prise de notes et attention en début d'apprentissage de l'interprétation consécutive—une expérience—démonstration de sensibilisation. *Meta* 36, 431–439.
- Gile, D. (1995/2009). *Basic concepts and models for interpreter and translator training*. Amsterdam/Philadelphia: John Benjamins Publishing Company.
- Gile, D. (2021). The effort models of interpreting as a didactic construct. *Adv. Cogn. Trans. Stud.* 139–160.
- Gile, D., and Chai, M. J. (2009). *Basic concepts and models for interpreter and translator training* 8). Amsterdam/Philadelphia: John Benjamins Publishing Company.
- Gillies, A. (2019). *Note-taking for consecutive interpreting: a short course*. Milton-Park: Taylor & Francis.
- González, M. A. (2012). The language of consecutive interpreters' notes: differences across levels of expertise. *Interpreting* 14, 55–72. doi: 10.1075/intp.14.1.03abu
- Gumul, E. (2018). Searching for evidence of Gile's effort models in retrospective protocols of trainee simultaneous interpreters. *Między oryginałem a przekładem* 24, 17–39. doi: 10.12797/MOaP.24.2018.42.02
- Hanusiak, D. (2021). The choice of language for note-taking for the purposes of consecutive interpreting: an English-polish case study. *Między Oryginałem a Przekładem* 27, 51–61. doi: 10.12797/MOaP.27.2021.54.03
- Jabaghyan, N. (2021). Memory and note-taking as key elements in consecutive interpretation. *Trans. Stud. Theory Pract.* 1, 101–108. doi: 10.46991/TSTP/2021.1.1.101
- Kurz, I. (1989). "Conference interpreting: User expectations," in *Coming of age: Proceedings of the 30th annual conference of the American Translators Association*. Medford, NJ: Learned Information, 143–148.
- Liu, J. (2010). Characteristics of English undergraduate students' Chinese-English interpreter notes and their relationship with interpretation performance: an empirical

Author contributions

YL contributed to data analysis and paper writing. WL contributed to the overall design and logic of the paper. XW was responsible for data collection. All authors contributed to the drafting and proofreading of the paper.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/feduc.2023.1157509/full#supplementary-material>

study based on students' interpreter notes. *For. Lang.* 2, 47–53. doi: CNKI:SUN:WYJY.0.2010-02-007

Liu, Q., and Xu, E. (2017). A study on the correlation between the number of English-Chinese consecutive interpreting notes and the quality of interpretation - an empirical study based on MTI students in a university in Shanghai. *Shanghai Trans.* 2, 69–73. doi: 10.3969/j.issn.1672-9358.2017.02.012

Man, D., Mo, A., Chau, M. H., O'Toole, J. M., and Lee, C. (2020). Translation technology adoption: evidence from a postgraduate programme for student translators in China. *Perspectives* 28, 253–270. doi: 10.1080/0907676X.2019.1677730

Marani, R., and Heidari Tabrizi, H. (2017). Professional interpreters' notes in Persian-English consecutive interpreting on the choice of form and language. *Res. Eng. Lang. Pedagog.* 5, 133–146.

Matyssek, H. (1989). *Handbuch der Notizentechnik für Dolmetscher*: I.

Maydosz, A., and Raver, S. A. (2010). Note-taking and university students with learning difficulties: what supports are needed? *J. Divers. High. Educ.* 3, 177–186. doi: 10.1037/a0020297

Mu, D., and Lei, R. (1998). A pilot study on comprehension and memory in interpreting note-taking training. *For. Lang. Teach.* 3, 82–84.

Orlando, M. (2010). *Digital pen technology and consecutive interpreting: another dimension in notetaking training and assessment* Melbourne: Monash University.

Orlando, M. (2014). A study on the amenability of digital pen technology in a hybrid mode of interpreting: consec-simul with notes. *Trans. Interp.* 6, 39–54. doi: 10.12807/ti.106202.2014.a03

Rozan, J.-F. (1956). *La prise de notes en interprétation consécutive*. Geneva, Switzerland: George & Cie S.A., Librairie de l'Université.

Shao, Z. (2013). Strategies to reduce the cognitive load of consecutive interpreters when interpreting. *Jiannan Literature (Classic Teaching Court)* 9, 248–250. doi: 10.3969/j.issn.1006-026X.2013.09.157

Sim, J., Saunders, B., Waterfield, J., and Kingstone, T. (2018). Can sample size in qualitative research be determined a priori? *Int. J. Soc. Res. Methodol.* 21, 619–634. doi: 10.1080/13645579.2018.1454643

Su, W. (2021). A study of scale-based assessment of interpretation at the undergraduate level. Beijing: Foreign Language Teaching and Research Press.

Szabó, C. (2006). Language choice in note-taking for consecutive interpreting. *Interpreting* 8, 129–147.

Viezzi, M. (1993). Written translation and simultaneous interpretation compared and contrasted: a case study.

Wang, J., and Guo, W. (2015). The correlation between interpretation notes perception and non-English majors' quality of delivery. *For. Lang. Teach.* 4, 68–74. doi: CNKI:SUN:WYJY.0.2015-04-012

Wang, X., Hu, Z., and Zou, Y. (2013). The influence of cognitive psychological factors on interpreting strategies: an empirical study of consecutive interpreting between professional and student interpreters. *For. Lang.* 1, 73–81. doi: CNKI:SUN:WYJY.0.2013-01-012

Wang, W., Zhou, D., and Wang, L. (2010). An empirical study on the characteristics of interpreting notes and the quality of interpreting. *For. Lang.* 4, 9–18. doi: CNKI:SUN:WYJY.0.2010-04-002

Wu, G., and Wang, K. (2009). Consecutive interpretation: a discourse approach. Towards a revision of Gile's effort model. *Meta: journal des traducteurs/Meta: Translators' Journal* 54, 401–416. doi: 10.7202/038305ar

Zhang, H., and Xu, J. (2009). *Modern psychological and educational statistics*. Beijing: Beijing Normal University Press.



OPEN ACCESS

EDITED BY

José Carlos Núñez,
University of Oviedo, Spain

REVIEWED BY

Kivanc Bozkus,
Artvin Çoruh University, Türkiye
Luis J. Martín-Antón,
University of Valladolid, Spain

*CORRESPONDENCE

J. C. Pinto

✉ joanacarneiropinto@ucp.pt

RECEIVED 13 March 2023

ACCEPTED 05 July 2023

PUBLISHED 19 July 2023

CITATION

Pinto JC and Costa-Ramalho S (2023) Effects of service-learning as opposed to traditional teaching-learning contexts: a pilot study with three different courses.
Front. Educ. 8:1185469.
doi: 10.3389/feduc.2023.1185469

COPYRIGHT

© 2023 Pinto and Costa-Ramalho. This is an open-access article distributed under the terms of the [Creative Commons Attribution License \(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

Effects of service-learning as opposed to traditional teaching-learning contexts: a pilot study with three different courses

J. C. Pinto* and Susana Costa-Ramalho

CRC-W - Católica Research Centre for Psychological, Family and Social Wellbeing, Universidade Católica Portuguesa, Lisbon, Portugal

Introduction: Service-Learning (SL) is an innovative teaching-learning proposal with an increasingly wide application in higher education. Previous studies show its potential to generate positive personal, academic, social and citizenship outcomes among students who participate in it. But studies that help understand in depth its real impact, particularly in comparison with more traditional teaching-learning contexts, are still scarce.

Method: This study explores the effects of Service-Learning on 122 university students, who were attending Psychology ($n = 80$), Social Work (SW; $n = 19$) and Applied Foreign Languages (AFL; $n = 23$) degree courses. These participants were organized into service-learning and traditional teaching-learning groups and assessed on expectations and impact of the service-experience, development of social and civic skills, and life goals.

Results: Results show significant differences between pre- and post-tests in life goals, namely an increase in hedonistic and wellbeing goals for Psychology students, political, hedonistic, religious, personal development, and wellbeing goals for SW students, and social and wellbeing goals for AFL students. Students in Psychology and AFL increased their expectations with the service and students in the AFL developed more pro-social behaviors.

Discussion: These results are encouraging for the expansion of this transformative teaching-learning practice to courses of different scientific areas, although with some specificities, with the purpose of contributing to a more responsible, critical and participatory society in the creation of the common good.

KEYWORDS

service-learning, traditional teaching-learning contexts, expectations and impact, social and civic skills, life goals

Introduction

Service-Learning (SL) is an experiential teaching-learning methodology that combines academic learning with community service (Celio et al., 2011) with the goal of enhancing learning, teaching civic responsibility, and strengthening communities (Fiske, 2001).

Previous studies, including very recent findings, have highlighted its relationship with several benefits for the participating students, including gains in these key domains (Celio et al., 2011; Salam et al., 2019; Folgueiras et al., 2020; Lin and Shek, 2021; McDougale and Li, 2023): attitudes toward self, school and learning, civic engagement, social skills such as teamwork and adaptation to new situations, academic performance, and life satisfaction. The SL experience seems to be associated with positive emotions such as interest, enthusiasm, inspiration, and

determination, which are maintained throughout the experience (Opazo et al., 2018). Other authors also highlight SL as a significant experience impacting participants' life goals by focusing on contributing to "the common good" (Opazo et al., 2018).

In addition to the students, who can benefit personally, socially, and academically, the SL programs have also shown (e.g., White, 2001; Conway et al., 2009) a positive influence on the community receiving the services and on the educational institution hosting the program. The use of this methodology is meaningful in a context where, particularly in the last two decades, there has been a growing emphasis on the transformation of higher education in Europe, with the promotion of an active and democratic citizenship through formal higher education being a primary concern (Ribeiro et al., 2021). SL has proven to be a powerful didactic methodology to achieve these ideals, becoming a widespread strategy in schools around the world, with an exponential growth of contributions over the last 20 years (Queiruga-Dios et al., 2021; Sotelino-Losada et al., 2021) as opposed to more traditional teaching-learning models (e.g., Opazo et al., 2018; Prado et al., 2020).

SL is based on the theoretical proposal of Dewey (1938), an American educator and philosopher who strongly influenced movements for the renewal of education in various parts of the world. His theory ("learning by doing") proposes that individuals reflect on and use prior knowledge from personal experiences to achieve authentic learning, leading to new ways of seeing education as an active connection between knowledge and experience through engagement and reflection on the world beyond the classroom. It proposes to increase students' understanding of the content learned and, at the same time, to promote the fulfilment of community needs (Salam et al., 2019), since – in Dewey's conception – the world constitutes an ever-changing reality, and it is only through action that it is possible to know it. It is therefore up to educational institutions to provide this action, suppressing the obstacles of the community as much as possible.

Thus, through SL, students find very specific opportunities to apply their knowledge and skills in projects developed outside the university setting that aim to benefit the community or a certain group of people with a specific need (Waldner et al., 2012). This experiential learning, potentially beneficial for all stakeholders (Henry and Breyfogle, 2006; Tijmsa et al., 2020), allows students to apply theoretical knowledge in a "real world" context, enhancing their understanding about theoretical concepts and promoting multiple skills and personal growth (Salam et al., 2019). In a very recent study, Lin et al. (2023) highlight the potential benefits of the SL experience even if conducted online (e.g., life satisfaction and leadership skills) and suggest the perceived benefits may vary for students depending on their psychosocial skills and learning experiences.

Following the first studies in our country (Veiga et al., 2021; Pais et al., 2022) seeking to understand the effect of the practice of SL experiences in Higher Education in Portugal, the present research aims to explore the effects of the use of this pedagogical model on students from a Portuguese university attending three different courses (Psychology, Social Work and Applied Foreign Languages) in the 2021–2022 academic year and organized into an experimental group (with SL experience) and a control group (without SL experience). Students were assessed at the beginning (February) and end (May) of the semester (pre-and post-test) on the following dimensions: expectations toward service-learning, perceived impact of the experience, development of civic and social skills, and life goals.

Research goals and hypotheses

The present study aims to evaluate the impact of the SL experience in three distinct courses, as opposed to traditional teaching-learning contexts. To achieve this goal, the following research hypotheses were developed:

H1: In each course, participants in both groups (experimental and control) show no differences at pre-test on the subscales regarding expectations and impact of the service-learning experience vs learning in course units, civic and social skills, and life goals.

H2: In each course, participants in both groups (experimental and control) show significant differences at post-test on the subscales regarding expectations and impact of the service-learning experience vs learning in course units, civic and social skills, and life goals. These differences are favorable to the experimental group.

H3: In each course, there are no significant differences from pre-to post-test in the control group on the subscales regarding expectations and impact of the service-learning vs learning experience in course units, civic and social skills, and life goals.

H4: In each course, there are significant differences from pre-to post-test in the experimental group on the subscales regarding expectations and impact of the service-learning vs learning experience in course units, civic and social skills, and life goals, with higher results at post-test.

H5: There are no significant differences between the three courses in the experimental group (SL) in the pre-test on the subscales related to expectations and impact of the service-learning vs learning experience in course units, civic and social skills, and life goals.

H6: There are no significant differences among the three courses in the experimental group (SL) in the post-test on the subscales in the variables related to expectations and impact of the service-learning vs. learning experience in course units, civic and social competencies, and life goals.

Methods

Participants

A total of 122 undergraduate students from the Faculty of Human Sciences at the Universidade Católica Portuguesa (UCP; Lisbon campus), enrolled in the academic year 2021/2022, participated in this study. These students were attending the Psychology degree in the 1st ($n=36$), 2nd ($n=20$) or 3rd ($n=24$) year of the course, the Social Work degree in the 1st ($n=7$), 2nd ($n=6$) or 3rd ($n=6$) year, and the Applied Foreign Languages (ALE) degree in the 1st ($n=9$), 2nd ($n=11$) or 3rd ($n=3$) year. In the control groups (CG) there was no previous contact of the students with the SL methodology. The experimental groups (EG) were attending for the first time a course unit using the SL methodology. Table 1 presents the characteristics of

the students comprising both the experimental and control groups per course.

reliabilities ranging from 0.68 to 0.84: economic, aesthetic, social, relationship, political, hedonistic, religious, personal development, and wellbeing.

Instruments

The research protocol consisted of a total of 4 separate sections:

- (i) Expectations regarding the learning-service experience: ten items, with a 5-point Likert response scale (1 = *Strongly Disagree* and 5 = *Strongly Agree*), that aim to assess the impact of the learning-service experience (or of the course units of that semester, in the case of the control group) on a set of knowledge, skills, abilities, and attitudes (e.g., *Be more responsible for my learning*). Exploratory factor analyses indicate that the items are grouped into two subscales: learning-related expectations and service-related expectations which explain 39% of the total variance. The assessment of internal consistency indicated a Cronbach's alpha of 0.71 for learning-related expectations and 0.86 for service-related expectations.
- (ii) Impact of the learning-service experience: ten items, with a 5-point Likert response scale, which intend to evaluate the perception of the impact that the learning-service experience had on oneself (student) and on others (e.g., *The service has contributed to better understand the contents of the curricular unit*) - completed only by the experimental groups at the post-test. The exploratory factor analysis indicated the existence of a single factor, which explains 48% of the total variance. The assessment of internal consistency indicated a Cronbach's alpha of 0.90.
- (iii) Civic and social skills: twenty items (CUCOCSA; Santos-Rego et al., 2021), with a 6-point Likert response scale (1 = *Strongly disagree* and 6 = *Strongly agree*), which aim to assess the extent to which the student considers having a set of competences (e.g., *I am able to work cooperatively with other people*). In the original version of the instrument the items are organized into four subscales that explain a variance of 50.96%: pro-social behavior ($\alpha = 0.79$), teamwork and relationships with others ($\alpha = 0.70$), intercultural competence ($\alpha = 0.73$), and leadership ($\alpha = 0.72$).
- (iv) Life goals: thirty-three items (Major Life Goals; Roberts and Robins, 2000), with a 5-point Likert response scale (1 = *Not at all important* and 5 = *Totally important*), which intend to assess to what extent a set of goals are valued by the student (e.g., *Make my parents proud*). The exploratory factor analysis performed at this sample indicated the existence of nine factors, which explain 54.75% of the total variance with alpha

Data collection procedure

The decision to include the Psychology, Social Work, and Applied Foreign Languages courses was based on the implementation of a phased and voluntary teaching methodology across multiple campuses, schools, study cycles, and courses at UCP. In the 2021/22 academic year, the only bachelor's degree in the Faculty of Human Sciences that did not incorporate this methodology was Social Communication. Therefore, we strongly believe that by including three distinct courses from diverse scientific fields (humanities, social services, and behavioral sciences), we can enrich the discussion on the impact of service-learning.

Students in the experimental groups were attending curricular units in the 2nd semester of the 2021/22 school year using the SL methodology, through which had the opportunity to learn and deepen some of the planned programmatic contents, while applying them by providing a service to the community.

In the Psychology course, the curricular unit was Educational Psychology, in which there was collaboration with a private organization that aims to achieve social action, health care, education and culture objectives, as well as the promotion of quality of life, particularly for people in situations of social and professional vulnerability. Students were integrated in the project "*Boost me up!: Promoting and supporting engagement, learning and wellbeing*," which consisted of preparing workshops on topics such as self-knowledge, exploring the world, developing social and emotional skills, and promoting wellbeing among the institution's users. The target-group was composed by students of alphabetisation, hairdressing, and elderly support courses. The university students were organized into six distinct groups, with each group being responsible for developing a workshop on one of the topics. Each workshop lasted 1 h and included a brief presentation followed by a set of dynamics/activities appropriate to the target-group. Two groups of students were also responsible for the organization of a visit to the university.

In the Social Work (SW), the project was developed in the course unit of Social Work and Social Administration. The main objectives included making a participatory organizational diagnosis and designing a strategic plan for sustainability, choosing a single axis of affirmative and participatory action, as a collaborative work between students and associative leaders/responsible of the services chosen as partners. The class was divided into four working groups

TABLE 1 Characterization of experimental and control groups, per course.

	Psychology course		Social work		Applied foreign languages	
	EG	CG	EG	CG	EG	CG
<i>n</i>	24 (3rd year)	56 (36 1st year +20 2nd year)	6	13 (7 1st year +6 2nd year)	9	14 (11 2nd year +3 3rd year)
Sex	83.3% female	85.7% female	100% female	84.6% female	83.3% female	88.2% female
Age	20.83 (SD = 0.817; Min-Max = 20–23)	20.38 (SD = 6.28; Min-Max = 18–58)	20.60 38 (SD = 0.894; Min-Max = 20–22)	19.92 38 (SD = 2.47; Min-Max = 18–27)	20.20 (SD = 1.30; Min-Max = 19–22)	20.18 (SD = 0.981; Min-Max = 20–22)

corresponding to each SL partner organization. The four NGOs selected were: (i) day care center with activities for adult people with physical or mental disabilities, whose focus of strategic intervention consisted in identifying partnerships for inclusion from the measure of socially useful activities; finding local companies and services to integrate these people in useful activities for their respective users; (ii) residential response institution as a measure of institutionalization for children and youth removed from their families, whose focus was to identify strategic partnerships for funding and sustainability of a day care project that can integrate children from the entire community including those flagged by the Court for the Protection of Children and Youth; (iii) senior academy - educational and socio-occupational forum for elderly men and women, in which students worked to enhance the knowledge of the elderly and intergenerational coexistence as a way to strengthen social ties between generations; and, (iv) socio-occupational forum for adults, men and women with mental illness, whose main action focused on analysing how art workshops can be shared with other groups in the community, bringing together people from inside and outside the institution.

In the Applied Foreign Languages (AFL), the *Translation for Equality and Inclusion* project was developed within the scope of the Generalist English Translation, a 1st year course. The partner was an association that aims at promoting equality of speech and inclusion practices. The intervention of the “translators” (students) would represent an added value for the dissemination of the association’s work across borders, spreading the support to the foreign community living in Portugal. The methodology consisted in dividing the students into teams, as if they were a translation agency. A project guide was made available to the students, with the designation of the teams and the division of tasks. Translation deadlines (English-Portuguese and Portuguese-English) and final revision were defined by each team. It would be the Team Leaders’ responsibility to deliver the final work to the professor. This work was essentially collaborative and took place outside the classroom and outside class time, providing students with a more practical context and approach close to their future professional reality.

Students in the control groups were attending course units scheduled for the 2nd semester of the 2021/22 school year, and none of them were using the SL methodology. Participants of all groups completed the pre-and post-test questionnaires in a classroom setting, in the presence of the researchers. The average completion time was 20 ± 15 min.

Data analyses procedure

Data were processed using IBM SPSS Statistics (version 23 for Windows) and Jamovi (version 2.3.18 for Windows). Descriptive statistical analyses which included measures of central tendency and measures of dispersion were performed. Additionally, inferential statistical analyses were conducted to examine differences between groups and evaluation times. U Mann-Whitney tests were used to compare the experimental and control groups of each course, while Wilcoxon tests were employed to analyze the pre-test and post-test variances. Kruskal-Wallis was used to analyze differences between the experimental and the control groups of all courses. The effect sizes of all the statistical analyses were also calculated, non-parametric tests were chosen due to the limited number of participants in the various

groups. Statistical significance was determined by a value of p of less than 0.05.

Results

Expectations of the service-learning experience

Regarding the Psychology course, results indicate there were no differences between pre-and post-test in both subscales for the experimental group. In the control group, there were differences between the two assessment moments in the *Learning-related expectations*, with a decrease in the results at post-test ($Z = -2.699$, $p = 0.007$; $r = 0.495$). In terms of comparison between the experimental and control groups, differences were found at pre-test, in the *Learning-related expectations* ($U = 443.500$, $p = 0.019$, $r = 0.328$) in favor of the control group, and in the *Service-related expectations* in favor of the experimental group ($U = 348.500$, $p = 0.006$, $r = 0.402$). Also at post-test, there were differences between groups in the *Service-related expectations* in favor of the experimental group ($U = 357.000$, $p = 0.005$, $r = 0.403$).

Regarding the Social Work course, in the experimental group, differences were found, in both variables, toward a decrease at post-test ($Z = -2.201$, $p = 0.031$, $r = 1.00$; $Z = -1.997$, $p = 0.046$, $r = 0.905$). In the control group, there were differences between the two assessment moments in the *Learning-related expectations*, with an increase at post-test ($Z = -2.441$, $p = 0.018$, $r = 0.944$). There were also differences between the experimental and control groups at post-test, in the *Learning-related expectations* ($U = 4.00$, $p = 0.003$, $r = 0.889$) in favor of the control group.

As for the Applied Foreign Languages course, in the experimental group, differences were found in the *Service-related expectations*, toward a decrease at post-test ($Z = -2.207$, $p = 0.036$; $r = 1.00$). In the control group, there were differences between the two moments in the *Service-related expectations*, representing a decrease at post-test ($Z = -2.955$, $p = 0.004$; $r = 1.00$). Differences between the experimental and control groups were registered both at pre-test ($U = 3.00$, $p < 0.001$, $r = 0.929$) and post-test ($U = 15.00$, $p = 0.021$, $r = 0.667$), but only in the variable *Service-related expectations*, and in favor of the experimental group (Table 2).

The comparison between the results of the three experimental groups (Psychology, Social Work, and Applied Foreign Languages) indicated that there were no statistically significant differences between groups at pre-test, either in the *Learning-related expectations* or *Service-related expectations*. There were statistically significant differences in the *Learning-related expectations* [$X^2(2) = 11.068$, $p = 0.004$, $\epsilon^2 = 0.316$] between Psychology and AFL and between SW and AFL at post-test, with worse results for AFL; but not in the *Service-related Expectations*.

Impact of the service-learning experience

The comparison between the results of the three experimental groups (Psychology, Social Work, and Applied Foreign Languages) indicated statistically significant differences between courses. Specifically, differences were found at: *the service performed*

TABLE 2 Service-learning experience vs. the experience in the different curricular units.

Course	Subscales	Experimental group (EG)			Control group (CG)			Differences pre-test – EG and CG	Differences post-test – EG and CG
		Pre-test Mean (SD; Mdn)	Post-test Mean (SD)	Differences pre and post-test	Pre-test Mean (SD)	Post-test Mean (SD)	Differences pre and post-test		
Psychology	Learning-related expectations	17.08 (2.08)	17.54 (1.96)	–1.132 (0.258)	18.22 (1.44)	17.29 (2.16)	–2.699 (0.007)	443.500 (0.019)	591.000 (0.709)
	Service-related expectations	27.68 (2.63)	25.23 (3.72)	–0.459 (0.647)	25.23 (3.72)	24.10 (4.30)	–1.343 (0.179)	348.500 (0.006)	357.000 (0.005)
Social work	Learning-related expectations	18.50 (0.138)	14.83 (2.04)	–2.201 (0.031)	17.33 (1.61)	18.75 (1.29)	–2.441 (0.018)	17.50 (0.069)	4.00 (0.003)
	Service-related expectations	27.67 (2.66)	21.33 (2.34)	–1.997 (0.046)	25.33 (5.18)	22.54 (2.53)	–1.573 (0.116)	27.50 (0.421)	28.00 (0.322)
Applied foreign languages	Learning-related expectations	18.17 (2.23)	19.17 (0.753)	–0.816 (0.414)	16.75 (1.57)	17.00 (3.01)	–0.032 (0.975)	24.00 (0.071)	27.50 (0.119)
	Service-related expectations	28.50 (1.97)	22.83 (1.47)	–2.207 (0.036)	23.93 (2.27)	19.53 (3.18)	–2.955 (0.004)	3.000 (<0.001)	15.00 (0.021)
Total	Learning-related expectations	17.5 (2.05)	17.36 (2.21)	–0.332 (0.740)	17.01 (1.59)	17.45 (2.30)	–1.143 (0.253)	1402.500 (0.589)	1384.500 (0.737)
	Service-related expectations	27.82 (2.48)	22.26 (2.16)	–4.900 (0.000)	25.01 (3.76)	20.51 (3.36)	–6.549 (<0.001)	723.500 (<0.001)	942.00 (0.005)

contributed to better understand the contents of the curricular unit [$X^2(2) = 7.104, p = 0.029, \epsilon^2 = 0.209$] between Psychology and Social Work and between Languages and Social Work, and *To what extent did your life purpose change as a result of the Service-Learning experience?* [$X^2(2) = 6.540, p = 0.038, \epsilon^2 = 0.187$] between Languages and Social Work, with results always more favorable for the AFL course (Table 3).

Civic and social skills

Regarding the Psychology course, no statistically significant differences were found relating to civic and social skills, both in intra and inter-group comparisons.

As for the Social Work course, there was a statistically significant difference in the *Leadership* subscale in the experimental group, with a decrease in the results at post-test ($Z = -2.060, p = 0.039; r = 0.100$).

And finally, in the Applied Foreign Languages course, there was a statistically significant difference in the post-test between the experimental group and the control group in the subscale *Pro-Social Behavior* ($U = 20.000, p = 0.040, r = 1.00$), in favor of the experimental group (Table 4).

The comparison between the results of the three experimental groups (Psychology, Social Work, and Applied Foreign Languages) indicated that there were no statistically significant differences between them in social and civic skills, considering both the pre-and the post-test.

Life goals

Regarding the Psychology course, the experimental group showed statistically significant differences between pre-and post-tests in the *religious goals*, toward an increase ($Z = -2.496, p = 0.013; r = 0.660$). In the control group, there were differences between the two assessment moments in six of the nine subscales (*relationship, political, religious, personal development, and wellbeing goals*). The differences in the *relationship* ($Z = -3.347, p = 0.001, r = 0.497$), *hedonistic* ($Z = -5.207, p < 0.001; r = 0.818$), *personal development* ($Z = -4.103, p < 0.001; r = 0.720$), and *wellbeing goals* ($Z = -4.120, p < 0.001; r = 0.772$) were toward a decrease, while the differences in *political goals* ($Z = -5.637, p < 0.001, r = 0.922$), and *religious goals* ($Z = -4.103, p < 0.001, r = 0.667$) were toward an increase. As for the differences between groups, in the pre-test there were two differences in favor of the control group, in *social goals* ($U = 449.500, p = 0.018, r = 0.331$) and *religious goals* ($U = 450.500, p = 0.019, r = 0.330$). At post-test there were differences on four subscales, two in favor of the control group - *political goals* ($U = 273.500, p < 0.001, r = 0.586$) and *religious goals* ($U = 355.500, p = 0.001, r = 0.461$) and two in favor of the experimental group - *hedonistic goals* ($U = 152.000, p < 0.001, r = 0.749$) and *wellbeing goals* ($U = 441.000, p = 0.015, r = 0.332$).

The Social Work course showed no statistically significant differences between pre-and post-tests in the experimental group. It does, however, revealed statistically significant differences in the *political goals* ($Z = -2.590, p = 0.10, r = 0.879$) of the control group, with

TABLE 3 Impact of the service-learning experience.

Item/course	Applied foreign languages M (SD)	Psychology M (SD)	Social work M (SD)	Differences between courses (df = 2)
The contents of the course unit were useful for the service performed	4.00 (0.632)	3.75 (0.737)	3.00 (0.632)	5.992 (0.050)
The service has contributed to better understand the contents of the curricular unit	4.00 (0.000)	3.78 (0.850)	2.83 (0.753)	7.104 (0.029)
The service is useful for my academic path	4.50 (0.548)	4.08 (0.830)	3.67 (0.516)	4.087 (0.130)
The service-learning experience contributed to my development as a person	4.17 (0.753)	3.96 (0.859)	3.33 (0.516)	3.622 (0.163)
The service-learning experience contributed to my development as a citizen	3.83 (0.408)	3.92 (0.717)	3.50 (0.548)	1.858 (0.395)
The service-learning experience contributed to my development as a future professional	4.33 (0.516)	4.08 (0.654)	3.50 (0.837)	4.639 (0.098)
To what extent has your life purpose changed as a result of the service-learning experience?	3.67 (0.516)	2.62 (1.013)	2.33 (1.211)	6.540 (0.038)
To what extent is the service you performed relates to your life purpose?	4.00 (0.000)	3.17 (1.090)	3.17 (1.211)	5.257 (0.072)
To what extent do you consider that being involved in activities to help others is part of your identity?	4.00 (0.632)	3.62 (0.924)	3.17 (0.983)	2.235 (0.327)
To what extent do you think your service in this course unit has helped others?	3.67 (0.516)	3.75 (0.794)	3.33 (0.516)	1.847 (0.397)

an increase at post-test. As for differences between groups, these were verified at post-test in *political* ($U=9.000$, $p=0.008$, $r=0.769$), *hedonistic* ($U=8.500$, $p=0.011$, $r=0.764$), *personal development* ($U=12.000$, $p=0.019$, $r=0.692$) and *wellbeing goals* ($U=13.000$, $p=0.019$, $r=0.667$), always in favor of the experimental group.

Finally, the Applied Foreign Languages course showed no statistically significant differences between pre-and post-test in the experimental group. It does, however, indicated statistically significant differences in *political* ($Z=-2.373$, $p=0.018$, $r=0.714$), *hedonistic* ($Z=-2.996$, $p=0.003$, $r=0.934$) and *wellbeing goals* ($Z=-2.362$, $p=0.018$, $r=0.736$), in the control group, with only the former increasing at post-test. As for the differences between groups, there are no differences at pre-test, and statistically significant differences at post-test were found only in *social goals* ($U=19.00$, $p=0.045$, $r=0.578$), in favor of the control group (Table 5).

The comparison between the results of the three experimental groups (Psychology, Social Work, and Applied Foreign Languages) indicated the existence of statistically significant differences between courses in *aesthetic* [$X^2(2)=9.276$, $p=0.010$, $\epsilon^2=0.265$] between the AFL and Psychology groups and *religious goals* [$X^2(2)=8.146$, $p=0.017$, $\epsilon^2=0.233$] between the AFL and Psychology; Social Work and Psychology groups at pre-test. At post-test, there were only differences between courses in *social goals* [$X^2(2)=5.992$, $p=0.050$, $\epsilon^2=0.176$] between AFL and Social Work.

Discussion and conclusion

The aim of this study was to explore the impact of using the Experiential Service-Learning (SL) pedagogical model versus traditional teaching-learning on students from a Portuguese university, attending three different courses.

As relevant results we highlight the increase in the *service-related expectations* of the Psychology students who participated in the SL experience, but not for the other two courses, which is partially in line with the conclusions of previous studies (e.g., Mosakowski et al., 2013; Winans-Solis, 2014) that show positive expectations and perceptions about the participation in SL. Although caution should be taken when interpreting inferential analyses with data obtained from each item independently, as was the case, we highlight the apparent impact of the SL experience on students, namely the recognition of the usefulness of the curricular contents for the service performance in the AFL students, the usefulness of the service for the understanding of the curricular unit contents in Psychology and AFL students, and the change in life purpose of the AFL students. In line with what was recently highlighted by Pais et al. (2022), it also emerges from our study that the contact with practical and real contexts of intervention enabled by the SL experiences gives meaning to the academic knowledge and skills they acquire throughout their training and allows them - ultimately - to understand how they can develop their professional activity in the real world. It is, therefore, suggested that the SL experience, by combining theory with practice, enables students to mobilize skills such as critical thinking, adaptability, and flexibility to articulate different knowledge and perspectives, which is also associated with the benefits and knowledge arising from an experience of “service to others” which would not otherwise take place.

In the meantime, the increase in pro-social behavior in the AFL students after conducting the SL experience is noteworthy. Previous studies (e.g., Smith, 2008) highlight how this experiential approach provides opportunities for participants to develop important relationships with others, whom they help meet needs while developing an “ethics of care” oriented toward social good and strengthening civic engagement (Chiva-Bartoll et al., 2021; Ribeiro et al., 2021). By observing the increase of pro-social behaviors only in

TABLE 4 Civic and social skills.

Course	Subscales	Experimental group (EG)		Differences pre and post-test	Control group (CG)		Differences pre and post-test	Differences pre-test – EG and CG	Differences post-test – EG and CG
		Pre-test Mean (SD)	Post-test Mean (SD)		Pre-test Mean (SD)	Post-test Mean (SD)			
Psychology	Pro-social behavior	36.33 (2.91)	36.59 (3.42)	−0.348 (0.178)	37.35 (2.70)	37.25 (2.58)	−0.300 (0.764)	498.000 (0.080)	538.500 (0.600)
	Teamwork and relationship with others	13.00 (1.32)	13.13 (1.36)	−0.539 (0.590)	13.41 (1.33)	13.51 (1.26)	−0.250 (0.803)	544.000 (0.168)	560.000 (0.274)
	Intercultural competence	13.00 (1.84)	13.42 (1.18)	−1.195 (0.232)	13.15 (1.54)	13.17 (1.53)	−0.250 (0.803)	653.500 (0.943)	609.500 (0.668)
	Leadership	23.75 (3.31)	24.04 (2.73)	−0.650 (0.516)	23.47 (3.20)	24.15 (2.90)	−1.152 (0.249)	609.000 (0.585)	641.000 (0.939)
Social work	Pro-social behavior	37.83 (1.47)	37.40 (1.67)	−0.184 (0.854)	36.92 (3.23)	35.38 (3.36)	−1.424 (0.154)	37.500 (0.898)	21.000 (0.289)
	Teamwork and relationship with others	13.83 (0.753)	13.67 (1.03)	−0.276 (0.783)	13.92 (1.32)	13.46 (1.20)	−1.222 (0.222)	32.500 (0.579)	35.500 (0.765)
	Intercultural competence	13.33 (1.51)	13.50 (1.38)	−1.000 (0.317)	13.69 (1.38)	13.85 (1.57)	−0.256 (0.798)	33.500 (0.639)	29.000 (0.416)
	Leadership	25.00 (4.00)	22.67 (3.39)	−2.060 (0.039)	24.85 (3.16)	24.46 (3.91)	−0.239 (0.811)	31.000 (0.924)	30.500 (0.467)
Applied foreign languages	Pro-social behavior	37.83 (2.14)	37.83 (3.13)	0.000 (1.000)	35.35 (3.90)	33.56 (4.87)	−1.848 (0.065)	29.500 (0.135)	20.000 (0.040)
	Teamwork and relationship with others	13.33 (1.03)	13.50 (1.38)	−0.184 (0.854)	12.76 (1.82)	12.19 (2.01)	−1.033 (3.01)	44.000 (0.658)	30.000 (0.203)
	Intercultural competence	14.00 (1.26)	13.17 (1.70)	−1.633 (0.102)	12.88 (1.83)	12.31 (1.81)	−1.208 (0.227)	33.000 (0.227)	35.000 (0.367)
	Leadership	23.33 (3.72)	23.67 (3.01)	−0.365 (0.715)	23.41 (2.90)	22.31 (3.73)	−0.552 (0.581)	45.500 (0.708)	40.500 (0.590)
Total	Pro-social behavior	36.83 (2.66)	36.94 (3.13)	−1.013 (0.311)	36.88 (3.11)	36.23 (3.54)	−1.788 (0.074)	1433.500 (0.580)	1193.000 (0.318)
	Teamwork and relationship with others	13.19 (1.21)	13.28 (1.30)	−0.349 (0.727)	13.36 (1.46)	13.25 (1.50)	−0.767 (0.443)	1382.000 (0.339)	1492.000 (0.906)
	Intercultural competence	13.22 (1.71)	13.39 (1.18)	−0.582 (0.561)	13.17 (1.58)	13.11 (1.64)	−0.386 (0.699)	1471.000 (0.732)	1415.000 (0.639)
	Leadership	23.86 (3.41)	23.75 (2.84)	0.000 (1.000)	23.67 (3.14)	23.84 (3.29)	−0.601 (0.548)	1400.000 (0.611)	1488.500 (0.974)

AFL students, we hypothesize that students in Psychology and Social Work courses would already be – by the nature of their chosen courses - more oriented towards an altruistic vision and action, admitting a “ceiling effect” that constrains the existence of significant increases at this level.

Regarding life goals, there was an increase in religious goals among Psychology students after the SL experiment, but also in the control group, in this case together with political goals. In the case of Social Work students, it is interesting to note that the experimental group stands out for the increase - compared to the control group - of

political, hedonistic, personal development, and wellbeing goals. In the case of AFL students, the increase in relationship, hedonic, personal development, and wellbeing goals is highlighted, with significant increases in the experimental group but not in the control group. Comparing the three courses, after the SL experience, only differences in social goals are evident, namely between AFL and Social Work.

In summary, the previously hypotheses were only partially confirmed, that is, (i) in each course, participants in both groups (experimental and control) showed differences at pre-test (H1) and post-test (H2) in the subscales related to expectations of the

service-learning experience vs. learning in the course units and life goals, but not in the civic and social competences, and these differences were not always in favor of the experimental group, as initially predicted; (ii) in each course, contrary to what was predicted (H3), there were statistically significant differences from pre-to post-test in the control group, in the variables

Learning-related expectations and life goals (and in *civic and social skills* but only for the AFL course); these differences showed an increase or decrease depending on the variables under analysis; (iii) in the Psychology course there were no differences from pre to post-test in the experimental group on the variables relating to the *learning-service expectations* and *civic and social skills*, but there

TABLE 5 Life goals.

Course	Subscales	Experimental group (EG)		Differences pre and post-test	Control group (CG)		Differences pre and post-test	Differences pre-test – EG and CG	Differences post-test – EG and CG
		Pre-test Mean (SD)	Post-test Mean (SD)		Pre-test Mean (SD)	Post-test Mean (SD)			
Psychology	Economic goals	25.13 (3.98)	26.00 (3.41)	–1.501 (0.133)	23.86 (3.46)	24.78 (4.07)	–1.783 (0.075)	582.500 (0.345)	499.000 (0.142)
	Aesthetic goals	7.58 (2.17)	7.92 (3.13)	–0.410 (0.682)	8.77 (2.70)	8.75 (2.30)	–0.017 (0.987)	491.500 (0.056)	537.000 (0.185)
	Social goals	11.63 (1.95)	11.87 (1.94)	–0.689 (0.491)	12.80 (1.70)	12.78 (1.70)	–0.007 (0.994)	449.500 (0.018)	464.000 (0.061)
	Relationship goals	16.87 (2.40)	17.35 (2.03)	–1.093 (0.274)	17.00 (1.78)	16.09 (1.96)	–3.347 (0.001)	598.500 (0.434)	447.500 (0.089)
	Political goals	9.71 (3.17)	10.33 (2.66)	–1.361 (0.173)	9.91 (2.20)	12.98 (1.83)	–5.637 (<0.001)	620.500 (0.586)	273.500 (<0.001)
	Hedonistic goals	12.88 (1.70)	12.90 (1.57)	–0.448 (0.654)	12.59 (2.07)	10.25 (1.60)	–5.207 (<0.001)	650.000 (0.814)	152.000 (<0.001)
	Religious goals	4.58 (2.22)	5.25 (2.45)	–2.496 (0.013)	5.75 (2.14)	7.07 (1.57)	–4.142 (<0.001)	450.500 (0.019)	355.500 (0.001)
	Personal development goals	18.25 (1.48)	17.91 (1.95)	–0.730 (0.465)	18.64 (1.34)	17.41 (1.65)	–4.103 (<0.001)	564.000 (0.242)	500.500 (0.142)
	Wellbeing goals	9.29 (0.999)	9.13 (1.12)	–0.884 (0.377)	9.38 (0.799)	8.53 (1.10)	–4.120 (<0.001)	672.000 (1.000)	441.000 (0.015)
Social work	Economic goals	27.00 (3.29)	26.17 (3.06)	–0.921 (0.357)	26.92 (4.82)	30.00 (4.24)	–1.964 (0.050)	38.500 (0.966)	17.500 (0.058)
	Aesthetic goals	10.00 (3.52)	8.67 (2.88)	–1.633 (0.102)	9.08 (1.85)	9.38 (1.89)	–0.498 (0.618)	25.500 (0.244)	34.500 (0.701)
	Social goals	13.17 (1.47)	13.17 (1.47)	0.000 (1.000)	13.38 (1.71)	12.69 (1.93)	–1.189 (0.235)	33.500 (0.639)	34.500 (0.701)
	Relationship goals	22.83 (1.83)	22.83 (1.72)	0.000 (1.000)	22.31 (3.12)	21.31 (2.18)	–1.793 (0.073)	37.000 (0.898)	25.500 (0.244)
	Political goals	11.00 (1.79)	11.33 (1.37)	–0.408 (0.683)	11.15 (1.68)	13.62 (1.33)	–2.590 (0.010)	35.500 (0.765)	9.000 (0.007)
	Hedonistic goals	13.00 (1.90)	13.50 (1.05)	–1.143 (0.257)	12.46 (1.90)	11.08 (1.83)	–1.661 (0.097)	33.500 (0.639)	8.500 (0.011)
	Religious goals	7.00 (2.00)	6.83 (2.04)	–0.378 (0.705)	7.08 (2.36)	7.04 (1.38)	–0.438 (0.661)	37.500 (0.898)	32.500 (0.579)
	Personal development goals	18.33 (1.51)	18.83 (0.983)	–0.736 (0.461)	18.08 (2.29)	16.69 (1.80)	–1.855 (0.064)	38.500 (0.966)	12.000 (0.019)
	Wellbeing goals	9.67 (0.516)	9.67 (0.516)	0.000 (1.000)	8.85 (1.28)	8.62 (0.870)	–0.776 (0.438)	25.000 (0.244)	13.000 (0.019)

(Continued)

TABLE 5 (Continued)

Course	Subscales	Experimental group (EG)		Differences pre and post-test	Control group (CG)		Differences pre and post-test	Differences pre-test – EG and CG	Differences post-test – EG and CG
		Pre-test Mean (SD)	Post-test Mean (SD)		Pre-test Mean (SD)	Post-test Mean (SD)			
Applied foreign languages	Economic goals	29.33 (0.437)	29.00 (2.76)	−0.425 (0.671)	28.35 (4.39)	29.67 (3.44)	−1.070 (0.285)	41.000 (0.516)	40.500 (0.733)
	Aesthetic goals	10.17 (0.408)	9.67 (1.97)	−0.680 (0.496)	9.53 (2.58)	10.67 (2.19)	−1.443 (0.149)	46.500 (0.759)	32.00 (0.340)
	Social goals	11.00 (2.37)	19.83 (0.752)	−0.322 (0.748)	11.71 (1.69)	12.07 (1.49)	−1.029 (0.304)	42.000 (0.562)	19.000 (0.045)
	Relationship goals	21.33 (2.66)	20.67 (2.58)	−1.633 (0.102)	19.29 (2.39)	19.13 (3.25)	−0.458 (0.647)	27.000 (0.101)	33.500 (0.381)
	Political goals	10.87 (2.33)	10.33 (1.97)	−0.108 (0.914)	9.76 (1.89)	11.67 (1.76)	−2.373 (0.018)	41.500 (0.516)	29.500 (0.231)
	Hedonistic goals	11.67 (1.51)	12.17 (2.32)	−0.828 (0.408)	12.24 (1.86)	10.53 (1.68)	−2.996 (0.003)	40.500 (0.473)	20.500 (0.055)
	Religious goals	6.33 (1.37)	6.33 (1.37)	0.000 (1.000)	6.19 (2.58)	7.33 (1.54)	−1.083 (0.279)	44.000 (0.802)	29.00 (0.235)
	Personal development goals	17.00 (2.37)	17.33 (1.51)	−0.412 (0.680)	16.82 (2.58)	16.67 (1.99)	−0.515 (0.606)	50.500 (0.973)	39.000 (0.677)
	Wellbeing goals	9.50 (0.837)	9.67 (0.516)	−1.000 (0.317)	9.06 (1.34)	7.60 (1.59)	−2.362 (0.018)	43.000 (0.609)	10.000 (0.005)
Total	Economic goals	28.36 (4.05)	28.76 (3.34)	−0.785 (0.432)	27.15 (0.401)	28.85 (4.10)	−3.240 (0.001)	1319.000 (0.197)	1386.000 (0.961)
	Aesthetic goals	8.42 (2.52)	8.33 (2.94)	−0.616 (0.538)	8.97 (2.56)	9.19 (2.32)	−0.837 (0.403)	1370.000 (0.314)	1220.500 (0.110)
	Social goals	11.78 (2.01)	11.91 (1.82)	−0.378 (0.706)	12.67 (1.76)	12.64 (1.70)	−0.127 (0.899)	1169.000 (0.031)	1112.000 (0.042)
	Relationship goals	21.42 (2.61)	21.41 (2.05)	−0.769 (0.442)	21.19 (2.66)	20.20 (2.56)	−3.363 (0.001)	1496.000 (0.769)	1024.500 (0.024)
	Political goals	10.08 (2.85)	10.50 (2.37)	−1.183 (0.237)	10.07 (2.10)	12.84 (1.83)	−6.669 (<0.001)	1532.500 (0.930)	665.000 (<0.001)
	Hedonistic goals	12.69 (1.72)	12.88 (1.64)	−1.093 (0.274)	12.50 (1.99)	10.43 (1.66)	−6.108 (<0.001)	1523.500 (0.889)	411.000 (<0.001)
	Religious goals	5.28 (2.26)	5.69 (2.29)	−2.048 (0.041)	6.04 (2.19)	7.16 (1.53)	−4.196 (<0.001)	1226.000 (0.082)	905.500 (<0.001)
	Personal development goals	18.06 (1.67)	17.97 (1.77)	−0.108 (0.014)	18.20 (1.91)	17.17 (1.75)	−4.148 (<0.001)	1409.500 (0.426)	1043.500 (0.014)
	Wellbeing goals	9.39 (0.903)	9.31 (0.980)	−0.607 (0.544)	9.23 (1.01)	8.37 (1.22)	−4.632 (<0.001)	1415.000 (0.408)	789.500 (<0.001)

were for *life goals*; on the opposite, in the Social Work and AFL courses, there were differences from pre to post-test in the experimental group on the *service-related expectations* and on the *civic and social skills*, but not on *life goals*. Moreover, these differences were not always in the direction of higher results at post-test (H4); and finally, the three courses in the experimental group (SL) did not show, at pre-test, differences with the

service-learning expectations, nor in *civic and social skills*, as anticipated, but did showed differences in *life goals* (H5); and, as for the post-test, there were differences between the three courses (H6) in terms of the *service-learning expectations* (with more favorable results for Psychology and SW), the *impact of the service-learning experience* (with more favorable results for AFL students), and the *life goals* (with more favorable results for SW and AFL).

Thus, overall, the SL experience seems to have an effective impact on many students, catalyzing their learning processes and psychological development, expressed for example in their life goals, as evidenced also in previous studies (e.g., [Conway et al., 2009](#)). Furthermore, the apparent effect of SL on students' engagement with social issues, examples of which include pro-social conduct, social and political goals, point – as in previous studies (e.g., [Opazo et al., 2018](#)) – to a potential development of awareness of their agency in transforming social inequalities. The focus on social and political goals leads us to consider that students critically go further when they reflect on the social realities they face, empowering them to develop a sense of mission and active citizenship. Being part of an SL experience seems, in some way, and as also pointed out by previous authors (e.g., [Pais et al., 2022](#)), to predispose students to reflect on the impact that their actions can have on the populations they serve, particularly when the objective is to empower people. In other studies (e.g., [Billig et al., 2005](#); [McIlrath et al., 2019](#)), students participating in SL experiences have demonstrated more internalized moral standards, sensitivity to their communities and their needs, and stronger beliefs that one can make a difference in the world. From [Reinders and Yourniss' \(2009\)](#) longitudinal study examining elements of SL activities and how students experienced or interpreted them, it is evident that – over time – having direct interactions with people in need increases their perception of being helpful to others which, in turn, leads to greater civic engagement.

Although the results have been less consistent than expected, they support the use of the SL methodology and are in line with what is proposed in the [Declaración de Bolonia \(1999\)](#), emphasizing that higher education institutions should train professionally competent and socially responsible citizens, critical of injustice and communally participative, in order to contribute to the improvement of society, disadvantaged people and groups, and the environment.

Limitations and future research

The results of this study, although very exploratory, can be used to guide decisions around curriculum development and implementation of SL projects but should be interpreted in light of important limitations. First, while relying on a longitudinal design and comparison with control groups, the study used convenience sampling, the number of participants should have been higher and similar for the different groups, response rates were low (compared to the total number of students) and, the SL methodology was applied in two courses to 3rd year students and on the other course to 1st year students. In addition, other factors such as time/maturation and other courses the students were taking at the same time could have accounted for some differences between the first and second assessment moments (which may even account for some differences found between pre and post-tests in the control groups).

Second, all assessments were based on students' self-reports, so the relationships between variables should be considered sparingly. It would be interesting to be able to rely on the evaluation of others (e.g., professors, peers) about the changes related to the experience. Furthermore, it is unknown how long the positive changes will persist, since only two moments (i.e., pre and post-test) were evaluated.

The time elapsed between the pre-test and post-test moments (February and May) may also be a determining factor for the results obtained. Several authors (e.g., [McLeod, 2003](#)) have discussed the “ideal time” that should separate these two assessment moments to

capture the true change caused by the intervention and not the impact of other factors such as memory, maturation, or life experiences.

Despite the limitations mentioned above, this study suggests that SL can serve as an effective educational approach to strengthen diverse student competencies, promoting – in academic terms – a more holistic pedagogy that favors the integral development of the participants, while allowing the university to go beyond its walls.

Practical implications

Despite its limitations, our study holds significant practical and intervention-related implications that are highly relevant to educators and those involved in shaping curricular possibilities in higher education. By providing empirical evidence, our study confirms the benefits of Service-Learning (SL) methodology in higher education. Our findings reinforce that the implementation of SL in higher education offers a compelling model for integrating academic learning with community service. In the current landscape of global educational trends, universities are uniquely positioned to address the needs of students and society. They bear the responsibility of preparing citizens who can drive change, engage in social and political action, and carry academic knowledge. Their mission and resources allow them to cultivate future leaders who can navigate the complexities and diversities of the twenty-first century, fostering the conditions for the development of well-informed and responsible individuals.

Understanding these processes can inform the development of interventions that support and enhance the natural growth of wellbeing or disrupt negative trends. Although the studies concerning SL do not provide definitive answers, they do provide valuable insights into potential possibilities. For instance, [Martin and Kilgo \(2015\)](#) discovered that being part of a “structured learning community,” where coursework is completed with a consistent group of students, predicted wellbeing over both one-and four-year periods. Additionally, also important, academic achievement and wellbeing may have a reciprocal causal relationship ([du Toit et al., 2022](#)).

Also, educators and institutions interested in implementing SL programs, should consider that, when engaged in service activities, students actively sought to establish a meaningful connection between their classroom learning and its practical application in the real world ([Li et al., 2016](#)). The improvements in their learning outcomes provided positive reinforcement, allowing students to recognize the value of their education. Concurrently, students gradually became aware that their strengths and efforts made a difference and brought value to those they served ([Pinto and Costa-Ramvalho, 2022](#)). This perceived value, both for themselves and the recipients of their service, played a crucial role in shaping the meaning they derived from their service-learning experiences. Students began to view service tasks as significant and worthwhile endeavors, dedicating themselves wholeheartedly to such activities. In essence, acts of charity and academic achievements both contribute to students' construction of meaning regarding service-learning, expanding their perceived value to encompass not only their academic gains but also the well-being of others.

From our practical work, extensive literature review and the results of this study, we can thus suggest some good SL practices: (a) learning and service goals should be intertwined and unified; (b) student assignments, classroom activities and assessment are purposefully structured to align and complement the experiences in the community; (c) the community partnership is characterized by

continuous collaboration, starting from the initial planning stages until the project's completion; (d) the experience is integrative, fostering connections between students' in-class and out-of-class activities, and encouraging the integration of diverse perspectives and knowledge from all participants; and, (e) the pedagogy is intentionally crafted to be adaptable, allowing for dynamic situations and responsiveness to the capacity-building needs and opportunities of all individuals involved.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by the Católica Research Centre for Psychological, Family and Social Wellbeing (CRC-W). The patients/participants provided their written informed consent to participate in this study.

References

- Billig, S. H., Root, S., and Jesse, D. (2005). "The relationship between the quality indicators of service-learning and student outcomes" *Improving service-learning practice: Research on models to enhance impacts*, 97–115.
- Celio, C. I., Durlak, J., and Dymnicki, A. (2011). A meta-analysis of the impact of service-learning on students. *J. Exp. Educ.* 34, 164–181. doi: 10.1177/105382591103400205
- Chiva-Bartoll, O., Ruiz-Montero, P. J., Olivencia, J. J. L., and Grönlund, H. (2021). The effects of service-learning on physical education teacher education: a case study on the border between Africa and Europe. *Eur. Phys. Educ. Rev.* 27, 1014–1031. doi: 10.1080/07294360.2020.1756748
- Conway, J. M., Amel, E. L., and Gerwien, D. P. (2009). Teaching and learning in the social context: a meta-analysis of service learning's effects on academic, personal, social, and citizenship outcomes. *Teach. Psychol.* 36, 233–245. doi: 10.1080/00986280903172969
- Declaración de Bolonia (1999). *Declaración conjunta de los Ministros Europeos de Educación [joint declaration of the European ministers of education]*. Available at: <https://www.educacionyfp.gob.es/dctm/boloniaeees/documentos/02que/declaracionbolonia.pdf?documentId=0901e72b8004aa6a>
- Dewey, J. (1938). *Experience and education*. New York: Macmillan.
- du Toit, A., Thomson, R., and Page, A. (2022). A systematic review and meta-analysis of longitudinal studies of the antecedents and consequences of wellbeing among university students. *Int. J. Wellbeing* 12, 163–206. doi: 10.5502/ijw.v12i2.1897
- Felten, P., and Clayton, P. H. (2011). Service-learning. *New Dir. Teach. Learn.* 2011, 75–84. doi: 10.1002/tl.470
- Fiske, E. B. (2001). *Learning in deed: the power of service-learning for American schools*. Ohio State Univ: Columbus. W.K. Kellogg Foundation.
- Folgueiras, P., Aramburuzabala, P., Opazo, H., Mugarra, A., and Ruiz, A. (2020). Service-learning: a survey of experiences in Spain. *Educ. Citizen. Soci. Justice* 15, 162–180. doi: 10.1177/1746197918803857
- Henry, S. E., and Breyfogle, M. L. (2006). Toward a new framework of "server" and "served": De (and re) constructing reciprocity in service-learning pedagogy. *Int. J. Teach. Learn. High. Educ.* 18, 27–35.
- Li, Y., Guo, F., Yao, M., Wang, C., and Yan, W. (2016). The role of subjective task value in service-learning engagement among Chinese college students. *Front. Psychol.* 7:954. doi: 10.3389/fpsyg.2016.00954
- Lin, L., and Shek, D. T. (2021). Serving children and adolescents in need during the covid-19 pandemic: evaluation of service-learning subjects with and without face-to-face interaction. *Int. J. Environ. Res. Public Health* 18:2114. doi: 10.3390/ijerph18042114
- Lin, L., Shek, D. T., and Li, X. (2023). Who benefits and appreciates more? An evaluation of Online Service-Learning Projects in Mainland China during the COVID-19 pandemic. *Appl. Res. Qual. Life* 18:625–646. doi: 10.1007/s11482-022-10081-9
- Martin, G. L., and Kilgo, C. A. (2015). Exploring the impact of commuting to campus on psychological well-being. *New Dir. Stud. Serv.* 2015, 35–43. doi: 10.1002/ss.20125
- McDougle, L. M., and Li, H. (2023). Service-learning in higher education and prosocial identity formation. *Nonprofit Volunt. Sect. Q.* 52, 611–630. doi: 10.1177/08997640221108140
- McIlrath, L., Aramburuzabala, P., and Opazo, H. (2019). "Europe engage: developing a culture of civic engagement through service learning within higher education in Europe" in *Embedding service-learning in higher education. Developing a culture of civic engagement in Europe*. eds. P. Aramburuzabala, L. McIlrath and H. Opazo (London: Routledge, Taylor & Francis.), 69–80.
- McLeod, J. (2003). *Doing counselling research. 2nd Edn*. Thousand Oaks: California: Sage Publications Ltd.
- Mosakowski, E., Calic, G., and Earley, P. C. (2013). Cultures as learning laboratories: what makes some more effective than others? *Acad. Manag. Learn. Educ.* 12, 512–526. doi: 10.5465/amle.2013.0149
- Opazo, H., Aramburuzabala, P., and Ramírez, C. (2018). Emotions related to Spanish student-teachers' changes in life purposes following service-learning participation. *J. Moral Educ.* 47, 217–230. doi: 10.1080/03057240.2018.1438992
- Pais, S. C., Dias, T. S., and Benício, D. (2022). Connecting higher education to the labour market: the experience of service learning in a Portuguese university. *Educ. Sci.* 12:259. doi: 10.3390/educsci12040259
- Pinto, J. C., and Costa-Ramvalho, S. (2022). Boost me up!: promoting and supporting engagement, learning and wellbeing. Oral presentation of Service-Learning Experiences. ORSIES—Observatório da Responsabilidade Social e Instituições do Ensino Superior.
- Prado, E. L.-d.-A., Higuera, P. A., and Carvajal, H. O. (2020). Diseño y validación de un cuestionario Para la autoevaluación de experiencias de aprendizaje-servicio Universitario [design and validation of a questionnaire for the self-evaluation of university service-learning experiences.]. *Educ. XXI* 23, 319–347. doi: 10.5944/educXXI.23834
- Queiruga-Dios, M., Santos Sánchez, M. J., Queiruga-Dios, M. Á., Acosta Castellanos, P. M., and Queiruga-Dios, A. (2021). Assessment methods for service-learning projects in engineering in higher education: a systematic review. *Front. Psychol.* 12:629231. doi: 10.3389/fpsyg.2021.629231
- Reinders, H., and Yourniss, J. (2009). School-based required community service and civic development in adolescents. *Appl. Dev. Sci.* 10, 2–12. doi: 10.1207/s1532480xads1001_1
- Ribeiro, Á., Aramburuzabala, P., and Paz, B. (2021). Reflections on service-learning in european higher education. *RIDAS* 12, 3–12. doi: 10.1344/RIDAS2021.12.2
- Roberts, B. W., and Robins, R. W. (2000). Broad dispositions, broad aspirations: the intersection of personality traits and major life goals. *Personal. Soc. Psychol. Bull.* 26, 1284–1296. doi: 10.1177/0146167200262009

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

- Salam, M., Iskandar, D. N. A., Ibrahim, D. H. A., and Farooq, M. S. (2019). Service learning in higher education: a systematic literature review. *Asia Pac. Educ. Rev.* 20, 573–593. doi: 10.1007/s12564-019-09580-6
- Santos-Rego, M. A., Mella Núñez, Í., Naval, C., and Vázquez Verdera, V. (2021). The evaluation of social and professional life competences of university students through service-learning. *Front. Educ.* 6:109. doi: 10.3389/feduc.2021.606304
- Smith, C. M. (2008). Does service learning promote adult development? Theoretical perspectives and directions for research. *New Dir. Adult Contin. Educ.* 2022, 1–4. doi: 10.1002/ace.20462
- Sotelino-Losada, A., Arbués-Radigales, E., García-Docampo, L., and González-Geraldo, J. L. (2021). Service-learning in Europe. Dimensions and understanding from academic publication. *Front. Educ.* 6:4825. doi: 10.3389/feduc.2021.604825
- Tijmsma, G., Hilverda, F., Scheffelaar, A., Alders, S., Schoonmade, L., Blignaut, N., et al. (2020). Becoming productive 21st century citizens: a systematic review uncovering design principles for integrating community service learning into higher education courses. *Educ. Res.* 62, 390–413. doi: 10.1080/00131881.2020.1836987
- Veiga, N., Couto, P., Ribeiro, C., Ferreira, A., Ribeiro, L., Themudo, C., et al. (2021). “Service learning at Universidade Católica Viseu – a pilot study” in *Transformación universitaria. Retos y oportunidades* (Salamanca: Spain. Ediciones Universidad de Salamanca), 31–38.
- Waldner, L. S., Widener, M. C., and McGorry, S. Y. (2012). E-service learning: the evolution of service-learning to engage a growing online student population. *J. High. Educ. Outreach Engagem.* 16, 123–150.
- White, A. E. (2001). A meta-analysis of service learning research in middle and high schools. Thesis, Dissertations, Student Creative Activity, and Scholarship. 67. Available at: <https://digitalcommons.unomaha.edu/slcedt/67>
- Winans-Solis, J. (2014). Reclaiming power and identity: marginalized students’ experiences of service-learning. *Equity Excell. Educ.* 47, 604–621. doi: 10.1080/10665684.2014.959267

Frontiers in Education

Explores education and its importance for individuals and society

A multidisciplinary journal that explores research-based approaches to education for human development. It focuses on the global challenges and opportunities education faces, ultimately aiming to improve educational outcomes.

Discover the latest Research Topics

[See more →](#)

Frontiers

Avenue du Tribunal-Fédéral 34
1005 Lausanne, Switzerland
frontiersin.org

Contact us

+41 (0)21 510 17 00
frontiersin.org/about/contact



Frontiers in Education

