IRRODL

THE INTERNATIONAL REVIEW OF RESEARCH IN OPEN AND DISTRIBUTED LEARNING

Vol 25 No 1

February 2024

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 25, Number 1

February – 2024

Editorial – Volume 25, Issue 1

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I would like to start off this first issue of the new year with an observation that I noted at the ICDE Conference in Costa Rica last November. We are receiving articles that refer to the Covid 19 pandemic as causing disruption in education, when it is clear from the content of the articles that the authors are referring to the **Covid lockdown,** not to the actual illness. It is possible, of course, for an article that does refer to the illnesses caused by the pandemic in relation to ODL; however, up to now, we have not received any. They all specifically mean the **lockdown**, not the actual pandemic. So, we have decided to advise authors to make the correction by referring to the "Covid lockdown" (or present a rationale for referring to the pandemic illnesses specifically).

In this issue, there is a renewed interest in MOOCs with three articles, ranging from quality assurance to social cognition and task-technology, and MOOC determinants at Chinese universities. In the lead article by **Sebbeq** and **El Faddouli,** they conduct a comprehensive review on quality assurance in MOOCs, developing a quality framework to guide MOOC designers, learners, and researchers. **Kamble, Upadhyay,** and **Abhang**, researching social cognition and task-technology as predictors, suggest that these features can affect the intentions of sales professionals to continue to engage in MOOCs. Determinants that drive Chinese universities to engage in MOOCs is the subject of the third MOOC paper by **Wang, Criado,** and **van Hemmen.**

In the following paper, **Riwanda, Ridha,** and **Islamy** demonstrate through their research that PDF hyperlinks significantly influence learning outcomes with positive feedback from students. Open education and credentialing in Europe are the subject of the paper by **Griffiths, Burgos,** and **Aceto.** They identified several themes related to the use of OER in Europe, including the lack of open assessment tools. They also highlight that organizational and practical problems are more of a problem than technologies.

Sezgin and **Firat** focus on the digital divide in open education in Türkiye. They looked at several variables that could affect digital divide competency, noting that those working in the private sector scored higher. From Türkiye to Fiji, for the final research paper in this edition, where **Tagimaucia, D'Souza,** and **Chand** explore the difficulties of Physical Education teachers in adjusting to online learning during the Covid lockdown.

In *Book Notes*, there are three reviews covering digital learning and assessment, distance education and blended learning, and Jon Dron's new open-access guide on teaching, technology, and technique. The *Literature Review* section includes a systematic review of Artificial Intelligence in blended learning followed by a comprehensive review of articles on course features and learner profiling. Finally, in *Notes*

From the Field, **Waterhouse** and **Moller** describe an OER tool for supporting learners at work or in the home. This is followed by the description of an intervention in the online teaching of business statistics by **Boritshwarelo** and **Jayasinghe**.

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Towards Quality Assurance in MOOCs: A Comprehensive Review and Micro-Level Framework

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Abstract

MOOCs (massive open online courses), because of their scale and accessibility, have become a major area of interest in contemporary education. However, despite their growing popularity, the question of their quality remains a central concern, partly due to the lack of consensus on the criteria establishing such quality. This study set out to fill this gap by carrying out a systematic review of the existing literature on MOOC quality and proposing a specific quality assurance framework at a micro level. The methodology employed in this research consisted of a careful analysis of MOOC success factor's using Biggs' classification scheme, conducted over a four-year period from 2018 to 2022. The results highlighted the compelling need to consider various indicators across presage, process, and product variables when designing and evaluating MOOCs. This implied paying particular attention to pedagogical quality, both from the learner's and the teacher's point of view. The quality framework thus developed is of significant importance. It offers valuable guidance to MOOC designers, learners, and researchers, providing them with an in-depth understanding of the key elements contributing to MOOC quality and facilitating their continuous improvement. In addition, this study highlighted the need to address aspects for future research, including large-scale automated evaluation of MOOCs. By focusing on pedagogical quality, MOOCs can play a vital role in providing meaningful learning experiences, maximizing learner satisfaction, and ensuring their success as innovative educational systems adapted to the changing needs of contemporary education.

Keywords: MOOC quality, quality assurance, pedagogical quality framework, MOOC success factors

Towards Quality Assurance in MOOCs: A Comprehensive Review and Micro-Level Framework

The educational landscape has undergone rapid transformation, with a pronounced shift towards online learning models, seen most notably in the widespread use of massive open online courses (MOOCs) by universities. However, defining excellence in these diverse online courses poses a considerable challenge, impacting the design and quality of pedagogical content. The multifaceted nature of MOOCs demands a comprehensive assessment of their quality, in harmony with participants' varied motivations, goal orientations, and behaviors (Littlejohn & Hood, 2018).

Recognizing the crucial role of quality in effective learning within online systems, this systematic literature review delved into the complex area of pedagogical quality in MOOCs. The lack of precise consensus on what constitutes quality in these courses highlights the complexities of the educational framework, prompting a closer look at its various dimensions (Chansanam et al., 2021).

This research sought to understand and evaluate the multifaceted dimensions of pedagogical quality in MOOCs, focusing specifically on the micro level of quality management. The main objective was to explore quality assurance as a fundamental approach to maintaining high standards in these constantly evolving online learning environments.

In the midst of the evolving online education landscape, this systematic literature review has become of paramount importance. By examining pedagogical quality in MOOCs, it aimed to unravel the complexities surrounding quality assessment, filling important gaps in the existing literature. The results of this research offered valuable insights into effective quality assessment and improvement in MOOCs, contributing significantly to the field of online education knowledge. Furthermore, the practical implications of this study were envisaged as beneficial for educators, policy makers, and institutions striving to raise the quality standards of MOOC-based education.

Literature Review and Results

Existing Literature Reviews

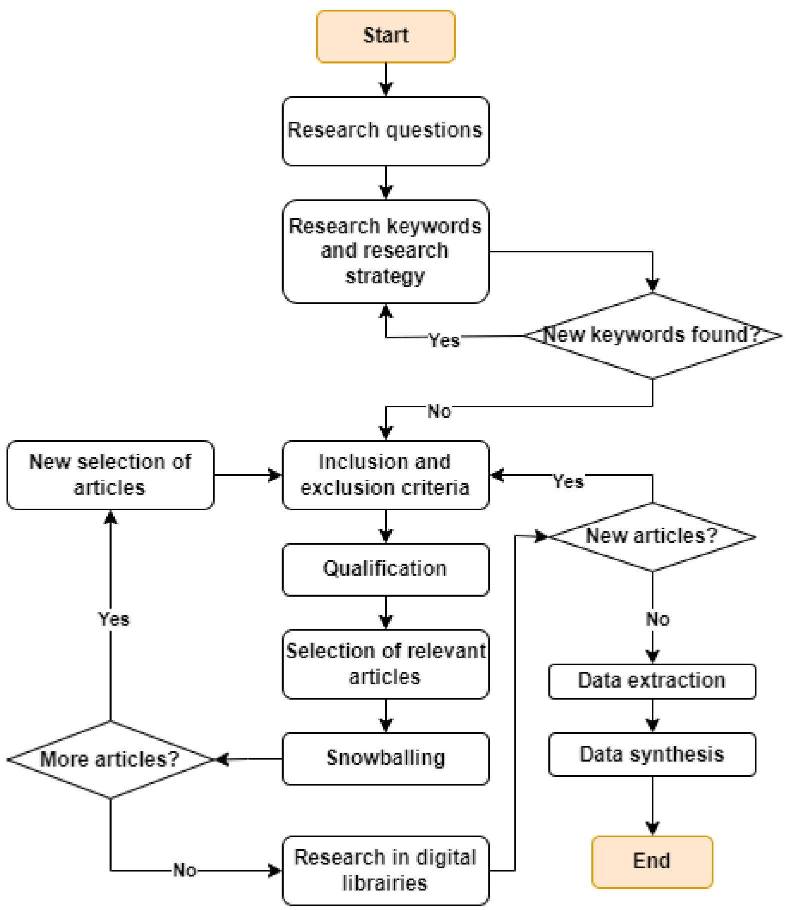
This section outlines our analysis of existing literature reviews on the quality, success, and effectiveness of MOOCs. There have been few systematic scientific publications related to quality in MOOCs. The majority investigated the factors influencing the success and effectiveness of MOOCs but did not assess the pedagogical quality of MOOCs (Albelbisi et al., 2018, p. 5486). Some studies have proposed classification schemes based on factors from previous reviews but not on their review of existing work. Other reviews did not go as far as proposing classification schemes, (Chansanam et al., 2021; Suwita et al., 2019). The limited scope and small number of articles reviewed are also important limitations of some studies. For their part, Stracke and Trisolini (2021) conducted a literature review on a large number of articles (n = 103) and established a categorization scheme for the different dimensions. But their classification did not take into account the learner and the teacher as main inputs. It should also be noted that the main difference between our review and these previous reviews lies in the depth of our analysis and the longer period of years considered in our review. The overall aim of our review was to carry out a systematic review of the academic literature on quality in MOOCs in the period between 2018 and 2022, to analyze the aspects of pedagogical quality in MOOCs addressed in this literature.

Review Methodology

In this section, we detail the research methodology used for this literature review, following Kitchenham's guidelines (Kitchenham et al., 2010) and incorporating the so-called snowballing procedure proposed by Wohlin (2014). Our systematic literature review aimed to achieve several objectives: (a) summarize empirical evidence, (b) identify research gaps, and (c) provide a contextual framework for future investigations. Specifically, our study focused on examining existing quality assurance frameworks and criteria influencing the success and quality of MOOCs. By conducting an extensive database search, we identified several quality assurance methods and carefully selected those that corresponded to the criteria defined for the study.

Figure 1

Steps in the Literature Review Process



The study rigorously followed a structured three-phase process for its literature review—planning, implementation, and reporting—as illustrated in Figure 1. Planning defined the research questions and developed a methodological protocol. Implementation identified relevant sources, assessed their quality, and extracted data for in-depth analysis. Finally, the reporting phase synthesized the results into a comprehensive report, offering a clear view of the research journey.

Research Questions

This comprehensive review encompassed both theoretical and empirical contributions and sought to address the following research questions.

1. What constitutes quality in the context of MOOCs?
2. What recent research, spanning the years 2018 to 2022, has examined the pivotal factors that impact the achievement of MOOCs?
3. What frameworks are available for ensuring quality in MOOCs?
4. What are the key determinants influencing the quality and success of MOOCs?
5. How can these diverse critical factors be integrated into the formulation of a classification scheme?

Selection and Qualification

Our article selection process was guided by a set of inclusion and exclusion criteria, as outlined below. We included (a) theoretical and empirical works on factors influencing the quality or success of MOOCs; and (b) theoretical and empirical works that proposed frameworks for quality assurance or improvement in MOOCS, pedagogical quality in particular.

We excluded items according to the following criteria:

- Disregard items that were not peer-reviewed.
- Consider only publications available in French or English; exclude all other languages.
- Eliminate dated articles addressing the same research topic; retain only the most recent article, particularly if it extends the primary article.
- Exclude articles that lacked a clearly defined research problem relevant to the MOOC field.

Keywords and Search Strategy

We conducted a comprehensive manual search employing various permutations of keywords related to our research, such as (a) assurance, (b) improvement, (c) pedagogical quality, (d) quality framework, (e) MOOCs quality, (f) pedagogical quality in MOOCs, (g) instructional design quality assurance in MOOCs, and (h) success MOOC. We searched for papers containing one or more of these keywords in their titles or abstracts. Despite the labor-intensive nature of manual searching, it was deemed more reliable than automated methods, as it could encompass keywords present in article titles, abstracts, and occasionally within the article content. We employed Boolean expressions (e.g., Or, And) to refine our searches, continually expanding our keyword list as our investigations advanced.

To ensure the completeness of our research, we used reputable computer science and information technology citation databases such as Springer, IEEE Explore, ACM Digital Library, Scopus, and Science Direct. Our study focused on the last seven years (2018–2022) to capture recent advances and emerging trends. This analysis covered not only empirical studies, but also theoretical articles.

In the first phase, we identified an initial set of 97 sources, then applied rigorous criteria to retain 69 relevant sources. We also checked whether the authors had produced other publications related to the subject.

By introducing the snowballing method into our selection process, we incorporated new elements discovered in the first iteration to add another eight sources in the second iteration. This rigorous methodology resulted in a comprehensive and up-to-date collection of relevant sources.

Data Extraction and Organization

We used Zotero to extract data from the search results and to organize detailed bibliographic information to facilitate the article selection stage. An Excel file was used to summarize and classify the various contributions selected.

Analysis

Quantitative Analysis

The initial search yielded 97 research papers. After applying inclusion/exclusion and qualification criteria by analyzing titles and abstracts, only 77 were classified as relevant sources. Table 1 shows the results of searches in academic databases.

Table 1

Results of Searches in Academic Databases

Academic data source	Number of relevant papers
IEEE	9
Springer	6
ACM	2
Science Direct	19
Taylor & Francis	2
International Review of Research in Open and Distributed Learning	3
Google Scholar	36

Figure 2

Distribution of Selected Publications

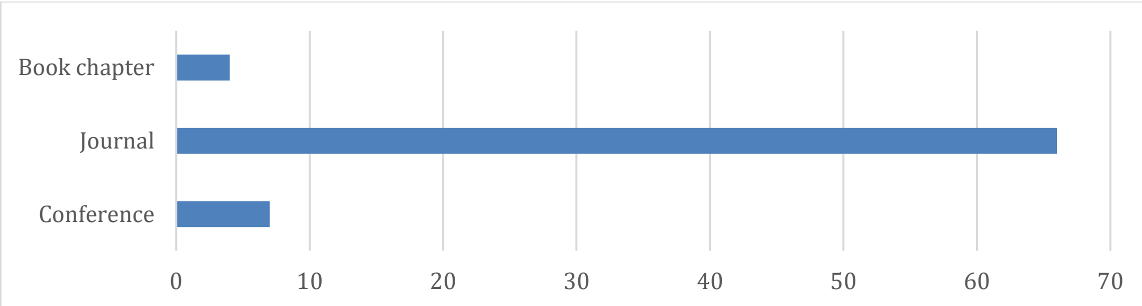


Figure 2 shows the distribution of selected publications by type. Of the 77 studies found, 66 were in journals, while just seven were conference papers and four were book chapters.

Figure 3

Annual Breakdown of Literature by Type

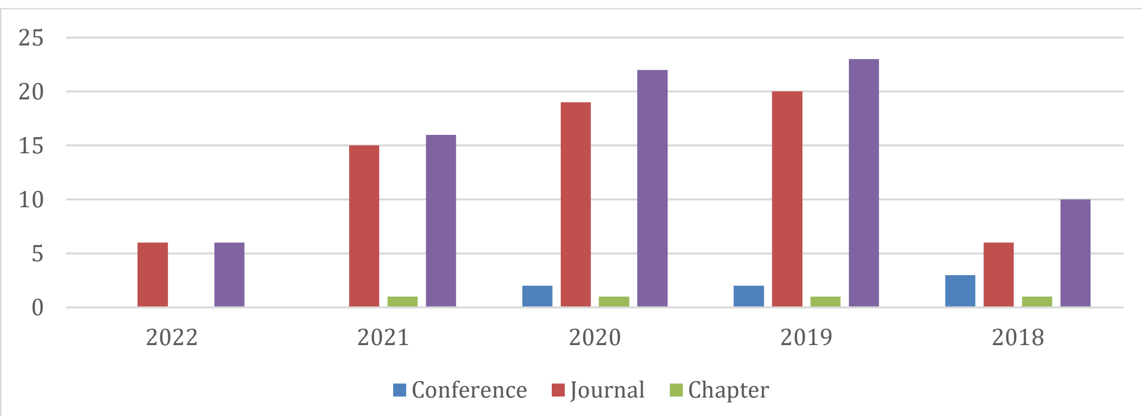


Figure 3 shows the growth of work around quality assurance in MOOCs towards the year 2020.

Qualitative Analysis

The Proposed Classification Scheme

In-depth study of the literature on MOOCs revealed complex interactions among their components. To explore quality in MOOCs, Biggs' 3P model was adopted, adapted, and applied (Biggs, 1993). This model depicted educational ecosystems as having foreshadowing, process, and product variables (Gibbs, 2010). Our analysis redefine these variables in order to better understand their interrelation. As MOOCs are learning ecosystems, reassessing their composition is crucial. The systematic search for key factors in the literature facilitated a methodical classification according to the three categories of variables below, and as detailed in Table 2.

- Presage: These variables encompassed inputs pertinent to the teaching and learning process, such as learner and teacher characteristics.

- Process: This category pertained to the environment, intricately linked with the presage variables, and included elements like instructional design and teaching methodologies.

- Product: These variables signified outcomes, and encompassed metrics such as completion rates and the overall quality of MOOCs.

Figure 4

Number of Studies per Factor

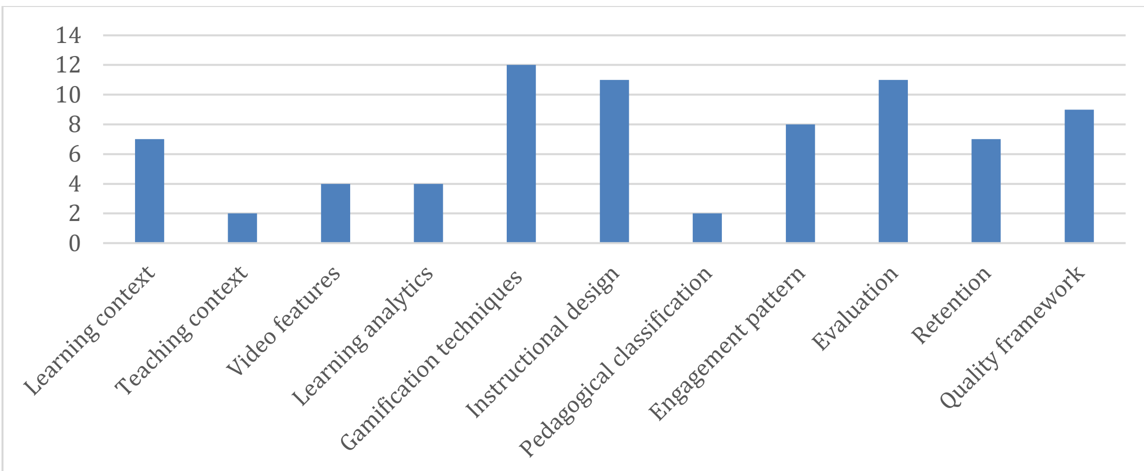


Figure 4 shows that gamification techniques was the factor most addressed, followed by evaluation and instructional design, then quality framework. Pedagogical classification and teacher context were the least addressed in the literature.

Table 2

Classification Scheme for Studies Included in the Review

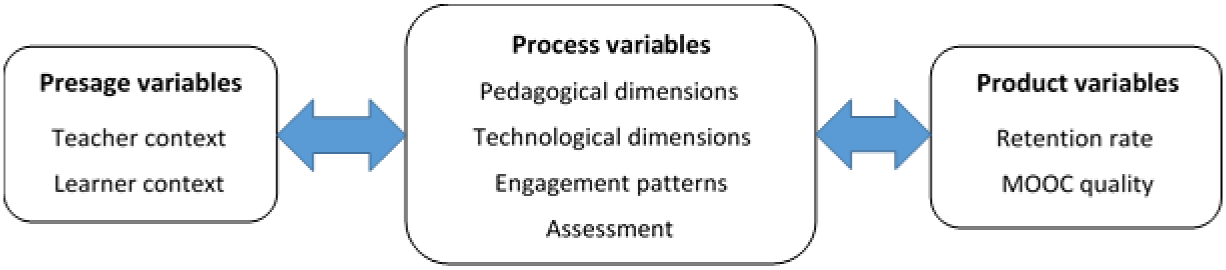
Variable	Factor	Study
Presage	Learner context	Chen et al. (2019); Costello, Brunton et al. (2018); Demetriadis et al. (2018); Gamage et al. (2020); Sun & Bin (2018); Sun et al. (2019)
	Teacher context	Bonk et al. (2018); Ray (2019)
Process	Technological dimensions	
	Video features	Fassbinder et al. (2019); Lemay & Doleck (2022); Stoica et al. (2021); van der Zee et al. (2018)

	Learning analytics	Cross et al. (2019); Hooda (2020); İnan & Ebner (2020); Shukor & Abdullah (2019)
	Gamification techniques	Aparicio et al. (2019); Bai et al. (2020); Buchem et al. (2020); Danka (2020); Jarnac de Freitas & Mira da Silva (2020); Khalil et al. (2018); Osuna-Acedo (2021); Rahardja et al. (2019); Rincón-Flores et al. (2020); Romero-Rodriguez et al. (2019); Sezgin & Yüzer (2022); Tjoa & Poecze (2020)
	Pedagogical dimensions	
	Instructional design	Anyatasia et al. (2020); Giasiranis & Sofos (2020); Guerra et al. (2022); Julia et al. (2021); Jung et al. (2019); Littlejohn & Hood (2018); Nie et al. (2021); Sabjan et al. (2021); Smyrnova-Trybulska et al. (2019); Wang, Lee, et al. (2021); Wong (2021)
	Pedagogical classification	Davis et al. (2018); Xing (2018)
	Engagement pattern	Alemayehu & Chen (2021); Dai et al. (2020); Deng et al. (2020); Estrada-Molina & Fuentes-Cancell (2022); Guajardo Leal et al. (2019); Liu et al. (2022); Wang et al. (2019); Xing (2018)
	Assessment	Alcarria et al. (2018); Alexandron et al. (2020); Avgerinos & Karageorgiadis (2020); Bogdanova & Snoeck (2018); Costello, Holland, et al. (2018); Douglas et al. (2020); Farrow et al. (2021); Gamage et al. (2018, 2021); Nanda et al. (2021); Pilli et al. (2018); Xiao et al. (2019)
Product	Retention or completion rate	Bingöl et al. (2019); Dalipi et al. (2018); Goel & Goyal (2020); Gregori et al. (2018); Hew et al. (2020); Mrhar et al. (2021); Wang, Khan, et al. (2021)
	MOOC quality: Framework for pedagogical quality assurance	Aloizou et al. (2019); Li et al. (2022); Nie et al. (2021); OpenupEd (n.d.); Ossiannilsson (2020); Quality Assurance Agency for Higher Education (n.d.); Quality Matters (n.d.); Stracke et al. (2018); Su et al. (2021); Yuniwati et al. (2020); Zhou & Li (2020)

Presage Variables

Figure 5

Framework for MOOC Quality Measurement



Traditional measures of presage variables include teacher quality and learner quality. MOOCs disrupt these traditional measures and call for new measures of quality. These new measures have important implications for process and product variables. Figure 5 shows the framework for MOOC quality measurement. In the following, we detail the results of our literature review according to this framework.

Learner Context. In MOOCs, there are three types of interaction involving the learner: (a) learner interaction with activities and xontent, (b) teacher-learner interaction, and (c) learner-learner interaction and collaboration. Studies into the role of interactivity in MOOC quality assurance have been based on frameworks such as the academically productive talk (APT) framework (Costello, Brunton et al., 2018) for integrating a conversational agent that facilitates learner-learner interactivity. Another study, Sun and Bin (2018) was based on the local community detection framework.

Teacher Context. The literature has been divided between those who demonstrated that the role of the teacher in MOOCs is not paramount and those who have seen it as necessary. The literature regarding the context of the teacher in MOOC quality assurance included studies on useful activities, tools, approaches, and resources for teachers to develop their teaching experience (Askeroth & Richardson, 2019; Bonk et al., 2018; Ray, 2019).

Process Variables

Pedagogical Dimensions.

Pedagogical Design for MOOCS. Several studies have examined the importance of defining a homogeneous, coherent, and integrative course structure, taking into account the constraints of the number of modules and the time between them.

Most work on the quality of pedagogical scripting in MOOCs has been based on questionnaires for learners (Sabjan et al., 2021). Some looked as a single MOOC (Giasiranis & Sofos, 2020) while others examined several MOOCs (Julia et al., 2021). The analysis and review of MOOC design has often drawn on frameworks such as ADDIE (analysis, design, development, implementation, evaluation; Smyrnova-Trybulska et al., 2019), the educational scalability framework (Julia et al., 2021), or the 10-principle framework (Wang, Lee, et al., 2021). Some works were limited to manual analysis (e.g., Giasiranis & Sofos, 2020), while others relied on sentiment analysis and automated tools such as the course scan questionnaire (Wang, Lee, et al., 2021).

Pedagogical Classification of MOOCs. Various studies have focused on improving the pedagogical design of MOOCs by comparing different pedagogies suitable for large-scale learning and teaching. However, analyzing and classifying MOOCs has been challenging due to their content, structures, designs, and variety of providers. Researchers have taken different approaches to understand these variations and identify pedagogical models in MOOC instructional design.

Several descriptive frameworks and evaluation tools have been proposed to categorize and assess MOOCs. Examples include a 10-dimension MOOC pedagogy assessment tool (AMP) used for evaluation (Quintana & Tan, 2019).

Some researchers have used machine learning algorithms like k-nearest neighbor (k-NN) and k-means to automatically classify MOOCs based on their design features and pedagogical approaches (Davis et al., 2018; Xing, 2018). Other studies incorporated theoretical foundations to guide their classification and evaluation processes. Overall, these efforts aimed to help educators and designers make informed decisions about MOOC pedagogy, enhance learner engagement, and improve the quality of MOOC experiences.

Technological Dimensions.

The technological quality of online educational resources has been studied. Our literature review identified three main technological dimensions: (a) video characteristics, (b) gamification, and (c) the use of learning analytics.

Fassbinder et al. (2019) proposed models for high-quality video-based open educational resources in MOOCs, with the aim of improving learning experiences. Lemay and Doleck (2022) used neural networks to predict student performance in MOOCs by analyzing video viewing behavior, highlighting the role of motivation and active viewing. Stoica et al. (2021) explored the prediction of learning success in MOOC videos, while van der Zee et al. (2018) advocated active learning strategies, demonstrating their positive impact on student quiz performance in online education.

Gamification techniques have been used in e-learning and have yielded positive results in improving learner engagement and motivation (Khalil et al., 2018). Sezgin and Yüzer (2022) studied the contribution of adaptive gamification on e-learning; they deduced that this approach facilitated high-quality interactive learning experiences for distance learners. Osuna-Acedo (2021) confirmed that integrating gamification into MOOCS models positively affected learner motivation and engagement. In the same vein, Rincón-Flores et al. (2020) evaluated the effect of gamification in a MOOC. Of 4,819 participants, 621 completed the course and 647 took up the gamification challenge. The results showed that over 90% of participants experienced greater motivation and stimulation than with conventional teaching methods. Other studies, (Bai et al., 2020; Danka, 2020;) confirmed the contribution of gamification to the success and quality of MOOCs.

Learning analytics have shown potential for supporting learner and teacher engagement, and promoting the quality of the teaching and learning experience, by providing information that can be useful for both teacher and learner. İnan and Ebner (2020) analyzed various forms of learning analytics in MOOCs, ranging from data mining to analysis and visualization. Hooda (2020) examined learning analytics and educational data mining, and demonstrated the impact on the learner and instructor in different learning environments. Similarly, Shukor and Abdullah (2019) demonstrated the positive effect of learning analytics on the quality of instructional scripting.

Patterns of Engagement.

Studies on MOOCs have attempted to better understand the different types of learner behavior by analyzing patterns of persistence, perseverance, and interaction. But given the heterogeneity of learner profiles in MOOCs, this calls for drawing a distinction between different learner profiles. To this end, several studies adopted a statistical approach. These studies have carried out in-depth analyses to obtain information on learners' motivations and establish a classification of learners according to their type and degree of engagement. Learner engagement has many definitions, depending on one's perspective. In the MOOC context, engagement refers to the learner's interactions with peers, the teacher, content, and activities. These interactions can take many forms and occur throughout the teaching/learning process. So, to improve the quality of this process, it is necessary to consider the different forms of engagement when designing and delivering a MOOC.

We found two literature reviews that addressed the role of engagement in MOOC quality assurance. Guajardo Leal et al. (2019) conducted a systematic literature mapping to thoroughly explore the concept of academic engagement in massive and open online learning. Estrada-Molina and Fuentes-Cancell (2022) analyzed 40 studies between 2017 and 2021. The results showed that the main variables were (a) the design of e-activities, (b) intrinsic and extrinsic motivation, and (c) communication between students. This article confirmed that the main challenges for guaranteeing engagement in MOOCs are individualized tutoring, interactivity, and feedback. The evaluation, measurement, and classification of engagement patterns have been the subject of various research studies. Liu et al. (2022) used a robust model (BERT-CNN; bidirectional encoder representations from transformer, BERT, combined with convolutional neural networks, CNN) to analyze the discussions among 8,867 learners. Structural equation modeling indicated that emotional and cognitive engagement interacted and had a combined effect on learning outcomes.

Assessment.

There are several types of assessment: (a) formative assessment, during the learning process; (b) summative assessment, at the end of the course; or (c) an initial test to check learners' knowledge before the course begins. In MOOCs, tests are generally self-assessment or peer assessment in which participants examine and evaluate the work of other learners. In their review of literature between 2014 and 2020, Gamage et al. (2021) provided summary statistics and a review of methods across the corpus. They highlighted three directions for improving the use of peer assessment in MOOCs: the need to (a) focus on scaling learning through peer assessments, (b) scale and optimize team submissions in team peer assessments, and (c) integrate a social peer assessment process.

Product Variables

Retention Rate. Traditional indicators of learning quality are not appropriate for measuring the quality of MOOCs, as success is not the goal of all learners. Course completion does not always correspond to learning satisfaction or success. Conventional measures such as retention and completion cannot guarantee quality in MOOCs.

Bingöl et al. (2019) identified success factors and completion elements for MOOCs, focusing on instructors, course design, and personal factors. Dalipi et al. (2018) examined dropout prediction in MOOCs using machine learning, while Goel and Goyal (2020) explored dropout reduction strategies, using semi-supervised learning. Mrhar et al. (2021) proposed a dropout prediction model for MOOCs using neural networks. Wang, Khan, et al. (2021) studied user satisfaction and reuse intentions in MOOCs during the COVID-19 pandemic using the unified theory of acceptance and use of technology (UTAUT) model, highlighting critical factors influencing user behavior.

MOOC Quality: Framework for Pedagogical Quality Assurance. Our literature review detected proposals for quality assurance frameworks (e.g., Quality Matters, n.d.). In this framework, quality management is a process of peer review and faculty development based on eight dimensions. While it provided a reasonable argument for online learning, it did not specifically address the MOOC context. Aloizou et al. (2019) conducted a literature review to identify the most mature existing MOOC quality assurance methods. Two quality assurance frameworks that met most of their criteria were selected, including OpenupED (n.d.) and Quality Matters (n.d.). An evaluative case study was then carried out to apply the selected methods to a MOOC implementing active learning pedagogies. Yuniwati et al. (2020) developed an evaluation instrument to measure platform quality, using the plomp model, consisting of five phases: (a) design; (b) construction; (c) test, evaluation, and revision; and (d) implementation.

Other studies have relied on learners' data (e.g., their comments on feedback) to make manual or automatic analyses and reveal the factors that affect MOOC quality. For example, Zhou and Li (2020) used the BERT model to classify student comments while Li et al. (2022) relied on sentiment analysis of learner feedback to measure MOOC quality.

Discussion and Conclusion

This paper endeavored to establish a micro-level framework for ensuring quality in MOOCs, striving to establish connections among the diverse factors that influence MOOC quality and success. To achieve this goal, we conducted an extensive literature review, meticulously analyzing and categorizing publications pertinent to quality in MOOCs. Our objective was to gain deeper insights into the factors that impact MOOC success. Our approach was rooted in systematic literature review methodologies, systematically identifying and scrutinizing the critical factors that contribute to MOOC success.

By focusing our literature review on the facets influencing quality in MOOCs, particularly pedagogical quality, we were able to classify these factors based on a scheme inspired by Biggs' framework (Biggs, 1993). Our quantitative analysis revealed that interest in quality in MOOCs reached its zenith in the year

2020 and continues to captivate researchers in this domain. Moreover, the distribution of the 77 studies across the various dimensions of our classification scheme displayed disparities, signifying distinct research interests and emphases.

The primary outcome of our study was the development of a quality framework that represented a classification scheme encompassing key aspects of MOOC quality, with a clear distinction among three dimensions—presage, process, and product. The presage dimension was detailed and expounded upon in a total of nine studies arranged in two hierarchical levels; there were seven primary studies concerning the learner context and two secondary studies addressing the teacher context. The process dimension was explored in 33 studies, with gamification techniques the factor addressed most, then evaluation and instructional design, followed by quality framework. Pedagogical classification and teacher context were addressed the least in the literature.

The three factors of learner context, instructional design, and engagement patterns emerged as the most frequently discussed in the literature. This prevalence can be attributed to the predominant focus on quality from the learner's perspective. Conversely, the foreshadowing factor related to the teacher's context.

The qualitative analysis explored various variables relevant to MOOC quality. Learner context came to the fore, highlighting the importance of peer interaction and community sensing in fostering enriching learning experiences. Likewise, the context of the teacher sparked debate, with studies looking at tools, resources, and approaches to improve pedagogical strategies for instructors in online learning environments. Process variables highlighted the importance of pedagogical dimensions, such as instructional scripting and design frameworks, as well as technological aspects, including the use of video features and gamification techniques to promote learner engagement and motivation. In addition, models of engagement, revealing the complexity of learner behaviors, proved crucial for adapting pedagogical strategies and course designs.

In terms of product variables, studies focused on retention rates, addressing dropout prediction, and factors influencing user satisfaction, particularly during the COVID-19 pandemic. In addition, the assessment of quality assurance frameworks provided insights into the evolution of quality assessment in MOOCs, calling for comprehensive assessment tools and peer-reviewed frameworks.

These analyses elucidated the dynamic nature of MOOC quality assurance, highlighting the pivotal role of learner-teacher interactions, structured instructional designs, and technological innovations in creating effective online learning environments. The implications of these findings are far-reaching, offering opportunities for educators, designers and policy-makers to refine pedagogical strategies, exploit technological advances, and develop comprehensive quality assessment frameworks for MOOCs.

Another crucial takeaway from this systematic literature review was the imperative to consider and address several key indicators related to MOOC design and quality across all three dimensions when conducting research on MOOC quality. While the majority of studies emphasized quality from the learner's viewpoint, the remaining three dimensions (i.e., presage, process, and product) are equally relevant and instrumental in shaping the design and quality of MOOCs. Therefore, a comprehensive approach necessitates the consideration of each dimension when designing MOOCs.

In conclusion, we have highlighted promising avenues for future research in this domain. We advocate for the incorporation of two product variables, namely completion rates and MOOC quality, in assessing MOOC success. According to our literature review, relying solely on completion rates is inadequate to measure MOOC success, necessitating the development of a comprehensive quality measurement framework. Existing frameworks, while present in the literature, often lacked automatic evaluation tools and encompassed only a limited number of MOOCs. Consequently, we recommend further research focusing on large-scale, automated evaluations of MOOCs as an area with significant potential.

We firmly believe that this systematic literature review and its findings are pertinent to both MOOC designers and learners. It empowers them to identify the critical quality categories aligning with their objectives, facilitating the selection of the most suitable MOOC methods. The principal outcome of this review, the quality framework for MOOCs, should serve as a valuable resource for future MOOC research, offering applications in MOOC design guidelines, fostering discussion and benchmarking among MOOC design teams, and facilitating standardized descriptions and assessments of MOOC quality. Additionally, it can serve as a foundation for conducting systematic reviews of subsequent literature in the future.

Moreover, it is essential to underscore that, like any e-learning initiative, the successful adoption of MOOCs hinges on the active participation of all stakeholders, particularly instructors and learners. Special attention should be directed towards ensuring pedagogical quality in MOOCs right from their inception, with ongoing support for educators. The findings of this research should be harnessed and evaluated in the development of new MOOCs, offering insights into the feasibility of the four dimensions and their quality indicators. Using mixed-methods research can foster a more comprehensive understanding and facilitate improved strategies for enhancing the design, implementation, and evaluation of future MsOOCs, ultimately enhancing their quality. Incorporating these elements will guarantee that MOOCs are designed and delivered effectively, promoting meaningful learning experiences and enhancing learner satisfaction, thereby contributing to the success of MOOC systems.

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International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 25, Number 1

February – 2024

Navigating the Learning Landscape: Social Cognition and Task-Technology Fit as Predictors for MOOCs Continuance Intention by Sales Professionals

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Abstract

Massive open online courses (MOOCs) have gained popularity among sales professionals who use them for self-directed learning and upskilling. However, research related to their intentions to continue learning is scarce. Drawing from the social cognition theory, this research aimed to address this gap by investigating the role of task-technology fit, self-development, and social recognition in sales professionals' continued use of MOOCs. The study hinged on empirical research and used a survey to collect data from 366 sales professionals. The results suggest that task-technology fit, self-development, and social recognition play a significant role in sales professionals' continued use of MOOCs. The study has practical implications for organizations promoting employee learning and development. The findings provide valuable information for MOOC designers and providers to develop more effective courses that meet the needs of sales professionals.

Keywords: self-directed learning, MOOC, sales professional, social cognition theory, self-development, social recognition, task-technology fit, continued intentions

Introduction

Massive open online courses (MOOCs) have gained immense popularity among learners worldwide due to the development of information and communication technologies. MOOCs complement traditional classroom teaching and learning, making education more accessible to learners from all walks of life (Shao, 2018). Tseng et al. (2022) have discussed how technological advancements can enhance the effectiveness of education, thereby increasing students' efficiency. However, despite numerous benefits, MOOCs have some limitations, such as issues with access, modularity, and benefits to learners and providers (Celik et al., 2020). The dissimilarities between MOOCs and traditional learning setups can be attributed to learner behavior, instructional design, evaluation patterns, and interactions between participants and instructors (Celik et al., 2020).

Studies have reported the worth and possible uses of MOOCs in higher education, human resource development, workplace learning, and professional sales training (Celik et al., 2020; Park et al., 2018; Rollins et al., 2014; Shapiro et al., 2017; Tseng et al., 2022). Sales professionals indulge in self-directed learning as evident from earlier research (Lassk et al., 2012). However, few studies have investigated the intentions of sales professionals to use MOOCs for self-development and upskilling through self-directed learning. Sales professionals learn new skills through self-directed learning initiatives such as participating in forum discussions and social media engagement (Conde et al., 2021). To better understand voluntary participation in MOOCs, previous studies have investigated the factors influencing learners' continued intentions to use MOOCs (Kuo et al., 2021; Milligan & Littlejohn, 2017; Wan et al., 2020). For instance, the successful completion of MOOCs largely depends on learners' ability to direct their efforts toward accomplishing learning goals (Milligan & Littlejohn, 2017). Furthermore, corporate-sponsored training programs result in limited learning for sales professionals (Conde et al., 2021). Also, neglecting social aspects may also limit the ability of the model to ascertain continued intentions of users (Wan et al., 2020). MOOCs for self-directed learning and upskilling have become increasingly popular among sales professionals. Task-technology fit (TTF), self-directed learning skills, and social recognition are other factors that can influence learners' continued use of MOOCs (Kuo et al., 2021; Wan et al., 2020; Wu & Chen, 2017; Zhou, 2016). Sales professionals employed in various organizations undertake self-directed learning assignments due to intrinsic and extrinsic motivation factors stemming from their social cognition. Individuals exhibit social cognition based on the learnings received from others (Bandura, 1986). Similarly, sales professionals undertake learning assignments due to similar behavior observed among their peers and their past experiences with such assignments (Olsson, 2016).

However, the translation of such intent into continued intention needs further investigation. This research endeavored to address this gap by exploring the role of TTF, self-directed learning skills, social recognition, and perceptions of learning in sales professionals' continued use of MOOCs. We examined the following research question: What are the key factors that influence the continued intentions of sales professionals to use MOOCs, and to what extent do they predict it?

This study provides theoretical and practical contributions to e-learning in the workplace, with implications for both MOOC developers and providers and sales professionals seeking to enhance their self-development and upskilling through self-directed learning. Identifying these key factors provides a better understanding of the motivators that drive professionals in these fields to participate in MOOCs. Our results will be useful in designing more effective MOOCs that meet their needs. Additionally, understanding the extent to which self-directed learning skills predict the continued use of MOOCs among sales professionals and the types of self-directed learning skills that are most critical for them provides useful information to MOOC designers and providers on how to structure and design their courses to meet the needs of these learners.

Moreover, investigating how social recognition impacts the continued use of MOOCs by sales professionals and identifying the most meaningful forms of social recognition are useful for MOOC designers and providers in enhancing the social recognition mechanisms in their courses. Furthermore, investigating how sales professionals perceive the differences between MOOCs and traditional learning setups and how this perception affects their intentions to use MOOCs contributes to the existing literature on learner behavior. It helps bridge the gap between the two learning setups. The research also offers insights for sales professionals on the advantages and disadvantages of MOOCs over traditional learning setups, helping them make informed decisions when choosing between the two.

Literature Review

Research on MOOCs for Working Professionals

The professional development of working professionals has become increasingly digitized (Griffiths et al., 2022). Various courses and learning opportunities are available over digital platforms for working professionals' development (Greenhow & Lewin, 2016). Owing to the increasing demand for competence and skills among working professionals, there is an impetus toward professional development in organizational settings (Olsson, 2016). Various studies have explored MOOCs for human resource professionals (Radford et al., 2014), teachers (Castaño-Muñoz et al., 2018; Koukis & Jimoyiannis, 2019), and physical education teachers (Griffiths et al., 2022), and for the professional development of working professionals (Olsson, 2016; Park et al., 2018). In their investigation, Radford et al. (2014) found that many employees were taking up MOOCs for professional and self-development. They also found organizations to be keen on providing financial assistance to their professionals for taking up MOOCs, provided they complete the course and can deliver heightened results. Park et al. (2018) explored MOOCs in organizational settings leading toward employees' professional development. The study found that the MOOCs administered for human resource development can yield positive results by contributing to the organization's and employees' professional development. The practice of undertaking MOOCs may lead to the professional development of learners as the platform is mobile, accessible, and personalized, and provides the learners with the autonomy to complete the course through the learner's self-motivation and at minimal cost.

Social Cognitive Theory

According to Bandura (1986), the social cognitive theory (SCT) examines how intrinsic psychological motivations and external environmental factors combine to affect human behavior through interactions. Furthermore, "SCT estimates the ability of an individual to engage in a targeted behavior, based on internal and external parameters and their interrelationships" (Martin et al., 2014, p. 2). The SCT consists of three aspects: individual factors, environmental factors, and actual behavior (Hosen et al., 2021). External environmental factors, such as social relationships, recognition, and intrinsic motivations such as personal achievement and self-development, impact an individual's behavioral intention (Hosen et al. 2021; Liu et al., 2022; Wang & Wu, 2008). The interaction influence of intrinsic motivation and the underlying external environmental factors determine the behavior of individuals

(Cooper & Lu, 2016). The SCT has been applied to various studies concerning online teaching-learning environments with its application in studies related to self-regulated learning (Zhang et al., 2022), self-efficacy, learning engagement, and academic emotions (Kuo et al., 2021), and self-betterment and learning intentions (Kim et al., 2021; Mısır & Işık-Güler, 2022). Bussey and Bandura (1999) concluded that people contribute to their self-development through actions provided they are versed with the processes. The role of self-efficacy in users' choice processes leads to their self-development based on their potential. Consistent with the debate of extant literature on SCT, individuals participate in MOOCs with a pre-determined objective to achieve some outcome (Kim et al., 2021; Mısır & Işık-Güler, 2022). Individuals' intentions to participate are often associated with accomplishing or enhancing their repute (Moghavvemi et al., 2017). Self-development can help individuals achieve their outcomes (Liu et al., 2022). Consequently, social recognition can be the external factor motivating individuals (Wu & Chen, 2017). Bandura's (1986) social cognitive theory focuses on the idea that individuals learn from observing others, and social recognition is an important aspect of this process. However, measuring one's need for social recognition is a complex task involving subjective experiences and perceptions. These are assessed using individuals' self-perceptions of their desire for social approval, recognition, and belonging through social recognition and self-development scales. Earlier studies have reported using the SCT in various contexts, but scant literature is available on sales professionals' uptake of MOOCs for self-development and social recognition.

Task-Technology Fit (TTF)

Successfully adopting and using any technology depends on identifying the tasks to be performed and the fit between the task and the technology. TTF in this regard identifies an individual's performance and their capabilities to complete the task (Goodhue & Thompson, 1995). The framework uses technology characteristics, task characteristics, and TTF as three main factors for determining an individual's performance and use (Wan et al., 2020). The TTF model specifies the actual use of technologies by users, along with the fit between the task and the technology. Earlier studies have used TTF in various contexts, but few researchers have studied its influence with regards to MOOCs (Wan et al., 2020; Wu & Chen, 2017). The task and technological characteristics significantly affect users' performance and use of the technology.

Learning Initiatives by Sales Professionals

The increase in client demand for customized business solutions has mandated that sales professionals maintain an expert's working "knowledge base" (Artis & Harris, 2007; Homburg et al., 2002). Additionally, organizations expect their sales professionals to master new technologies and techniques to be more responsive, self-starting, autonomous, and efficient in performing their duties (Hunter & Perreault, 2006). Artis and Harris (2007) proposed the concept of self-directed learning for sales professionals, supplementing sales training received through the organization and traditional educational methods to improve performance. Studies have investigated the usefulness of social media as a learning orientation tool for sales professionals (Itani et al., 2017). Knowles (1975) defined self-directed learning as "a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources, choosing and implementing appropriate learning strategies, and evaluating learning outcomes" (p. 18).

Furthermore, self-learning gives learners more control over their purpose, process, and results (Knowles et al., 2020). Self-directed learning usually involves salespeople pursuing education through additional and optional sources, such as reading materials, whitepapers, and participation in online independent study courses (Lassk et al., 2012). Organizations may encourage their sales professionals to voluntarily participate in third-party asynchronous online courses (Lassk et al., 2012). Since MOOCs are a type of self-directed learning assignment, sales professionals enroll for such courses based on a personal or organizational goal. Participation in MOOCs by sales professionals for achieving personal goals may be a part of self-development by an individual to excel and grow in their career.

Hypotheses Development

Based on the literature review and understanding of sales professionals' use of MOOCs, this research set out to investigate the key factors influencing their continued intentions to use MOOCs and explore the role of TTF, self-directed learning skills, social recognition, and perceptions in the process.

The expected rewards achieved by an individual participating in MOOCs, such as learning and improving skills, are forms of self-development (Nov et al., 2010; Shao, 2018). MOOCs allow participants to engage in online forums with instructors, teaching assistants, and fellow learners (Shao, 2018). The sharing of knowledge and ideas and the learners' collective contribution can benefit the individuals' self-learning process, exploring other areas and applying existing knowledge (Shao, 2018). Furthermore, according to Nov et al. (2010), participation in online communities results in acquiring new knowledge from fellow users. Apart from this, the self-study materials available with online courses aids self-development (Sablina et al., 2018). An individual's behavior is also influenced by intrinsic motivations, such as self-development, which helps them perform and achieve (Hosen et al., 2021; Zhang et al., 2022). Also, the skills and knowledge gained from online resources improve learning efficacy and assist in individual development (Kim et al., 2021). Therefore, we propose this hypothesis:

> H1. Self-development positively influences the perceived usefulness of MOOCs for sales professionals.

Recognition can be a driving force for sales professionals to engage in skills enhancement through MOOCs. Social recognition also helps individuals realize their abilities and facilitates social interaction among learners in an online course. Learning initiatives help sales professionals develop new skill sets and foster relationships in their careers. External factors, such as social recognition and relationships, influence individuals' behavior (Hosen et al., 2021; Zhang et al., 2022). Sales professionals undertaking MOOCs may be motivated by future career growth, learning new skills, strategies, and technologies, and better pay and reward structure, among other influences. Organizations also encourage sales professionals to undertake online courses for skills enhancement (Lassk et al., 2012). Owing to the social recognition offered to individuals, the usefulness of enrolling in MOOCs also increases. Therefore, we propose this hypothesis:

> H2. Social recognition positively influences the perceived usefulness of MOOCs for sales professionals.

To understand the continued intentions of sales professionals to use MOOCs for self-development, we must understand their motivations and ability to conduct task-oriented activities linked to the device. TTF explains the correlation between information technology and individuals' performance (Goodhue & Thompson, 1995). Researchers have investigated TTF from various standpoints related to MOOCs (Wu & Chen, 2017), healthcare (Wang et al., 2020), and retail (Khashan et al., 2023). Previous research has suggested that TTF positively influences perceived usefulness (Alyoussef, 2021; Rahi et al., 2021;

Wan et al., 2020; Wu & Chen, 2017)—perceived usefulness is one factor contributing to a user's perception of technologies. As pointed out, perceived usefulness is affected by TTF (Wan et al., 2020), meaning that a higher fit between task and technology can lead to a perception of usefulness for that tool. In the case of MOOCs, sales professionals find a fit between the task and the technology. Therefore, we propose this hypothesis:

> H3. Task-technology fits positively influences the perceived usefulness of MOOCs for sales professionals.

Perceived usefulness measures learners' beliefs that MOOCs effectively enhance their performance (Singh & Sharma, 2021; Wu & Chen, 2017). Furthermore, the easy accessibility of MOOC platforms over the Internet through web browsers provides individuals with a means to enhance their skills and performance (Wu & Chen, 2017). Perceived usefulness remains a vital indicator for investigating the behavior of individuals in learning environments (Singh & Sharma, 2021). While individuals' initial acceptance and participation in MOOCs can be explained through technology acceptance, investigating individuals' motivation for continued use requires further research. To enroll in MOOCs, internal and external environmental factors such as self-development and social recognition drive sales professionals. For the present study, satisfaction influences sales professionals' continued intentions to use MOOCs. Perceived usefulness explains the initial acceptance (Venkatesh & Davis, 2000); satisfaction provides a path for examining the route from initial acceptance to confirmation and continued intentions (Bhattacherjee, 2001).

Studies have examined the influence of perceived usefulness on satisfaction (Filieri et al., 2021; Singh & Sharma, 2021; Yan et al., 2021). Filieri et al. (2021) investigated the continued intentions of consumers toward online tourism services. The study revealed that usefulness influences customer satisfaction, further impacting their continuance usage. Similarly, in the context of mobile health apps, the perceived usefulness of the apps led to satisfaction and further continued intentions of its users. Singh & Sharma (2021), in their study on MOOCs as an internship alternative, provided support for the relationship between perceived usefulness and satisfaction. Few studies were conducted in different online service settings and, hence, lacked the understanding of sales professionals enrolling for MOOCs and their continued use. Thus, we propose this hypothesis:

> H4. Perceived usefulness positively influences the satisfaction of sales professionals using MOOCs.

Next, concerning the relationship between perceived usefulness and continued intentions, studies have shown a positive relationship (Daneji et al., 2019; Huang & Ren, 2020; Wu & Chen, 2017). Daneji et al. (2019) indicated a positive relationship between the perceived usefulness of MOOCs and the intentions of individuals to continue to use these courses. In the case of mobile health apps, a similarly significant relationship between perceived usefulness and consumers' continued intentions was reported (Huang & Ren, 2020). A study by Cho et al. (2009) explored the influence of perceived usefulness and satisfaction on continued intentions for self-paced e-learning tools. The results indicated a significant relationship between perceived usefulness and satisfaction with the learners' continued intentions for the e-learning tools. Thus, we developed this hypothesis:

> H5. Perceived usefulness positively influences continued intentions to use MOOCs by sales professionals.

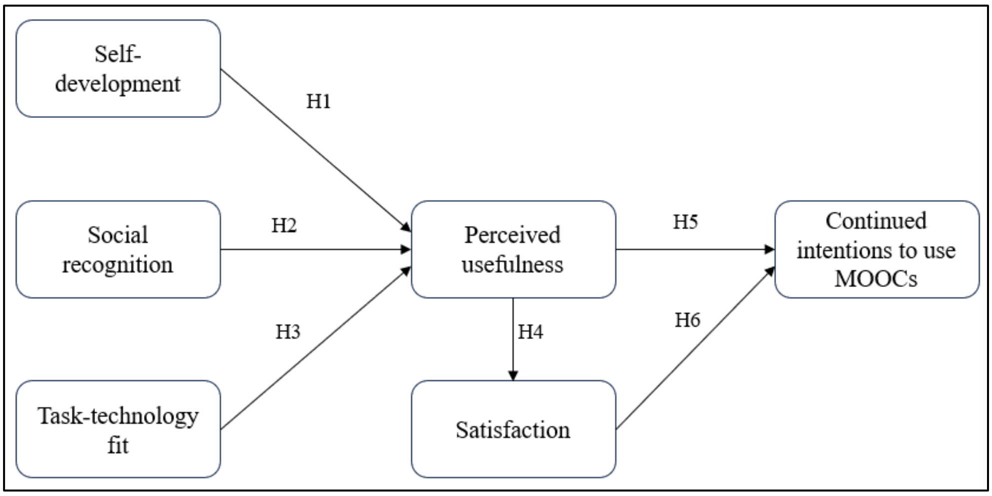
While studies have reported the relationships between the variables for either credit or non-credit-receiving individuals, no specific study has reported it for sales professionals. As discussed earlier, motivations for sales professionals to enroll in MOOCs might differ depending on educational settings. Sales professionals enrolling in MOOCs do so for various benefits related to career advancement, better pay packages, and learning new skill sets and technology. Hence, the influence of MOOCs' perceived usefulness plays an important role in determining satisfaction and continued intentions. Therefore, we propose this final hypothesis:

> H6. Satisfaction positively influences continued intentions to use MOOCs by sales professionals.

The proposed research model with the hypothesized relationships for the study is mentioned in Figure 1.

Figure 1

Proposed Research Model



Method

Participants and Procedures

The respondents to our survey were sales professionals working with organizations with roles and responsibilities related to business and industrial sales and marketing. The study sought to investigate the continued intentions of sales professionals to use MOOCs as a learning tool for gaining expertise and skills, self-development, and career enhancement. Business-to-business, industrial, or channel sales professionals require skills and expertise to close a sales call (Artis & Harris, 2007; Hunter & Perreault, 2006). In doing so, they may need to update their learnings and acquaint themselves with new technologies and marketing strategies (Rollins et al., 2014). We relied on a trade directory procured from a trade and commerce association to recruit participants. Upon contacting the sales offices of industrial manufacturers and service providers, we conducted thorough discussions with managers to gain access to their sales professionals. The sales professionals recruited for the study were directly involved in business and industrial product and service sales, having been in a similar role for more than two years. Furthermore, participants had previously used MOOCs for self-development and career enhancement.

Data collection was carried out from April to June 2023. Given the focus of the study to investigate the continued intentions of sales professionals to study in a MOOC, prior experience with MOOCs was considered a mandatory requirement for completing the questionnaire. Given the requirement of understanding the participants' intentions to continue using MOOCs, a face-to-face briefing was preferred over online recruitment. Ten associates were tasked with briefing the participants about the study, explaining the objectives of the research and creating consensus for participation. During the briefings, participants were informed about these aspects of the study: confidentiality and anonymity of the collected responses; unpaid participation; and, no compulsion for participation.

Instrument

The research used validated instruments from earlier studies (Daneji et al., 2019; Filieri et al., 2021; Hosen et al., 2021; Shon et al., 2021; Wan et al., 2020; Wu & Chen, 2017; Zhang et al., 2022) to measure the latent constructs (Fowler, 2002) (See Appendix). Self-administered questionnaires reduced risk related to the reliability of the data and eliminated differences emerging from questions and their representation (Fowler, 2002). The survey targeted the sales professionals' views on technologies and skills, self-development, increments, promotion, and career advancement.

The questionnaire consisted of 20 closed-ended multiple-choice questions. A 7-point Likert scale was employed, with responses ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Four experts from the areas of sales management and information systems established the face validity of the questionnaire. Acting on their directions, rewording a few items, and piloting the instrument with a small group increased the questionnaire's effectiveness and clarity. Based on the pilot, the time for completion of the questionnaire was noted and an introduction was added to familiarize respondents with the purpose of the research.

The survey was administered among consenting sales professionals in organizations primarily responsible for sales functions. The research employed purposive sampling as sales professionals using MOOCs for skills enhancement and self-development were considered for the study. Out of the 550 questionnaires sent out, 421 were returned. Fifty-five responses contained missing data and fields; after discarding these, 366 (66.5% response rate) were considered for the study.

Data Analysis

The study analyzed the data using two-step structural equation modeling (SEM). SEM enables estimating the multiple and interrelated dependent relationships among latent constructs with multiple indicators (Hair et al., 2019). Using a priori theory, the measurement model was developed, indicating the relationships between the target variables followed by confirmatory factor analysis (CFA). Further path analysis was conducted by testing the significance of the hypothesized relationships.

Results

Sample

The profile of the 366 respondents is shown in Table 1. Just under half of the respondents were females with more than half belonging to the ages between 26 to 41 years. As all the respondents were sales professionals, their experience in the domain varied from 2 years to 20 years with over half of them having sales experience between 5 and 20 years. More than three quarter of respondents had bachelor's education and above. The nomenclature for the educational qualifications is as per the Indian education system wherein a postgraduate degree constitutes a master's program and post-graduate diploma programs offered by institutions and universities. The detailed demographics are presented in Table 1.

Table 1

Demographic Characteristics of Participants

Characteristic	*n*	%
Gender		
Male	191	52.2
Female	175	47.8
Age group		
18–25	64	17.5
26–33	102	27.9
34–41	109	29.8
42–49	51	13.9
50–57	21	5.7
58 and above	19	5.2
Work experience		
< 2 years	24	6.6
2–5 years	117	32.0
5–10 years	112	30.6
10–20 years	104	28.4
> 20 years	9	2.5
Education		
Non-matriculation (education below 16 years of age)	12	3.3
Matriculation (education up to 16 years of age)	27	7.4
10+2/Intermediate (education up to 18 years of age)	44	12.0
Graduate (bachelor's degree)	150	41.0
Postgraduate (master's degree)	133	36.3

Note. *N* = 366.

Measurement Model

Two indicators (SR3 = 0.423, TTF4 = 0.466) were deleted after the first CFA due to very poor standardized regression weights (Hair et al., 2019). The new CFA results provided an acceptable fit for the data set and measurement model with χ^2/df = 1.039, CFI = 0.995, GFI = 0.906, NFI = 0.929, RMSEA = 0.018, and an incremental fit index of 0.996. The Cronbach's alpha values ranged from 0.863 to 0.934, indicating good reliability with the AVE values providing adequate convergent validity (Hair et al., 2019). See Table 2 for details of the CFA. The discriminant validity was examined using Fornell and Larcker's (1981) approach and comparing the square root of AVE and its correlations with other constructs. The discriminant validity of all the constructs was established, as shown in Table 3.

Table 2

Results of Confirmatory Factor Analysis of the MOOC Continuance Survey

Construct	Item	Factor loading*	Cronbach's alpha	CR	AVE
Self-development (SD)	SD1	0.800	0.898	0.901	0.661
	SD2	0.822			
	SD3	0.819			
Social recognition (SR)	SR1	0.847	0.877	0.878	0.678
	SR2	0.832			
	SR4	0.824			
Task-technology fit (TTF)	TTF1	0.817	0.894	0.894	0.662
	TTF2	0.824			
	TTF3	0.821			
	TTF5	0.789			
Perceived usefulness (PU)	PU1	0.821	0.901	0.902	0.687
	PU2	0.818			
	PU3	0.814			
Satisfaction (SAT)	SAT1	0.826	0.863	0.870	0.692
	SAT2	0.842			
	SAT3	0.817			
	SAT4	0.811			
Continued intentions to use MOOCs (CI)	CI1	0.900	0.934	0.935	0.788
	CI2	0.896			
	CI3	0.890			

Note: *N* = 366. CR = composite reliability; AVE = average variance extracted.

* These are standardized regression weights as per a six-factor measurement model.

Table 3

Discriminant Validity Testing of the MOOC Continuance Survey

Construct	1	2	3	4	5	6
1. Self-development	(.762)					
2. Social recognition	.623**	(.919)				
3. Task-technology fit	.578**	.539**	(.882)			
4. Perceived usefulness	.591**	.689**	.443**	(.720)		
5. Satisfaction	.485**	.357**	.436**	.502**	(.854)	
6. Continued intentions to use MOOCs	.681**	.637**	.588**	.595**	.537**	(.832)

Note: Square root of AVE is given on the diagonal in brackets.
$^{**}p < .01$.

Structural Model

The proposed model provided an adequate fit based on the output results (χ^2/df = 1.564, CFI = 0.963, NFI = 0.919, incremental fit index = 0.971, RMSEA = 0.057). Self-development, social recognition, TTF, perceived usefulness, and satisfaction explained 83.45% of the variance of continued intentions to use MOOCs (Hu & Bentler, 1999).

Examining the path loading for the hypothesized model revealed that three factors positively influenced perceived usefulness: self-development (β = .139; $p \leq .001$); social recognition (β = .485; $p \leq .001$); and TTF (β = .591; $p \leq .005$), thus supporting H1, H2, and H3. Perceived usefulness positively influenced satisfaction (β = .357; $p \leq .001$) and continued intentions to use MOOCs (β = .521; $p \leq .001$), thus supporting H4 and H5. Satisfaction also positively influenced continued intentions to use MOOCs (β = .263; $p \leq .005$), supporting H6. See Table 4. Also the path loadings for the hypothesized research model are shown in Figure 2.

Table 4

Results of the Structural Equation Modeling of the Research Hypotheses

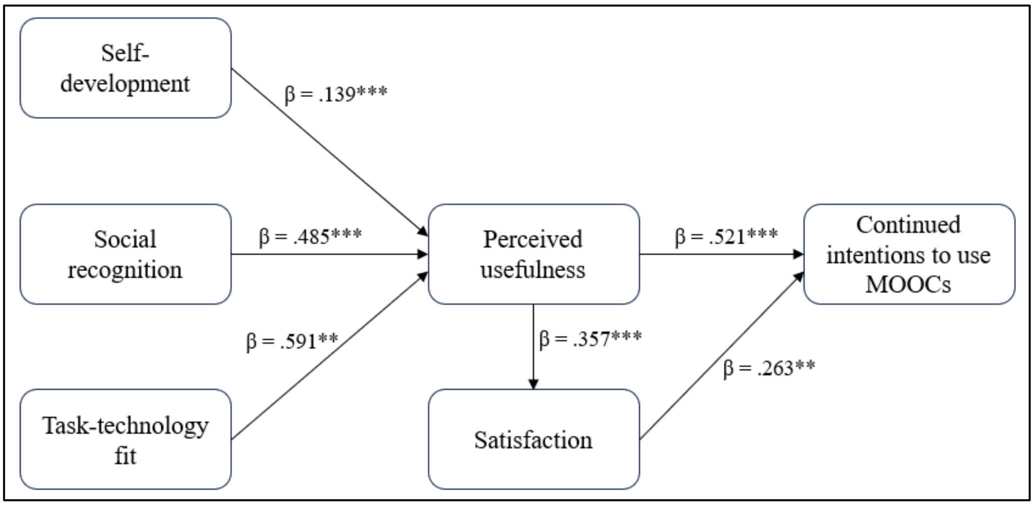
Path	Coefficient	*t*	*p*	Result
H1: SD → PU	0.700	5.837	.001	Supported
H2: SR → PU	0.362	4.102	.000	Supported
H3: TTF → PU	0.589	8.693	.003	Supported
H4: PU → SAT	0.288	3.454	.000	Supported
H5: PU → CI	0.544	8.204	.000	Supported
H6: SAT → CI	0.235	3.767	.002	Supported

Note. H = hypothesis; SD = self-development; PU = perceived usefulness; SR = social recognition; TTF = task-technology fit; SAT = satisfaction; CI = continued intentions to use MOOCs.

The Sobel test was used to examine the significance of the mediating effect of satisfaction on the relationship between perceived usefulness and continued intentions ($z = 5.66$, $p \leq .05$).

Figure 2

Path Loadings for the Hypothesized Model



Note: $^{**}p < .005$. $^{***}p < .001$.

The examination of variance depicted the R^2 of perceived usefulness and satisfaction as 37.4% and 62.6%, respectively, with 78.2% for continued intentions, demonstrating a good explanatory power of the research model.

Discussion

This study focuses on understanding the antecedents responsible for sales professionals continued intentions to use MOOCs. The research results have implications for sales professionals and organizations that seek to promote their learning and development.

The study's first hypothesis, that self-development positively impacts the perceived usefulness of MOOCs for sales professionals, is supported, indicating that individuals participate in MOOCs for self-development, to learn new skills, and to improve their existing knowledge (Hosen et al., 2021; Kim et al., 2021; Zhang et al., 2022). The first hypothesis has a strong positive relationship compared to the rest. The sharing of ideas and the collective contribution of learners can benefit the self-learning process, leading to a positive perception of the usefulness of MOOCs. The results also support the influence of social recognition on the perceived usefulness of MOOCs for sales professionals and align with the earlier studies (Hosen et al., 2021; Lassk et al., 2012; Zhang et al., 2022). This attests to the argument that individuals' exhibited behavior is influenced by their observations of others (Bandura, 1986; Martin et al., 2014). In this research, we show that sales professionals undertake self-directed learning initiatives based on their intrinsic motivations stemming from a desire for career advancement along with extrinsic factors influenced by peer networks. Among other influences, sales professionals undertaking MOOCs may be motivated by future career growth, new skills, strategies, and technologies. Organizations also encourage sales professionals to undertake online courses for skills enhancement.

This external motivation, combined with the social recognition offered to the individuals, increases the usefulness of enrolling in MOOCs.

The second hypothesis suggests the influence of social recognition on perceived usefulness of MOOCs by sales professionals. The results support this hypothesis, indicating that sales professionals sometimes take MOOCs for social recognition among their peers, work colleagues, and other social groups.

The third hypothesis suggests that the TTF has a favorable effect on the perceived usefulness of MOOCs for sales professionals. The study results support this hypothesis, indicating that a greater fit between the task and the technology helps individuals perceive the system as more useful, leading to continued participation in MOOCs. The results demonstrated a strong relationship between these factors. Similar results have been found in past research on TTF and its influence on the perceived usefulness of MOOCs (Wan et al., 2020; Wu & Chen, 2017). When comparing MOOCs to traditional classroom settings, MOOCs provide individuals with greater control, interactive features, better navigation and search, and communication with other learners, facilitators, and instructors.

This study also examines the relationship between perceived usefulness, satisfaction, and continued intentions. Perceived usefulness measures learners' beliefs that MOOCs are an effective means to enhance their performance. The study findings indicate that satisfaction influences sales professionals' continued intentions to use MOOCs. The results concur with earlier studies conducted in various contexts (Filieri et al., 2021; Singh & Sharma, 2021; Yan et al., 2021). Perceived usefulness remains a vital indicator for investigating the behavior of individuals in learning environments, and satisfaction provides a path for examining the route from initial acceptance to confirmation and continued intentions.

Implications

This study's theoretical implications and contributions are significant in advancing the understanding of MOOCs as a technology-enhanced learning tool in the workplace, especially for sales professionals. By identifying the key factors that influence the continued use of MOOCs, the study provides insights into the factors that drive professionals in these fields to participate in self-directed learning. The study highlights the importance of social recognition, TTF, and satisfaction in promoting the continued use of MOOCs among sales professionals. Consistent with earlier studies, the research provides an understanding of the applicability of the social cognition theory by validating the intentions of sales professionals to enroll in MOOCs (Kim et al., 2021; Mısır & Işık-Güler, 2022). The study provides theoretical underpinnings for the applicability of social cognition theory in the context of self-directed learning initiatives. This can provide useful information to MOOC designers and providers on how to structure and design their courses to meet the needs of these learners.

The practical implications of this study are significant for both sales professionals seeking self-development and upskilling through MOOCs and for MOOC designers and providers. For sales professionals, the study highlights the importance of self-directed learning, social recognition, and TTF in shaping their perception of the usefulness of MOOCs. The study findings suggest that MOOCs provide a valuable opportunity for self-development and upskilling and that individuals who engage in MOOCs with the goal of self-development are likely to perceive them as useful. Furthermore, social recognition and relationships play a significant role in motivating sales professionals to enroll in MOOCs, and TTF is a critical factor that influences the perceived usefulness of MOOCs. For MOOC designers and providers, the study provides implications that have a bearing on the motivators that drive sales professionals to participate in MOOCs and the specific aspects of TTF that are most important to this target group. By understanding these factors, MOOC designers and providers can design more effective courses that meet the needs and expectations of sales professionals.

Limitations and Future Scope of Research

This research considers the continued intentions of sales professionals to undergo self-development using self-directed learning tools such as MOOCs. The research findings are limited to the continued intentions to use MOOCs by professionals engaged in sales and marketing activities. Future studies must be conducted in other contextual settings to generalize the results.

The applicability of the social cognition theory in the present context yielded the desired results, thus implying its usefulness. Further studies could consider other constructs for further investigating this field. The self-determination theory (SDT) was not considered for this research, as it posits innate choices made by individuals in the absence of external influences. The present study considered SCT owing to its application in the research, though further researchers could consider SDT given its theoretical underpinnings in the present context.

A longitudinal study may provide varied insights into the actual use of MOOCs by sales professionals. Future research could also consider the interplay between employer sponsored training and voluntary training initiatives to chalk out patterns arising from it.

The sample for this research was context-specific and centered on sales professionals from India. Applying the research in different geographies could provide useful insights, perhaps reinforcing the present research and its results.

Conclusion

This study highlights the importance of MOOCs as a technology-enhanced learning tool for sales professionals. The study sheds light on the key factors that influence the perceived usefulness of MOOCs, including self-development, social recognition, and TTF. The research also emphasizes the role of satisfaction in predicting the continued use of MOOCs among sales professionals.

The study’s theoretical implications contribute to the existing literature on technology-enhanced learning and learner behavior, providing insights into the motivators that drive professionals to participate in self-directed learning. The study’s practical implications are significant for both sales professionals seeking to enhance their self-development and upskilling through self-directed learning and MOOC designers and providers seeking to develop more effective courses that meet the needs of sales professionals. The study provides valuable information for organizations seeking to promote employee learning and development and highlights the potential benefits of MOOCs in achieving these goals.

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Appendix

Sources of Construct and Items

Construct	Item	Statement	Source
Self-development	SD1	Participation in the MOOCs allows me to learn new things.	Nov et al., 2010
	SD2	Participation in the MOOCs enables me to become more proficient.	
	SD3	Participation in the MOOCs enhances my expertise.	
Social recognition	SR1	I feel valued and appreciated when others acknowledge my achievements.	Bandura, 1989; Helm et al., 2013
	SR2	Receiving praise or validation from others motivates me to work harder and achieve more.	
	SR4	Non-recognition of my accomplishments discourages me.	
Task-technology fit	TTF1	MOOCs are fit for the requirements of my learning.	Wan et al., 2020; Wu & Chen, 2017
	TTF2	Using MOOCs fits with my educational practice.	
	TTF3	It is easy to understand which tool to use in MOOCs.	
	TTF5	MOOCs are suitable for helping me complete online courses.	
Perceived usefulness	PU1	MOOCs can improve my level in my specialty.	Davis, 1989
	PU2	MOOCs can improve my productivity in learning.	

	PU3	MOOCs can help me with my present studying schedule.	
Satisfaction	SAT1	I am satisfied with learning in MOOCs	Bhattacherjee, 2001; Spreng et al., 1995
	SAT2	I am pleased to study MOOCs for career advancement.	
	SAT3	I am content with the MOOCs for career progression and development.	
	SAT4	Learning in MOOCs is a very delightful experience.	
Continued intentions to use MOOCs	CI1	Using MOOCs for learning is a great idea.	Bhattacherjee, 2001; Taylor & Todd, 1995
	CI2	I intend to continue participating in the MOOC platform.	
	CI3	I plan to continue using MOOCs to learn new knowledge.	

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 25, Number 1

February – 2024

Addressing the Resource-Based View: Determinants That Drive Chinese Universities to Offer MOOCs

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Abstract

This study involved 51 Chinese universities from the Quacquarelli Symonds (QS) World University Ranking 2021. With based the resource-based view (RBV) as a framework, it aimed to identify the determinants of human resource capital that were related to universities' production of MOOCs. Three determinants were detected—size, lifelong learning, and proximity to the political centre. Both size and proximity to the political centre proved to be significant. The findings provide timely implications for university managers and suggest that the variety of management spaces be expanded to increase the portfolio of high-quality Chinese universities that facilitate the production of MOOCs. In addition, universities should increase their proximity awareness to remedy the disadvantages of uneven resource allocation due to geographical proximity.

Keywords: MOOCs, resource-based view, knowledge management, proximity

Addressing the Resource-Based View: Determinants That Drive Chinese Universities to Offer MOOCs

MOOCs (massive open online courses) are viewed as a means to promote and publicize universities, given increasing demand from students for online learning options coupled with the advanced information and communication technology (ICT; Wang et al., 2022). MOOCs have offered universities the opportunity to connect with students from different countries, which expands their profiles and increases their potential competitive advantages, given the influence of higher education marketisation (Howarth et al., 2022). Additionally, Chinese students have perceived the usefulness of MOOCs and continue seeking for appropriate MOOCs as an alternative way to improve themselves (Wang, 2023).

In particular, universities have been challenged to connect and incorporate diverse roles and facets of value-added management processes (Chatterton & Goddard, 2000). It is essential to ascertain the forces driving organizational success and competition regarding MOOCs. Therefore, understanding the determinants that affect Chinese universities in producing MOOCs is of the utmost importance considering the rapid expansion of online education; this is especially relevant given China's unique educational landscape and potential impact on global online learning trends.

This study aimed to identify and interpret the determinants affecting Chinese universities to produce MOOCs. Following the sample selection method from Zakharova (2019) and considering the impact MOOCs caused on university internationalization (Chuang & Ho, 2016), this study considered only the universities from the Quacquarelli Symonds (QS) World University Ranking 2021 (see Appendix, Table A1), given that leading universities initiated MOOCs before other universities with various online courses. The resource-based view (RBV) is an organizational framework that focused on the resources an organization can use to achieve its sustainable and competitive advantage (Barney et al., 2001). Therefore, this paper considered RBV as the theoretical framework to detect the determinants affecting Chinese university to produce MOOCs.

To begin, exploratory factor analysis (EFA) was used to identify the underlying factors among the data set. Ordinary least squares (OLS) and Tobit regression were adopted to further verify the relationship between the factors and the production of MOOCs, which could help us understand the determinants driving MOOCs' operation in universities.

Literature Review and Hypotheses

MOOCs in China

MOOCs are defined as an instructional approach that uses technologies to provide learners opportunities to access online courses freely worldwide (Wang et al., 2022). Zheng and Yang (2017) considered that MOOCs have changed the relation of supply and demand in terms of knowledge acquisition in China. Compared with traditional education, advances in ICT make MOOCs possible in practice. They also argued that universities should bear the support and service roles for producing and developing MOOCs. Hence, 14 Chinese MOOC platforms, established by enterprise and university respectively or jointly, have appeared since 2012 (Zheng et al., 2018). Most published literature has focused on six categories (Moreno-Marcos et al. 2018): (a) dropout, (b) scores prediction, (c) forum posts classification, (d) students' motivation, (e) relevance of content, and (f) students' and teachers' behaviour. Little literature has considered the university side and sought to identify the determinants that influence universities to produce MOOCs. This study served to bridge the research gap.

Resource-Based View

RBV is an organizational framework used in strategic management (Khanra et al., 2022); it focuses on the interaction of an organization's internal resources—which are variable, rare, inimitable, and non-substitutable—to determine the strategic resources an organization may use to achieve its sustainable and competitive advantage (Barney et al., 2001). The resources in RBV include tangible as well as intangible assets. Intangible resources hinder competitors' efforts to imitate and substitute in the short term, due to the inherent complexity and specificity of their accumulation process, including financial and capital assets, reputation, human capital, management skills, organizational processes, and an organization's information and knowledge (Battisti et al., 2022).

Focusing on higher education institutions (HEIs), researchers have expanded the RBV in researching global alliances (Sanders &Wong, 2021), competitive strategy making (Valaei et al., 2022), and information technology (IT) adoption (Karim et al., 2022). Institutional resources are essential for universities to achieve objectives (Williams, 2014). It is crucial for universities to manage the tangible and intangible resources that can be bundled to construct organizational capabilities to produce MOOCs as innovative educational products of HEIs. Therefore, this study used RVB as a research framework to identify the underlying determinants behind MOOCs and further interpret how these determinants, integrated as complementary capabilities, help MOOCs be successful in terms of higher education strategic management.

Research Model and Hypotheses

Empirical studies of higher education management have included measures of institutional resources as independent variables or control variables. This study considered the variables confirmed by Lowry (2004), Muscio et al. (2013), Sav (2013), Schlesselman and Coleman, (2013), and Ospina-Delgado et al. (2016). Several hypotheses were generated and are outlined below.

Wernerfelt (1989) considered an organization's age to be an intangible resource that impacted performance. In addition, Schlesselman and Coleman (2013) and Ospina-Delgado et al. (2016) determined the year in which a college was established to be significantly correlated with the performance of HEIs. Therefore, we proposed our first hypothesis:

H1: The age of a university positively influences it to produce MOOCs.

In terms of resource-related measures, Huang and Lee (2012) indicated that human resources were one of a university's essential internal resources, and they considered the number of teaching faculty to be an input variable (Sav, 2013). In this sense, we proposed a second hypothesis:

H2: The number of teachers positively influences a university to produce MOOCs.

Student enrollment has been viewed as a resource acquired by the university, which is a crucial indicator of institutional characteristics and a university's ability to achieve economies of scale (Worthington & Higgs, 2011). Therefore, we proposed a third hypothesis:

H3: The number of students positively influences a university to produce MOOCs.

Rothschild et al. (1991) indicated that the degree program portfolios offered by a university were a crucial resource factor for competing against rivals in the marketplace. Loukkola et al. (2020) stated that the number of degrees obtained at each of the bachelor, master, and doctoral levels were crucial indicators in funding mechanisms. Thus, we proposed our fourth, fifth, and sixth hypotheses:

H4: The number of bachelor programs positively influences a university to produce MOOCs.

H5: The number of master programs positively influences a university to produce MOOCs.

H6: The number of doctoral programs positively influences a university to produce MOOCs.

The location of university can be defined as geographical proximity, which has been well documented as being related to organizational outcomes such as innovation and knowledge creation (Catalini, 2018). Besides, the political environment has the capacity to influence education policies, school curricula, and investment in education and research (Boschma, 2005; Jowett & O'Donnell, 2014). For this reason, we proposed a seventh hypothesis:

H7: Proximity to the political centre (Beijing) positively influences a university to produce MOOCs.

Internationalization as a concept and strategic agenda is a diverse phenomenon in tertiary education (De Wit & Altbach, 2021). The international activities in universities have expanded dramatically, ranging from traditional study-abroad programs to foreign language programs. Loukkola et al. (2020) suggested that international students be part of statistics related to measuring internationalization. Therefore, we proposed our eighth hypothesis:

H8: The number of international students positively influences a university to produce MOOCs.

The number of post-doctoral positions played a crucial role in research productivity (Scaffidi & Berman, 2011). According to Chen et al. (2015) post-doctoral positions can be viewed as a university's research resource. Thus, we proposed a ninth hypothesis:

H9: The number of post-doctoral programs positively influences a university to produce MOOCs.

Hence, following the hypotheses above, we proposed the research model below:

Testable model: $NMC = \alpha + \beta 1Factor1 + \beta 2Factor2 + \cdots + \beta 9Factor9 + \varepsilon$

Where, NMC = the number of MOOCs; α = the intercept of the regression equation; β = coefficients of independent variables; and ε = error term.

Methodology

Data Collection

The data considered for this study were all secondary data from university Web pages, accessed from September to December, 2021. This period was selected because September was the first month of a new academic year for Chinese universities and all the data would be updated and presented through the university Web pages. Furthermore, based on the extant literature and discussion with professors who were experts in the field of online learning and higher education management, this study followed previous empirical methods for selecting variables. The number of MOOCs was the dependent variable, with the following independent variables: (a) age of the university (Year); (b) number of teachers (NT); (c) number of students (NS); (d) number of bachelor programs (NBP); (e) number of master programs (NMP); (f) number of doctoral programs (NDP); (g) number of post-doctoral programs (NPDP); (h) distance to Beijing (political centre of China; DB); and (i) number of international students (NIS).

Examining Variance Inflation Factors (VIF)

Table 1 presents the results of examining VIF for the independent variables and indicates that the variables were highly correlated and the multicollinearity issue exists. Therefore, factor analysis was used to elicit the data.

Table 1

VIF Values

Variable	Year	NT	NS	NBP	NMP	NDP	NPDP	DB	NIS
VIF	1.76	2.00	2.69	2.13	9.20	11.67	5.18	1.15	1.49

Exploratory Factor Analysis

This study adopted exploratory factor analysis to elicit information regarding interrelationships among the variables. Conducting exploratory factor analysis considered three stages, namely to assess the suitability of data, extract factors, and rotate factors.

Regarding the adequacy of a sample size, the consensus is that the larger the sample size, the better. Later studies have confirmed the adequacy of a small sample size, less than 50, for evaluation research (Costello & Osborne, 2005; Mundfrom et al., 2005). Therefore, a sample size of 51 was considered adequate for this study. In terms of the interrelationship among the variables, the correlation matrix approach has been recommended to look for coefficient values, the more there are coefficient values higher than 0.3, the more acceptable the sample size (Ogunsanya et al., 2019). We used the approaches of correlation matrix, Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, and Bartlett’s test of sphericity to confirm the conditions above. KMO statistics vary from 0 to 1, with values greater than 0.5 considered acceptable, values between 0.5 and 0.7 mediocre, values between 0.7 and 0.8 good, and values between 0.8 and 0.9 considered superior (Kaisier, 1974).

This study adopted principal component factor analysis to extract factors, and the varimax approach for factor rotation. In terms of factor loadings, greater than 0.3 are considered significant, greater than 0.4 are considered more critical, and 0.5 or higher are considered very significant (Hair et al., 2003).

OLS Regression and Tobit Regression

OLS is a type of linear least square method for examining the unknown parameters in a linear regression model based on the assumption of independent observations (Kashki et al., 2021). OLS selects the parameters of a linear function of a set of explanatory variables according to the principle of least squares, which minimizes the sum of squares of the difference between the observed dependent variable and the linear function prediction in a given dataset (Ahmad et al., 2021). In this study, OLS was considered one of the methods to model a dependent variable regarding its relationship with a set of independent variables. In comparison, the Tobit model (Tobin, 1985) was designed for estimating linear relationships among variables when the dependent variable is either left-censored or right-censored (Kumari et al., 2021). Thus, following the methods of Schlup and Brunner (2018), Tobit regression analysis was further considered as a robust test for validating the estimating results.

Results

Data Description

Table 2 shows the general variable description of the number of MOOCs.

Table 2

Data Description

Variable	Mean	Std. dev.	Min.	Max.
NMC	79.62745	68.33329	0	340
Year	90.23529	32.08837	11	128
NT	4,144.098	2,795.349	790	15,772
NS	3,6845.31	1,6401.76	8,024	73,677
NBP	86.13725	27.01779	29	141
NMP	106.2745	91.53209	7	398
NDP	70.17647	84.88574	3	337
NPDP	25.60784	12.95697	0	60
DB(km)	1,075.137	1,599.794	0	11,458
NIS	3,046.958	1,905.885	562	7,793

The Results of Exploratory Factor Analysis

Regarding the suitability of data, (see Appendix, Table A2) shows correlation coefficients and proves the inter-correlation strength among the variables in this study. Table A3 (see Appendix) indicates the data are appropriate for performing factor analysis with the KMO value of 0.703 and a significant P-value of 0,000. The values of communality (Table A4, see Appendix) further demonstrate the adequacy of a small sample size for this study since the average value is 0.729 and all the values are higher than 0.5.

Table 3 shows three values extracted with an eigenvalue of greater than 1, which explained 72.855% of the total variance, and the eigenvalue of the fourth factor is far from the reference value of eigenvalue of 1.

Table 3

Total Variance Explained

Component	Initial eigenvalue			Extraction sum of squared loading		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.915	43.498	43.498	3.915	43.498	43.498
2	1.467	16.301	59.799	1.467	16.301	59.799
3	1.175	13.056	72.855	1.175	13.056	72.855
4	0.800	8.889	81.744			
5	0.662	7.357	89.101			
6	0.472	5.249	94.350			
7	0.312	3.462	97.812			
8	0.149	1.650	99.462			
9	0.048	0.538	100.000			

Table 4 shows that three factors were generated, each impacting Chinese universities to produce MOOCs. Six variables were represented in the first factor, namely the (a) number of post-doctoral programs, (b) number of teachers, (c) years of existence, (d) number of students, (e) number of bachelor programs, and (f) number of international students. Given that the role of post-doctoral study is mainly for academic research, teachers were also required to conduct academic research. Size was the label we gave to this first factor. The second factor was represented by two variables—the number of master programs and the number of doctoral programs. We named this factor lifelong learning, given that the master programs (professional and academic) and doctoral programs were aimed at training people for pursuing careers (McCorkle et al., 2023). The third and final factor was represented by one variable, namely the distance to Beijing. Thus, we named this factor proximity to the political centre.

Table 4

Rotation Factors and Sums of Squared Loadings

Variable	Factor 1	Factor 2	Factor 3
NPDP	0.8496		
NT	0.7753		
NS	0.7095		
Year	0.6547		
NBP	0.6150		
NIS	0.5550		
NMP		0.9663	
NDP		0.9556	
DB			0.8188
Principal components statistics			
Eigenvalue	3.915	1.4670	1.1750
% of variance	43.498	16.301	13.056
Cumulative variance explained %	43.498	59.799	72.855

Results of OLS and Tobit Regression

Tables 5 and 6 both support the hypothesis of this study and show that the goodness of fit was considered. The two factors of size and proximity to the political centre indicated that the hypotheses as proposed were significantly supported except the number of master programs (H4) and the number of doctoral programs (H5). The positive correlation coefficients between the number of MOOCs and size indicated that the size of universities would increase the number of MOOCs produced. However, proximity to the political centre was found to be negatively correlated with the number of MOOCs, idicating that the closer universities were to the political centre, the fewer MOOCs they produced.

Table 5

OLS Regression Analysis Results

NMC	Coefficient	*SE*	*t*	*P* > |*t*|	[95% CI]	
Factor 1	0.5857016	0.1130429	5.18	0.000***	0.3578785	0.8135246
Factor 2	0.1365193	0.1130429	1.21	0.234	-0.0913038	0.3643424
Factor 3	-0.3113383	0.1130429	-2.75	0.009***	-0.5391614	-0.0835153
_cons	0.0408178	0.1118592	0.36	0.717	-0.1846196	0.2662552

Note. Prob > F = 0.0000; R^2 = 0.4492; Adj-R^2 = 0.4117.

* p < 0.1. ** p < 0.05. *** p <0.01.

Table 6

Tobit Regression Analysis Results

NMC	Coefficient	*SE*	*t*	P > |*t*|	[95% CI]	
Factor 1	0.5857016	0.1082304	5.41	0.000***	0.3677144	0.8036887
Factor 2	0.1365193	0.1082304	1.26	0.214	-0.0814678	0.3545064
Factor 3	-0.3113383	0.1082304	-2.88	0.006***	-0.5293255	-0.0933512
_cons	0.0408178	0.107097	0.38	0.000	-0.1748867	0.2565223
Var(e.y)	0.7419901	0.075729			0.589464	0.8945161

Note. Prob > Chi^2= 0.0000; pseudo R^2 = 0.2102.

*** $p < 0.01$.

Discussion and Conclusions

Size

In this study, the determinant of size (i.e., NPDP, NT, NS, Year, NBP, NIS) was considered the university's intangible resource within the RBV framework. The role of size should be stressed due to its impact on supply chain integration and sustainable performance. Studies have accentuated that size is an essential determinant for an organization, impacting the level of implementation for sustainability-oriented strategies and practices (Gallo & Christensen, 2011). Besides, many operational or strategic resources are associated with size, which could significantly impact the organization's ability to deliver projects (Carr and Pearson, 1999; Hong et al., 2019).

In China, MOOCs as the educational products of higher education involve high resource consumption, because MOOCs not only need to satisfy the diverse needs of students looking for alternative means to acquire new knowledge and skills, but also must strengthen universities' competitive advantage in the higher education industry. Size is an important factor analyzed in higher education management (Martínez, 2013) and is critical for promoting sustainability management and producing new projects (Hörisch et al., 2015). According to Williams (2014) size was considered one of the essential resources for universities, viewed as a proxy for the institution's operational and marketing capabilities. Therefore, big universities had an advantage in producing MOOCs to further implement their operational and marketing capabilities to meet the demands of students, as well as to reinforce their competence among HEIs. This was consistent with Ospina-Delgado et al. (2016) who found that size played an essential role in the production of MOOCs.

Lifelong Learning

The interface between lifelong learning and higher education has become increasingly important for updating professional skills. With the expansion of higher education, an increased proportion of the labour force is comprised of graduates (Brooks & Everett, 2008). Lifelong learning emphasizes the learning process wherein people can formally or informally engage in learning activities related to knowledge and skills necessary for personal, social, and employment-related demands (Taşçi & Titrek, 2019).

MOOCs could be seen as an opportunity to redesign dynamic environments with current learning styles, thus contributing to improving learning and lifelong learning (Ospina-Delgado et al., 2016). However, this determinants off NMP and NDP were confirmed as insignificant in impacting HEIs to produce MOOCs. As the existing literature has demonstrated, lifelong learning participants are mainly graduates rather than other groups of people (Brooks & Everett, 2008). Furthermore, graduate programs are aimed at training people for pursuing academic careers (McCorkle et al., 2023), which have been traditionally offered through face-to-face instruction rather than virtual. Additionally, academic procrastination has been one of the barriers for lifelong learning in HEIs (Barnová & Krásna, 2018).

Proximity to Political Centre

Proximity is often interpreted as geographical proximity, defined as the spatial distance between individuals or organizations, and considered as an external variable that stimulated the formation and evolution of institutions (Boschma, 2005; Christensen & Pedersen, 2018). There is a causal relationship between proximity to the political centre, and managerial and innovative operations (Funk, 2014). The political geography has a pervasive effect on investment in organizations, and those located in areas with strong control by the ruling party could experience greater opportunities, and more risk as well (Kim et al., 2012).

Our study has confirmed that proximity was a determinant that significantly impacted HEIs to produce MOOCs. This was consistent with the literature that organizational outcomes such as communication, social ties, innovation, and knowledge creation are positively associated with proximity to the political centre (Boschma 2005; Catalini, 2018). Furthermore, this study found that the coefficient of proximity to the political centre was negative—HEIs closer to the political centre produced fewer MOOCs than those farther away. This finding did not concur with previous studies, in which a positive relationship was observed between political proximity and the rate of investment.

In the current educational context in China, although the government is committed to improving education, there are considerable flaws in current educational processes; these affect educational equality, cost, and educational resources (Tang & Carr-Chellman, 2016). The universities located in Beijing can benefit from more opportunities and fundings brought by political geography, which highlights the issue of educational equality. However, after the COVID-19 pandemic, there has been a significant increase in the number of MOOCs and students have become accustomed to online learning. MOOCs, as an educational innovation, bridge the gap in educational equality. They offer hope to HEIs that are far from political centre without adequate educational resources to garner educational information and resources, address the inequality in HEIs, and further decrease educational cost. This represents the line regarding producing MOOCs that proximity for Chinese universities far away from political centre cannot be only viewed as the geographical disadvantage, but the opportunity to increase competence among the demand side of students and universities.

Conclusions

Following the COVID-19 pandemic, there was a significant increase in the number of MOOCs worldwide. In the educational industry, the sustainability and competitiveness benefits of delivering MOOCs are known, but among Chinese universities, the determinants that successfully impact MOOC production are diverse because different factors are responsible. Therefore, this study focused on the question of what determinants drive universities to produce MOOCs and aimed to identify and interpret the determinants affecting Chinese universities to produce MOOCs based on the RBV framework. In terms of results, except for lifelong learning, size and proximity to political centre were confirmed as significant determinants driving Chinese university to produce MOOCs.

Regarding the two perspectives of students' demand side and the competence among universities, the findings lent support to and aligned with studies in strategical management regarding higher education management. Therefore, it is recommended that efforts to increase the size of universities should be intensified; bigger universities perform better generating new competing projects such as producing MOOCs to satisfy the student's needs and strengthen their competitive capability. Awareness of proximity should also be intensified by those universities far away from the political centre to remedy the disadvantages of uneven resource allocation due to lack of geographic proximity.

Implications, Limitations, and Future Research Directions

This study was the first to explore and summarize the essential determinants behind MOOCs' operation in Chinese universities. In terms of theoretical implications, this study addressed the research gap of HEIs strategic management in the MOOC context and provided considerable variables for HEIs with respect to MOOC production.

This study further expanded the research scope of RBV in strategic management of HEIs by providing empirical evidence. As well, this study has extracted three new variables for future studies to explain the performance and strategy of universities regarding MOOCs. Focusing on managerial implications, size was proven to be a crucial determinant driving universities to produce MOOCs, indicating institutional resources are essential to operate new objectives for HEIs. Thus, this study suggested the universities should invest in fundamental resources and leverage their size to improve comprehensive competitive advantages and capabilities. Furthermore, proximity was also confirmed as a significant determinant influencing Chinese university to operate MOOCs. Thus, universities that are far away from the political centre with fewer educational resources, especially the universities located in the northern and western parts of China (e.g., Xinjiang Uygur Autonomous Region and Tibet Autonomous Region) could consider MOOCs to be a way to expand their profile regarding students' demands and marketing competence. Additionally, in light of the findings related to Chinese universities, universities outside China could further leverage their profile worldwide through MOOCs; the indicator of international students was positively involved in the determinant of size.

Addressing the limitations of this study, first, the sample size may have been a limitation, since we considered only Chinese universities from the QS ranking 2021, in line with Chuang and Ho (2016) and Zakharova (2019). Therefore, the future research could involve more Chinese universities from outside the QS ranking. The second limitation relates to data collection. University Web pages could not provide us enough detailed information such as the types of MOOCs these universities provided. The third limitation concerns the variables selected for this study. The literature has demonstrated both the lack of empirical evidence and the operationalisation of variables regarding MOOCs. The variables selected for measuring MOOC operations would differ, depending on country contexts and history due to cultural differences and parameters adopted for measuring success, which has also been advocated by a range of scholars (Welter, 2011). Thus, in future research, it would be interesting to establish a standard measurement for universities or HEIs, even if they have different contexts and are located in other latitudes. Given the increase in MOOCs, it is worth knowing the impact of these at regional, national, or international levels.

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Appendices

Table A1

Study Sample

International rank	University	Number of MOOCs
15	Tsinghua University	430
23	Peking University	208
34	Fudan University	123
47	Shanghai Jiao Tong University	161
53	Zhejiang University	363
93	University of Science and Technology of China	56
124	Nanjing University	184
246	Wuhan University	298
256	Tongji University	118
260	Harbin Institute of Technology	181
263	Sun Yat-sen University	62
279	Beijing Normal University	163
303	Xi'an Jiaotong University	298
323	Southern University of Science and Technology	17
377	Nankai University	62
387	Shanghai University	148
387	Tianjin University	84
392	Beijing Institute of Technology	152
396	Huazhong University of Science and Technology	121

432	Xiamen University	128
446	University of Science and Technology Beijing	82
449	Beihang University	61
462	South China University of Technology	78
485	Shandong University	441
493	Jilin University	170
493	Southeast University	166
501–510	East China Normal University	125
531–540	Northwestern Polytechnical University	95
531–540	Sichuan University	255
571–580	China University of Geosciences	17
581–590	Renmin University of China	85
591–600	Dalian University of Technology	231
601–650	East China University of Science and Technology	150
601–650	Hunan University	98
601–650	Jinan University	97
601–650	Shenzhen University	10
651–700	Beijing University of Technology	102
651–700	Central South University	169
651–700	Soochow University	97
701–750	China Agricultural University	104
701–750	Nanjing University of Science and Technology	67
701–750	University of Electronic Science and Technology of China	144

751–800	Beijing Jiaotong University	253
751–800	Chongqing University	143
751–800	Northwest University (China)	160
801–1000	Beijing Foreign Studies University	23
801–1000	Harbin Engineering University	41
801–1000	Lanzhou University	27
801–1000	Shanghai International Studies University	61
801–1000	Wuhan University of Technology	152
801–1000	Xi'an Jiaotong Liverpool University	0

Table A2

Correlation Matrix

	NMC	NIS	Year	NT	NS	NBP	NMP	NDP	NPDP	DB
NMC	1.0000									
NIS	0.4607*	1.0000								
Year	0.5226*	0.3324*	1.0000							
NT	0.4848*	0.2818*	0.2679*	1.0000						
NS	0.3031*	0.2416*	0.2273*	0.5961*	1.0000					
NBP	0.2641*	0.3174*	0.4042*	0.4337*	0.6646*	1.0000				
NMP	0.2598*	0.2626*	0.1885*	0.1262*	0.2880*	0.4501*	1.0000			
NDP	0.3122*	0.3334*	0.2126*	0.2108*	0.3802*	0.5183*	0.9370*	1.0000		
NPDP	0.6191*	0.5376*	0.5423*	0.6551*	0.6965*	0.6290*	0.4513*	0.5642*	1.0000	
DB	-0.1433*	-0.0974	-0.0754	-0.0184	0.1983*	0.0943	-0.0746	-0.0842	0.0239	1.0000

Note. * means variables related.

Table A3

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy	Bartlett's Test of Sphericity		
	Chi-square (approx.)	*df*	Sig.

KMO = 0.703	240.763	36	0.000

Table A4

Communalities Values

Variable	Description	Initial Communality	Extraction Communality
Year	Years of existence	1.000	0.552
NT	Number of teachers	1.000	0.617
NS	Number of students	1.000	0.764
NBP	Number of bachelor programs	1.000	0.642
NMP	Number of master programs	1.000	0.942
NDP	Number of doctoral programs	1.000	0.961
NPDP	Number of post-doctoral programs	1.000	0.863
DB	Distance to Beijing	1.000	0.687
NIS	Number of international students	1.000	0.529
Average Values		1.000	0.729

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 25, Number 1

February – 2024

Empowering Asynchronous Arabic Language Learning Through PDF Hyperlink Media

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Abstract

The migration to online learning has brought about several new problems. Poor signal quality, large Internet quotas, and device compatibility with learning applications are the most common complaints among students. Additionally, students' poor self-directed learning skills, the excessive number of assignments given by teachers, and the use of monotonous teaching methods and media are also identified as issues. Therefore, the development of learning media that facilitate students' learning processes and support their active engagement becomes crucial. This research aimed to develop PDF hyperlink learning media for online Arabic language learning at Madrasah Aliyah Negeri 4 in Hulu Sungai Tengah District, South Kalimantan, Indonesia (MAN 4 HST). The research model used in this study is the 4D model, consisting of four stages: define, design, develop, and disseminate. In this research, layout and accessibility received good validation scores of 4.3, and the presentation of the contents received a good validation score of 4.2. Additionally, the Wilcoxon test results indicated that the use of PDF hyperlink media significantly influences learning outcomes and receives positive feedback from students. Thus, the use of PDF hyperlink media is recommended for educational institutions experiencing digital divides, as well as those implementing asynchronous learning.

Keywords: Arabic learning, asynchronous, learning media, online learning, PDF hyperlink

Introduction

Despite progress in integrating digital technology into Arabic language learning in Indonesia, there are still several problems. One major issue is limited access to the required infrastructure, especially in rural or remote areas (Simamora et al., 2020). There is a digital divide in Indonesia, both in terms of geography and economy (Rasmitadila et al., 2020). Some students may not have access to adequate digital devices or internet at their homes. This can create inequality in learning and deepen the gap between affluent and less privileged students.

Effective integration of digital technology might be hindered in certain areas due to insufficient internet connectivity and inadequate hardware which present obstacles (Turnbull et al., 2021). Both students and teachers often experience problems gaining the requisite skills for using applications, online platforms, or specific software. Sufficient curriculum and training are crucial to guarantee student and teacher expertise in using technology.

Although there are many digital learning tools available, it can be difficult to discover suitable and excellent materials for studying the Arabic language in Indonesia (Reimers et al., 2020). The lack of digital material that is connected with the curriculum and suitable for local needs can impede the effective integration of technology (Bonfield et al., 2020). It is crucial to acknowledge that failed technology integration might happen when online learning just duplicates conventional classroom approaches (Chand et al., 2020). Efficient incorporation of technology should entail a deliberate choice of platforms and tools, guided by educational objectives rather than technological demands (Christopoulos & Sprangers, 2021).

Research has shown that digital technology has the potential to provide a worldwide learning environment that gives students a wide range of materials. This promotes efficiency in terms of cost and time, and also improves the interaction between students and teachers (Haleem et al., 2022; Serrano et al., 2019). Nonetheless, the shift to online learning must be a methodical and meticulously organised procedure, given that traditional and online learning have distinct planning phases and supporting elements. Furthermore, the preparedness and competencies of both teachers and learners have a substantial impact. Madrasah Aliyah Negeri 4 in Hulu Sungai Tengah District, South Kalimantan (MAN 4 HST), lacks preparation for online learning among its students (Riwanda et al., 2022, 2021).

In the initial phases of online learning adoption at MAN 4 HST, we discovered significant insights regarding the difficulties they encountered in this novel educational environment. Our investigation revealed that the shift to online learning led to an increased burden on students, as they had to handle a larger volume of assignments and independently engage with learning materials. Additionally, they encounter challenges when it comes to utilizing digital tools and navigating online learning platforms. This underscored the necessity for proper direction in using digital resources.

Furthermore, we observed that students encountered device constraints, such as insufficient storage and RAM, which impeded their capacity to access and preserve digital content. In addition, students exhibited passive learning tendencies, mainly depending on content provided by teachers, which may be less successful in an online setting that requires active participation. The volatile internet connections in the region exacerbated the difficulties, and students faced limited access to online contents due to internet restrictions.

Theoretical Framework

To ensure successful self-directed Arabic language learning at MAN 4 HST amidst digital disparities, we implemented a comprehensive strategy. This approach prioritized engagement through interactive activities, collaborative assignments, and discussion platforms, acknowledging variations in technology and Internet access. It aimed to ensure usability across diverse devices, including those with limited specifications. To accommodate students with restricted data, educational contents were optimized for reduced data usage, featuring compressed formats and offline access options. The ability to access resources on multiple devices provided flexibility for diverse learning preferences. This strategy offered a resilient solution for continuous learning during the COVID-19 pandemic, effectively addressing digital divide challenges.

The digital divide greatly affects the efficacy of online education. The insufficiency of device specs and the subpar quality of Internet connection provide challenges for students to engage in online learning and avail of learning contents. In the context of online learning, the PDF (portable document format) is significant for its potential to address these obstacles. PDF is a versatile file format that aids in achieving significant goals in online education, including promoting active student participation, ensuring accessibility, enabling data conservation, and facilitating compatibility across platforms (Hadaya & Hanif, 2019). Furthermore, PDF ensures a consistent format across many devices and operating systems (Triyason et al., 2020).

Hyperlinks are a valuable feature of PDF documents. Embedded hyperlinks in PDF publications establish linkages with external resources, such as websites or supplementary reading contents, thus enhancing the educational experience (Gurevych et al., 2022; Håkansson Lindqvist, 2019). PDFs enable teachers to generate engaging and comprehensive resources, guaranteeing universal access and seamless navigation for all students, irrespective of their device specs. Hyperlinks facilitate convenient access to external resources, augmenting engagement and fostering self-directed research.

The inclusion of hyperlinks inside PDFs can seamlessly incorporate diverse contents, providing students with an engaging and interactive educational experience (Alpizar-Chacon et al., 2020; Alpizar-Chacon & Sosnovsky, 2021). This methodology establishes a connection between fundamental ideas and additional resources, such as films and interactive games, which encourages active engagement from students (Lang & Baehr, 2023). PDF hyperlinks facilitate both asynchronous online learning in low-resource environments and the transmission of content in several formats, promoting meaningful interactions between teachers and students (Abou-Khalil et al., 2021).

The research questions are as follows:

1. What is the quality of PDF hyperlink learning contents for the purpose of Arabic language acquisition?

2. What is the efficacy of using the PDF hyperlink learning medium for the purpose of Arabic language acquisition?

Methodology

Research and Development Design

This research and development study was conducted on students taking 10th grade Arabic language at MAN 4 HST and followed four stages: defining, designing, developing, and disseminating (Thiagarajan, 1974).

Front-End Analysis

First, we conducted a front-end analysis to ensure the specifications of the PDF hyperlink learning media would be aligned with the challenges and characteristics of the students, including initial Arabic language competency, motivation to participate in Arabic language learning, and ability to use digital devices in learning. In this stage, we also performed a concept and task analysis to determine what would be needed to achieve the desired Arabic language learning goals, formulate specific learning objectives based on the previous analysis of tasks and concepts, determine the evaluation measurement format, and establish the learning contents to be delivered.

Learning Media Design

Based on the analysis conducted in the first stage, we took the following steps to design the learning media:

1. Determined the form and appearance of the developed media, which is PDF hyperlink;
2. Determined whether the learning contents would be best presented through narration or text;
3. Prepared the script, for explaining the contents, to be presented in video format; and
4. Developed evaluation instruments to measure learning outcomes.

In the third stage, we submitted the developed PDF hyperlink media product to two experts for validation: a learning media expert and a content expert. After the product was validated, we made revisions based on the experts' feedback and proceeded to the next stage.

PDF Hyperlink Implementation

In the fourth stage, we implemented the PDF hyperlink learning media in the 10th grade Arabic language class at MAN 4 HST. There were 32 students chosen randomly to take part in this stage. Implementation used an experimental method one-group pretest-posttest design to determine the effect of using the PDF hyperlink media on learning outcomes.

Results

Learning Conditions Faced by Students in Arabic Language Learning

We began with an exploration of the learning conditions faced by students through front-end and learner analysis. The migration to online learning posed a significant challenge for students because learning contents were previously available only in printed form. Following in-depth student interviews, we found six categories of online Arabic learning challenges as translated from Indonesian language below:

1. Difficulty managing study time due to the increased workload of reading assignments and completing tasks on student worksheets.

2. Struggles in finding additional learning contents, as students were not accustomed to online content searches and relied on printed textbooks.

3. Difficulty comprehending learning contents independently, as students were used to teachers' explanations.

4. Issues with device compatibility and storage limitations, hindering the use of certain digital learning files and new applications.

5. Adaptation challenges from the previous use of the grammar translation method in Arabic language education, making independent text translation using a digital dictionary unfamiliar.

6. Challenges with practice and product-based assessments, as students were more accustomed to formative evaluations involving fill-in-the-blank or multiple-choice questions.

The frequency of each category and sample statements are shown in Table 1.

Table 1

Online Learning Conditions Faced by the 10th Grade Students

Category	Frequency, *n*	Sample Statement
Numerous assignments make time management challenging	28	"The teacher consistently assigns tasks in every session, making it challenging to manage time to complete them all."
Finding additional references or learning contents	22	"Normally, learning contents are provided by the teacher. However, during online learning, we are required to find additional contents on our own, but we were never taught how to search for them."

Category	Frequency, n	Sample Statement
Focused on Grammar and Translation method (*Qawaid wa Tarjamah*)	18	"Usually, the teacher guides us by reading and translating directly. However, during online learning, we are asked to translate on our own, making it difficult."
Product-based assessment	26	"Usually, exams are only in the form of multiple-choice questions. However, during online learning, there are various types of assessments, such as creating videos and others."
Incompatible device	30	"The teacher once sent learning contents in EPUB format, but we were unable to access them."
Inadequate self-directed learning skills	25	"Self-studying at home is challenging because we are usually guided directly by the teacher."

Note. *N* = 149.

Challenging Content in Arabic Language Learning

We conducted an analysis of the essential concepts and tasks required to achieve the desired objectives in the Arabic language course. To conduct this analysis, we asked students to complete an online questionnaire, focusing on the most challenging learning contents and tasks. These are shown in Table 2.

Table 2

Most Challenging Contents and Tasks and Their Frequency According to the 10th Grade Students

Content	Frequency, n	Task	Frequency, n
Grammar (*Qawaid*)	127	Make sentences using the rules of the language you have learned	141
Reading text (*Qiraah*)	86	Analyze the rules of language in sentences	102
Conversation (*Hiwar*)	77	Practice conversations using existing language rules	95

Note. *N* = 149.

Based on these analyses, we defined the most suitable media for Arabic language learning, taking into consideration the current conditions of online learning during the COVID-19 pandemic and the characteristics of the 10th grade students at MAN 4 HST. The specifications for this online Arabic language learning media were as follows:

1. Accessible flexibly anywhere and anytime.

2. Accessible on all Android/iOS-based devices without requiring additional new applications.

The developed PDF hyperlink media also offered several benefits for asynchronous Arabic language learning adaptation. These advantages include the following:

1. Supports active student participation and collaboration in learning.

2. Focuses on Arabic language rules and provides progressively challenging tasks based on higher order thinking skills (HOTS).

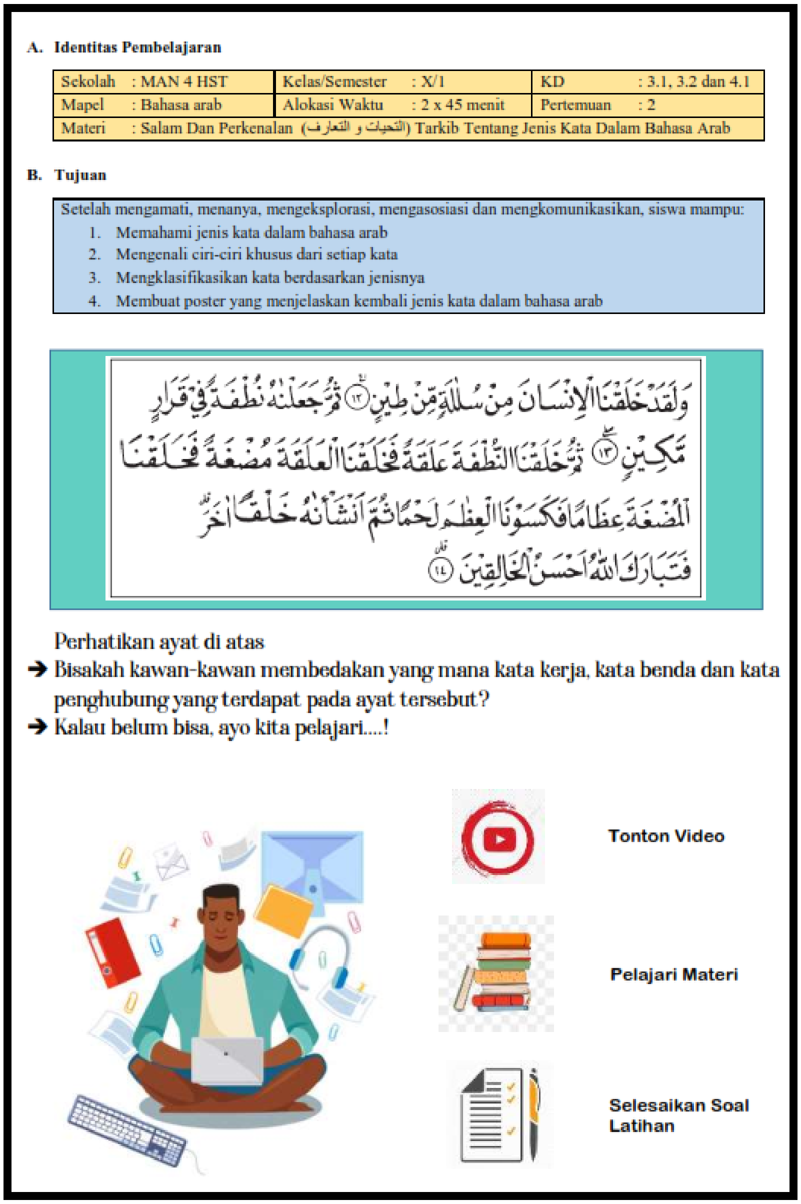
3. Integrates teacher explanations elaborated with project tasks and other learning resources as scaffolding for students' transition to independent learning.

Product Overview

In this stage, we developed PDF hyperlink media that could be accessed without requiring a large amount of data and without the need for specific application installations, thus suitable for low-end devices. The file size of the developed PDF hyperlink media was only around 500 kilobytes. Despite its relatively small size, it included learning identity, learning objectives, and probing questions to stimulate students' curiosity. Additionally, we embedded links in the PDF, including video explanations of the content, instructional material, and assessment via Google Forms. An example of the media is shown in Figure 1.

Figure 1

Sample PDF Hyperlink Media Home View for 10th Grade Arabic Language Class



A. Identitas Pembelajaran

Sekolah : MAN 4 HST	Kelas/Semester : X/1	KD : 3.1, 3.2 dan 4.1
Mapel : Bahasa arab	Alokasi Waktu : 2 x 45 menit	Pertemuan : 2
Materi : Salam Dan Perkenalan (التحيات و التعارف) Tarkib Tentang Jenis Kata Dalam Bahasa Arab		

B. Tujuan

Setelah mengamati, menanya, mengeksplorasi, mengasosiasi dan mengkomunikasikan, siswa mampu:
1. Memahami jenis kata dalam bahasa arab
2. Mengenali ciri-ciri khusus dari setiap kata
3. Mengklasifikasikan kata berdasarkan jenisnya
4. Membuat poster yang menjelaskan kembali jenis kata dalam bahasa arab

وَلَقَدْ خَلَقْنَا الْإِنْسَانَ مِنْ سُلَالَةٍ مِنْ طِينٍ ﴿١٢﴾ ثُمَّ جَعَلْنَاهُ نُطْفَةً فِي قَرَارٍ
مَكِينٍ ﴿١٣﴾ ثُمَّ خَلَقْنَا النُّطْفَةَ عَلَقَةً فَخَلَقْنَا الْعَلَقَةَ مُضْغَةً فَخَلَقْنَا
الْمُضْغَةَ عِظَامًا فَكَسَوْنَا الْعِظَامَ لَحْمًا ثُمَّ أَنْشَأْنَاهُ خَلْقًا آخَرَ
فَتَبَارَكَ اللَّهُ أَحْسَنُ الْخَالِقِينَ ﴿١٤﴾

Perhatikan ayat di atas
- ➔ Bisakah kawan-kawan membedakan yang mana kata kerja, kata benda dan kata penghubung yang terdapat pada ayat tersebut?
- ➔ Kalau belum bisa, ayo kita pelajari....!

Note. Learning identity is in the yellow box, learning objectives in the blue box, big questions related to learning topics to stimulate students' curiosity in the green box. Hyperlinks to access contents are embedded in video, book and assessment paper icons.

The PDF included hyperlinks to videos housed on Google Drive, allowing for immediate streaming or downloading. The videos had file sizes ranging from 40 to 60 megabytes. These videos, produced using the Filmora and Kinemaster programmes, provided concise discussions and illustrations. A still frame from one of the videos is shown in Figure 2.

The instructional material links led to documents, published on Google Drive, that had a file size of less than 1 megabytes. They included mind maps, pertinent examples, and graphics to facilitate students' rapid and succinct comprehension of the information.

The assessment links directed users to Google Forms where evaluation tools were presented in the form of quizzes that could only be accessed once to deter cheating. These quizzes offered instant response, showing scores and marking accurate and inaccurate answers. Furthermore, also through Google Forms, we offered project-based exams, allowing students to submit videos, photos, or other project forms. The evaluation categories in the PDF hyperlink sheet corresponded to particular rubrics customised for each item, governed by competency standards and learning objectives.

Figure 2

Still Frame From Video Learning Media Developed for 10th Grade Arabic Language Class

Note. Taken from the video on preposition in Arabic.

We decided to deliver this course asynchronously, knowing that it might be strange to students accustomed to rigid timetables in conventional classrooms. With the asynchronous model, students have flexibility to learn at their own speed, while still meeting specific deadlines for reading contents, pre-recorded lectures, assignments, and tests. This model enables students to exert control over their allocation of study time based on their own choices and circumstances. We implemented a mandatory, organised language rule practise within each one-week timeframe, without the conventional process of taking attendance. Student attendance was determined instead by the prompt completion of evaluations.

In order to facilitate the use of learning contents and support the transition, we also created separate WhatsApp groups for each class, enabling students and teachers to engage.

The PDF hyperlink sheets for each content were shared through those WhatsApp groups. These sheets provided interactive resources for supplementary information and helped to enhance understanding of linguistic norms. Students were urged to engage with teacher and classmates during specific time periods, promoting cooperative learning and significant conversations.

To provide further assistance to students, the teacher arranged videoconference sessions using Google Meet. These facilitated immediate engagement, allowing students to inquire and participate in live discourse. This tailored strategy mitigated the constraints of asynchronous learning by guaranteeing prompt and all-encompassing instruction. It facilitated the bridging of potential disparities in social contact and immediate feedback, which sometimes arise in asynchronous learning.

Quality of the PDF Hyperlink Media

The researcher submitted the developed product to a learning media and a content expert. The scoring guidelines used by the two experts to assess the suitability of the developed media are shown in Table 3.

Table 3

Experts' Assessment Criteria for PDF Hyperlink Media Developed for 10th Grade Arabic Language Classes

Score	Assessment	Criteria
5	Very good	Meet the criteria of Accuracy and fact-checking, objectivity, relevance and context, clarity and structure, creativity and originality, technical quality
4	Good	Meet the criteria of objectivity, relevance and context, clarity and structure, creativity and originality, technical quality
3	Enough	Meet the criteria of relevance and context, clarity and structure, creativity and originality, technical quality
2	Not enough	Meet the criteria of accuracy and fact-checking, objectivity, creativity and originality, technical quality
1	Bad	Meet the criteria of accuracy and fact-checking, objectivity, relevance and context

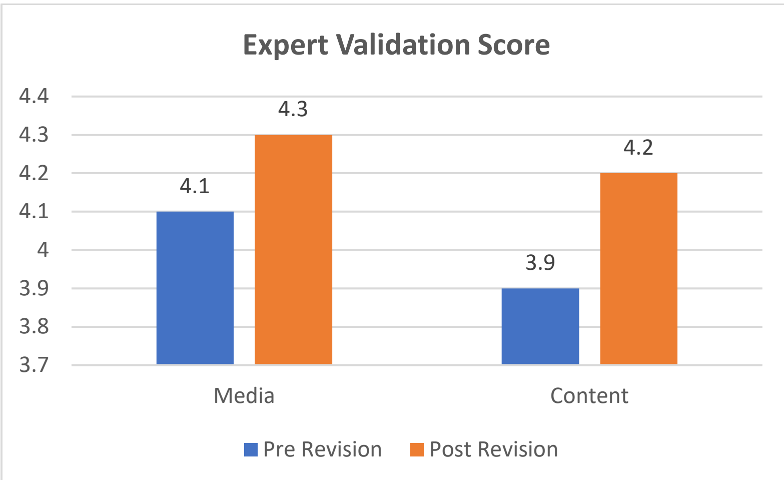
The content expert provided some improvement notes. First, the variety of evaluations should be enriched. Second, the cognitive taxonomy in evaluations should be raised to a higher thinking skill. Third, new content should be related to previous content to ensure coherence. Lastly, the probing questions should be designed to be implementable according to students' knowledge level.

The media expert also suggested several improvements to the PDF hyperlink media, including increasing the size of the text to highlights their importance and grab attention, rearranging the layout for links, and using formal language.

We then made minor revisions based on the feedback and again had the experts assess the content using the same criteria as shown in Table 3. Our experts found there were further improvements. Comparative results, pre- and post-revision, are shown in Figure 3.

Figure 3

Results of PDF Hyperlink Media and Content Expert Validation Pre- and Post-Revision



Note. Assessment scores: 5 = very good; 4 = good; 3 = enough; 2 = not enough; 1 = bad.

See Table 3 for explicit criteria used in assessment. The media validation score increased from 4.1 to 4.3 after the adjustment, indicating a positive outcome within the good category. The content validation score increased from 3.9 to 4.2 after revision, indicating a positive improvement and placing it in the good category.

The Effectiveness of PDF Hyperlink Media

After revision and reassessment, we implemented the PDF hyperlink media product into the Arabic language course for the 10th grade students. This PDF hyperlink media focused on the topic of types of sentences (*aqsamul kalam*) during the first semester. The objective of this implementation was to assess the influence and efficacy of the PDF hyperlink media on students' comprehension and engagement.

A group of 32 students were randomly selected from the 10th grade was given the PDF hyperlink media, which was specifically designed to cater to individual needs and difficulties. By using the PDF hyperlinks, these students could conveniently access supplementary resources such as instructional materials, videos, and audio recordings to enhance their understanding of types of sentences (*aqsamul kalam*), thereby having an engaging and interactive learning experience.

Throughout the implementation process, we evaluated the influence of the PDF hyperlink media on student learning outcomes. Our data came from conducting evaluations, gathering student feedback, and collecting teacher responses. The outcomes were expected to offer valuable understanding on the efficacy of this educational content.

For this evaluation, we used a one-group pre-test post-test model consisting of three steps. First, an evaluation was carried out to measure students' understanding of different sentence forms. Subsequently, the PDF hyperlink media was implemented in an asynchronous learning environment. Finally, the identical evaluation was conducted again to gauge enhancements in student scores between the pre-test and post-test. The results of this three-step evaluation, showing improvement in test scores, are displayed in Table 4.

Table 4

Pre- and Post-Test Scores of Students Using PDF Hyperlink Media on Aqsamul Kalam

	Pre-test	Post-test
M	62.50	85.16
Mdn	60.00	85.00
Mode	60	80
Minimum	50	75
Maximum	75	100

Note. N = 32.

Before data analysis, we evaluated the normality of our data, a requirement for parametric statistics. If the data were normally distributed, the analysis would use the paired sample *t*-test formula. However, if the data distribution were not normal, the analysis would use non-parametric statistics with the Wilcoxon formula. The normality test was conducted using the Shapiro-Wilk formula. Our decision-making for the test results was as follows: if the significance value (Sig.) was greater than 0.05, then the data would be considered normally distributed. Since we calculated Sig. values less than 0.05, we deemed the data distribution not normal, and therefore, we used the Wilcoxon formula in the next steps of our analysis. The results of the normality test are shown in Table. 5.

Table 5

Results of the Data Normality Test on Student Scores Pre- and Post-Test

Test type	Shapiro-Wilk normality test		
	Statistic	*df*	Sig.
Pre-test	.930	32	.039
Post-test	.911	32	.012

The Wilcoxon test was applied to this research as follows: if the Sig. was less than 0.05, then there would have been a significant influence of the media usage on learning improvement. However, if the Sig. was greater than 0.05, then the generated influence would not have been significant. The results of the Wilcoxon test, displayed in Table 6, showed an Asymp. Sig. (2-tailed) value of 0.000, which is smaller than 0.05.

Therefore, it can be concluded that there was a significant influence of using the PDF hyperlink media to improve Arabic language learning outcomes.

Table 6

Wilcoxon Test Results Measuring the Effect of the PDF Hyperlink Media on Student Scores

Test statistic	Post-test – Pre-test
Z	–4.989[a]
Asymp. Sig. (2-tailed)	.000

Note. [a] Based on negative ranks.

Students' Feedback and Teacher Responses

During post-implementation interviews, students reported the PDF hyperlink media was highly accessible and user friendly. They highlighted the convenience of being able to open PDF files on their smartphones without the need to install additional applications. This ease of use contributed to a seamless learning experience.

Students also expressed satisfaction with the numerous learning resources, encompassing videos, and instructional material. The short videos, ranging from 5 to 10 minutes in length and featuring concise explanations, were accompanied by background music, enhancing the learning experience by making it more engaging. The instructional material provided comprehensive explanations and abundant examples and were accompanied by useful mind maps to facilitate understanding.

Students valued the diverse assessment techniques and the ability to track their progress in real-time, which allowed them to adapt their learning approaches. The students emphasized the advantages of asynchronous learning, which enabled them to effectively allocate study time and modify their learning environment in order to guarantee a reliable Internet connection. This method catered to various learning styles and preferences, allowing students to study while engaging in activities such as listening to music or snacking, as long as their main objective of getting favourable evaluation outcomes was fulfilled.

Further details of student feedback post implementation are shown in Table 7.

Table 7

Student Feedback Grouped by Theme and Category Post Implementation of the PDF Hyperlink Media

Theme	Category	Frequency, *n*	Example quotation
Accessibility	User-friendly	32	"It's easy to use." "Even low-spec smartphones can access learning." "I just tap the book or video icon, and I can learn leisurely."
	Adaptive to digital divide	22	"It does not require additional applications to access." "It's accessible even without a high-quality Internet connection, and it saves mobile data."
Student engagement	Emotional engagement	28	"I become more enthusiastic about learning." "Online learning is now more than just doing assignments from teachers." "I look forward to the next learning because I quickly receive feedback from the previous one."
	Behavioral engagement	30	"I appreciate the flexibility in completing assessments." "Receiving relatively quick feedback is great." "I can adapt my learning style through video explanations and accessible text contents." "Online learning becomes more relaxed; no need for face-to-face via Zoom."
	Cognitive engagement	17	"The presence of concept maps really helps me understand the content." "The integration of interactive simulations enhances my understanding of abstract concepts."
	Agentic engagement	21	"This media supports me to learn independently."

Following the implementation, we conducted interviews with teachers to gather responses on the PDF hyperlink media. The teachers highlighted two significant insights. Meaningful learning interactions are facilitated when students have acquired the necessary knowledge prior to online class sessions. Furthermore, the allocation of learning time is adaptable due to the ability to overcome the need for direct content explanation through the use of learning videos and concept maps.

Discussion

Educational institutions highlight multiple crucial factors while implementing distance learning. First, their primary priority is on improving their educational technology infrastructure (Almaiah et al., 2020; Batmetan et al., 2023; Joseph, 2023). This includes enhancing technological resources, providing stable Internet access, and optimizing digital platforms and learning management systems (Azlan et al., 2020; El Firdoussi et al., 2020; Heng & Sol, 2021) to create a smooth online learning experience for both teachers and students.

Educational institutions prioritize addressing the issue of Internet connectivity during the implementation of distance learning (Adedoyin & Soykan, 2023; Sofi-Karim et al., 2023). Their efforts include enhancing and broadening Internet accessibility, engaging in partnerships with service providers, providing subsidies for Internet usage or allowances for mobile data, and investigating connectivity options in regions with restricted access.

Furthermore, educational institutions facilitate the preparation of and assistance for teachers and students in adapting to online learning. They offer professional development initiatives for teachers to improve their proficiency in digital literacy and pedagogical expertise (Falloon, 2020; Kasperski et al., 2022; Li & Yu, 2022). Students are provided with instruction and assistance to effectively traverse online platforms, use digital tools, and adjust to the virtual learning environment (Blau et al., 2020). In addition, educational institutions prioritize the mental well-being of students, teachers, and stakeholders by offering emotional support, counselling services, and mental health resources to address the potential difficulties and stressors that may arise from distance learning (Lee et al., 2021; Liu et al., 2022; World Health Organization, 2020). The objective is to establish a nurturing and all-encompassing online learning atmosphere that fosters mental and emotional health and a feeling of being part of a community.

Almanthari et al (2020) research emphasized the obstacles encountered in online education, such as restricted device capabilities, unreliable Internet connections, and the necessity to quickly adjust to novel learning methods. Teachers also encounter difficulties when creating and executing online instructional procedures. The research conducted by Azhari and Fajri (2022) highlighted the obstacles that prevent instructors from effectively using Information and Communication Technologies (ICT) devices and online learning platforms. These barriers are mostly caused by variables such as the teachers' skills and abilities, the economic conditions of parents, restricted Internet access, and the absence of proper direction. Wahyuni and Komariah (2021) proposed several solutions, including ongoing assessment of learning plans, providing customized resources and media for rural learning, and modifying tests to prioritize the mastery of specific topics for reliable analysis of learning outcomes.

The disparity in the quality and availability of digital learning spaces requires teachers to implement asynchronous learning (Al-Husban & Tawalbeh, 2023; Soydan Oktay & Yüzer, 2023). Asynchronous learning is the best alternative to ensure continuous learning during the COVID-19 pandemic, which implements distance restrictions. However, Huang (2020) reminded us that during the pandemic, one of the determining factors in generating students' interest in asynchronous learning was selecting the appropriate learning media. Therefore, the creativity of teachers in designing and implementing online learning, including methods, media, and evaluation stages, plays a crucial role in the meaningfulness and success of learning.

Challenges in online learning, such as limited data quotas and unstable Internet connections, must be addressed by providing digital learning media that are low data and easily accessible (Cheshmehzangi et al., 2022; Lembani et al., 2020). Teachers are also advised to choose and use learning media that are suitable and easily accessible for students according to their specific conditions (Ali, 2020; Churiyah et al., 2020), such as using module-based media. One common and user-friendly format for learning modules is the Portable Document Format (PDF). PDF can package and link various content elements such as images, fillable forms, audio, and video through hyperlinks.

In online learning, the interaction between teachers and students, as well as the interaction between students and learning content integrated within a learning media, is crucial. Therefore, media selection is an essential component of instructional design. Kustyarini et al. (2020) stated that learning media that integrate text, audio, and video elements play a vital role in achieving learning objectives, especially in the current digital era. Thus, delivering learning content in the form of text and integrating it with explanatory videos becomes crucial. Media enriches learning when well-designed and relevant to the instructional methods used (Abou-Khalil et al., 2021; Tuma, 2021). Afolabi (2021) stated that the features of a medium determine the success of learning because the format and features of media are directly related to students' learning styles and teaching strategies implemented by teachers. Previous studies have identified several attributes, including interactivity, flexibility, media richness, synchronicity, navigability, responsiveness, symmetry, display, participation, complexity, ease of use, feedback, demonstration ability, and individualization (Kristiana et al., 2023; Lusiyani & Anindya, 2021; Setiaji & Santoso, 2023).

In both synchronous and asynchronous online learning, the use of digital learning media tends to be more engaging and effective compared to print media. A study by Vo et al. (2019) on asynchronous learning revealed that students prefer and are more satisfied with learning through videos as compared to textbooks. More than three quarters (78.4%) of students expressed a preference for video-based learning over textbooks. Most students also expressed a high level of satisfaction with learning through videos. Asynchronous learning using electronic module media provides opportunities for students to access learning contents more flexibly, especially in conditions of unstable Internet connections and limited data quotas. Packaging learning contents in the form of asynchronous digital modules can be done, for example, by recording explanations from teachers in the form of videos or other audio formats. However, it is crucial to ensure active student participation by adding active strategies such as a series of questions to be answered while watching videos or listening to audio, making reflective notes, making statements, and similar activities (Chen et al., 2019; Hoang Oanh, 2020; Wang et al., 2019). A study conducted by Azlan et al. (2020)

also confirmed that 72.73% of students who watched instructional videos while answering short questions found that it improved their understanding of the presented topics.

Conclusion

Based on the validation results from learning media and content experts, the PDF hyperlink media developed received good ratings. The implementation results revealed that based on the Wilcoxon test, the significance value (Sig.) in the Asymp. Sig. (2-tailed) row was 0.000, which is smaller than 0.05. Therefore, it can be concluded that there is a significant influence in using PDF hyperlink media to improve Arabic language learning outcomes for 10^{th} grade students at MAN 4 HST in the first semester, specifically on the topic of types of sentences (*aqsamul kalam)*. Additionally, students also expressed that this media is easily accessible, provides multi-platform learning resources, and offers real-time evaluation. Furthermore, the asynchronous learning method applied in the use of PDF hyperlink media allows students to manage their time, place, and preferred learning style conveniently. This study emphasises the significance of adaptability and availability in the creation of online educational resources, particularly in regions impacted by the digital divide. Implementing technologies such as PDF hyperlink can address the issue of inadequate specifications of digital devices, poor Internet connection quality, and limited data quotas that affect students.

Acknowledgment

We would like to express our sincere appreciation to all those who have contributed to this research and the publication of this article. Heartfelt thanks are owed to the LPDP BIB Ministry of Finance of the Republic of Indonesia for their generous sponsorship and to esteemed media and learning content experts who provide valuable suggestions to improve the product. We are also deeply appreciative of the dedicated teachers and students of MAN 4 Hulu Sungai Tengah for their invaluable collaborative efforts throughout this research.

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International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 25, Number 1

February – 2024

Open Education and Alternative Digital Credentials in Europe

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Abstract

Learners who learn from OER often cannot have their learning assessed or receive a credential. Open credentials offer a potential solution to this problem, combining badges or micro-credentials with competence frameworks and digital seals. This study identified the current situation of open credentials in post-secondary education in Europe, the main themes of the discourse, and the points of agreement and divergence surrounding them. The data comprised a corpus of transcriptions from 12 expert interviews and a focus group. Qualitative text analysis identified the principal themes. Findings included the following: (a) few assessments are available as open content; (b) linking OER and credentials requires detailed and expensive work on learning outcomes and assessment; (c) the aggregation of open credentials to create higher-level qualifications is a widely accepted ambition; (d) the European Union's infrastructure to support open credentials is appropriate and effective and can foster trust; (e) the outstanding challenges are organisational and practical, not technological; (f) assessment and content provisions should belong to separate organisational functions; and finally, (g) funding and support for open credentials in professional accreditation are essential for further progress.

Keywords: OER, assessment, micro-credentials, badges, competence, specifications, infrastructure, business model

Open Education and Alternative Digital Credentials in Europe

Over a decade ago, Mackintosh, McGreal, and Taylor identified the core problem for open educational resources (OER):

> Individuals are free to learn from OER and other digital learning materials hosted on the Internet. The core problem is that learners who access these digital learning materials on the web and acquire knowledge and skills either formally or informally, alone or in groups, cannot readily have their learning assessed and subsequently receive appropriate academic recognition for their efforts. (Mackintosh et al., 2011, p. 2)

This problem has been addressed through multiple initiatives to create or support open credentials, in both formal education and lifelong learning. These include (a) badges, (b) micro-credentials, (c) competence catalogues linked to OER, (d) interoperability specifications for credentials and micro-credentials, and (e) alliances of institutions to deliver massive open online courses (MOOCs). The expert interviews and focus group carried out in this study examined how such approaches were being applied and identified salient themes and concerns in the discourse.

Scope and Context of the Study

Schools are often unable to innovate in awards, curricula, or assessment. We therefore focus on post-secondary education, in which states delegate the award of credentials to institutions and professional bodies.

Competences have long been seen as a way to make recruitment processes more effective and as a possible solution to the shortcomings of education in preparing citizens for employment. The history of competence-based approaches is too extensive and complex to summarise here, but it extends back to at least the influential paper by McClelland (1973). For a recent review of the field, see Škrinjarić (2022). Of particular relevance to the present paper was the work of the European Commission over the past decade in developing the European Skills, Competences, Qualifications and Occupations (ESCO) classification (European Commission, 2022) and more recently the DigComp digital competence framework (Vuorikari et al., 2022). Competence frameworks have also been adopted at the national level in Europe, for example in Germany (Federal Ministry of Education and Research, 2011). Increasing volumes of data about educational achievement have led to proposals for automated comparison of the competences of potential employees with the requirements for particular job roles (e.g., Boiko et al., 2021).

Increased economic integration has led to a need for comparison and equivalence of competences across borders, especially in a closely integrated economy such as that of the European Union. The Bologna Declaration (European Ministers of Education, 1999) called for the adoption of a system of easily readable and comparable degrees, together with a system of credits. This led to the further development of the existing European Credit Transfer Accumulation System (ECTS; European Commission, 2015), followed by the European Qualifications Framework (EQF) in 2008, which was revised in 2017. The European Commission described the EQF as “a common reference framework that allows qualifications from different countries to be compared easily." (European Commission, 2018, p. 2), and established the Europass service and tools to support it (see European Commission, n.d.).

A driver for alternatives to traditional credentials has been the 'skills gap' between increasing technological complexity and the capacity of citizens to carry out employment tasks (see, for example, Cornelius (2011), or Cappelli (2012) for a critical view). The European Commission (2016) noted that "40% of European employers have difficulty finding people with the skills they need to grow and innovate" (p. 2). Doubts have frequently been expressed about the capacity of traditional higher education (HE) courses, for example, to meet this challenge (Goulart et al., 2022). An early response was the use of open digital badges, defined by Fields (2015) as a digital signifier of accomplishments, skills, qualities, or experiences. These signifiers had embedded metadata that included the issuing organization, criteria for earning the badge, and evidence of the skill or knowledge acquired. The portability of the badges allowed badge earners to publicly share all learning experiences, whether acquired from formal or informal education settings, to social media sites like LinkedIn and Facebook.

More recently, the term micro-credential has become more prominent, but still corresponds to Fields' definition. Brown et al. (2021) have helpfully provided a summary of the various terms used to describe alternative digital credentials. The European Commission (2021) defined micro-credentials as "learning opportunities of smaller volume than for traditional qualifications [which] enable the targeted, flexible acquisition and recognition of knowledge, skills, and competence to meet new and emerging needs" (page 11). They added that "importantly, micro-credentials do not replace traditional qualifications. Instead, they can complement traditional qualifications and serve as a lifelong learning opportunity to all" (page 1). McGreal and Olcott (2022) offered a similar definition but add that micro-credentials "may or may not apply towards a higher credential" (page 3) suggesting that, *pace* the European Commission, there is indeed potential for micro-credentials to replace traditional qualifications.

Method

Semi-structured interviews of 45 to 65 minutes were conducted with experts, according to informed consent and data-processing arrangements that were approved by the UNIR Ethics Committee with the reference number PI049/2022. The interviewees were invited to edit their text, which all did except for one, which was then excluded. The first 10 interviews fed into the authoring of the ENCORE+ report "Credentialling learning in the European OER Ecosystem" (Griffiths et al., 2022). Then, two additional interviews were carried out. All interviewees were asked if they would like an edited transcript to be published, and eight took up this option (see UNIR, 2022). An online public focus group was also organised, with five interviewees plus one participant who had not been interviewed. The transcript was added to the body of text to be analysed. The resulting corpus contained 328,177 characters and is available to bona fide researchers via an application.

The objectives of the interviews were to identify and describe the:

- different ways in which knowledge obtained through OER is credentialled in OER repositories in Europe
- barriers to the certification of knowledge obtained through OER
- actions that could eliminate or mitigate the obstacles to the certification of knowledge obtained through OER

These objectives led to the following interview questions:

1. What is your involvement with OER repositories, now and in the past?
2. What credentialing approaches and methodologies for OER are you aware of? Relevant aspects include administrative processes, community actions, technological support, and mappings with curricula and competence structures.
3. What repositories do you know of which have considered implementing these approaches or methodologies (including your own work), and what were the results?
4. Which approaches or methodologies to credentialing learning through OER are, or could be, the most effective in providing a service to work-based learning and training as part of professional development?
5. What are the barriers to credentialing learning through OER that you have experienced or observed?
6. What practical solutions and mitigations to barriers to success have you identified and observed?
7. How can trust in the credentialing of learning through OER best be developed?
8. What are the most important actions that could be taken to enhance the effectiveness of credentialing learning though OER? Please think of some or all of the following:
    - learners
    - teachers
    - education and training providers
    - educational authorities and administrators
    - funders of research and innovation
9. Can credentialing through OER contribute to the sustainability of OER, and, if so, how?

Data Gathering

Interviewees were identified among the members of the ENCORE+ project or were recommended by those members, and 16 experts were invited. Given the large scale and range of activity in OER in Europe, it was not feasible to achieve a representative sample. However, an effort was made to include a range of countries and different professional roles. The 13 experts detailed in Table 1 provided their input, and the authors extend thanks to them all.

Table 1

Interviewees

Name	Sector	Organization	Country
Christine Jacqmot*	Academic	Université Catholique de Louvain	Belgium
Colin de la Higuera	Academic	Université de Nantes	France
Deborah Arnold	Sectoral organisation	AUNEGE	France
Don Olcott Jr.	Consultant	HJ Associates	Romania
Ebba Ossiannilsson	Sectoral organisation	ICDE International Council for Open and Distance Education, OER Advocacy Committee	Sweden
Gema Santos-Hermosa	Academic	University of Barcelona	Spain
Graham Attwell**	Consultant	Pontydysgu	Wales, UK
Ildiko Mazar	Industry	NTT DATA	Spain
Lorna Campbell	Academic	University of Edinburgh	Scotland, UK
Phil Barker	Consultant	Cetis LLP	Scotland, UK
Timothy Read	Academic	UNED	Spain
Ulf Ehlers	Academic	Baden-Wurttemberg State University	Germany
Yves Deville*	Academic	Université Catholique de Louvain	Belgium

Note: * Interviewed together; ** Only in the focus group discussion.

Analysis

The open-source QualCoder application was used to analyse the corpus of interviews. Although qualitative text analysis often seeks to identify an underlying conceptual structure or essence, this was not our purpose;

rather, the software resolved the practical problem of classifying and managing the many points made in a large corpus. The texts were coded, allowing multiple codes for the same section of text. The frequencies with which the codes were applied are shown in Table 2 to provide an indication of the content of the corpus, but they are not presented as statistical evidence.

Table 2

Codes Applied to the Corpus and Their Frequency

Code	Frequency	Code	Frequency
business model	52	sustainability	14
barrier	47	credentialing	13
assessment	42	learning outcomes	12
actions	35	verification	11
recruitment	28	badges	10
standards and specifications	26	MOOC	9
technology and infrastructure	23	competence	7
policy	19	community	3
aggregation	16	need	3
trust	15	quality	3
micro-credentials	14	courseware	2

The codes were clustered into themes; Table 3 shows the codes related to each theme and the total frequency of the codes for each theme.

Table 3

Themes, Codes, and Frequency

Theme	Codes	Total frequency in theme
Strategy	policy, barriers, action	101
Business models	business model, sustainability, need	69
Recruitment	recruitment	28
Assessment	assessment, learning outcomes, competence	61
Stackability	aggregation	16

Open credentials	credentialing, micro-credentials, badges, MOOC, courseware	48
Specifications (including competence frameworks)	standards and specifications	26
Trust	technology and infrastructure, trust, verification, quality, community	65

Reports were exported for these themes, containing all the coded text, organised by code and then by respondent. The reports were then examined to explore in greater detail the themes that had been identified. In order to distinguish a thread relating the different aspects to each other, the discussion here does not follow the order of frequency.

Discussion

Open Credentials

There was a consensus that it did not make sense to directly link OER with credentials, and no examples were found of repositories which issued credentials for the use of their resources. As Arnold (32–41) said:

> It's easier to see how you would deliver or issue a micro-credential for recognition of the use of an OER within a course. But I wouldn't say that you could . . . issue a micro-credential for the OER itself.

Similarly, Deville (125–127) emphasised that issuing a credential required the agency of individuals and/or institutions: quizzes or exam questions could also be open content, but this was not the assessment part. The assessment part is that someone organizes and chooses the assessment, and then decides if the student succeeds or fails. Santos-Hermosa (72–86) suggested it was simplest to use OER as part of an existing accredited course so they can be in parallel with other kinds of resources while the assessment remained the same. Such use of OER was seen as valuable but hardly met the original ambitions of the OER movement, for example the call in the Cape Town Open Education Declaration, 2007, for a "global revolution in teaching and learning" (Cape Town Open Declaration, 2017, page 25).

As Barker (78–80) commented, badges can be entirely self-asserted. "You can issue yourself with a badge that says 'I say that I know how to speak Spanish and you can test me on that if you want.' It's an assertion that you're making." Similarly, as Arnold (66–70) said:

> The whole badging movement is very much community-based, giving community recognition: "I will recognize you for this." It's very horizontal, very democratic. The micro-credentialing movement is more institutionalized. It is more the private training companies and higher education

> institutions that are looking at how they can break down their big whole degree offers into micro-credentials.

Most of the respondents emphasised MOOCs as vehicles for credentialing learning achieved through OER. For example, when asked for examples of credentialing learning from OER, Mazar (75) said "the things that immediately spring to mind are more MOOC platforms than OER repositories," while Read (182) gave the example that "in Madrid, the six or seven big players, their MOOC initiatives do successfully give certificates." However, MOOCs were, implicitly or explicitly, seen as a type of micro-credential. For example, Arnold (75) noted that "where we have seen micro-credentials taking off is for the recognition of MOOCs." The emphasis on MOOCs was stronger among interviewees from universities, whereas those in consultancy roles, in industry or in sectoral organisations spoke more of micro-credentials and badges.

Pedagogic Issues

If recognition of learning achieved through OER needs to occur through a validating institution, then the link between the institution and the OER inevitably involves assessment. Although not mentioned in any question, assessment was discussed repeatedly and by all but one of the interviewees, principally concerning how it should be paid for and documented. There was very little evidence in the corpus of assessment materials that were open content, and Campbell (139) was typical in attesting that "other than MOOCs, we don't really have individual open resources with assessment items embedded inside them." Mazar (198–200) ascribed this to a lack of capacity: "OERs take ages to develop then for the poor OER creator; to add more hours into the creation by coming up with an assessment and a credential, that's just too much extra effort for very little return." However, Deville and Jacqmot (388–391) argued that the underlying reason that credentialing learning from OER is problematic is

> because the marginal cost is zero for the openness and it's nonzero for credits. We want a learning pathway to be as open as possible, but as soon as we are dealing with assessment, then it cannot be fully open. It is just technically impossible.

In a traditional university it is usual that the same team designs both the course and the assessment of that course. This cannot be assumed for the assessment of learning from OER, which are designed (at least in principle) for reuse in different contexts. A process is therefore required to ensure that the assessment is appropriate for OER. Jacqmot (140–153) argued that consequently there needs to be a very strong alignment of learning outcomes between the OER and the assessment, with a rubric defining the learning outcomes corresponding to different levels of ability. She added that this is more often the case in the United States than in francophone or Latin education. Any format of learning outcome could answer this need, if accepted by both parties, but nine of the twelve interviewees discussed learning outcomes in terms of competence. The interviewees recognised the power of competence-based approaches, and the challenges in adopting them. For example, Olcott (449–451) stressed that "it's NOT easy when you have to sit down and you have to identify all those competencies and minimum skill levels and performance levels: it is a laborious and detailed process that requires very talented assessment people."

Similarly, de la Higuera (425–427), while supporting a competence-based approach, described the process as “tremendously tedious and difficult,” adding that “you have to again realign evaluation or assessment or accreditation with these competences, which is what I don’t think is being done.” Legal issues are an additional challenge, and Campbell (323–324) stressed that it is important for colleagues “to understand how open education resources can be used and understand the licensing and the copyright implications.”

Stackability

Competences, claimed through micro-credentials, can be combined to create a profile which meets the requirements for a higher-level credential or job role. All the interviewees accepted this as part of the rationale behind micro-credentials. For example, Ehlers (32–35) said:

> There is a vision . . . that micro-credentials . . . would in the future allow a very autonomous and self-organized way through learning opportunities that can then be coupled to each other and stacked on each other and then again, maybe also validated by an institution.

Mazar (154) believed that stacking could “make credentialing more sensible” for OER providers. However, Ehlers (35–36) believed that stacking “is still very experimental and does not exist for a broad user group.” He diagnosed the problem in Germany as the lack of a qualification framework. Olcott (74–76) also argued that “if you want to stack these micro-credentials onto, let’s say, a credit certificate, then you’re going to have convert it within some context so that it fits within that qualifications framework.” Barker (125–126) believed that “for many people, it would be very advantageous if they could learn in a way that suited their particular circumstances.” However, Barker (109–113) was concerned that “universities do a great job of aggregating together lots of different things that need to be learned in order to master a subject. There’s a risk of losing the expertise that’s required to build learning pathways.” Barker’s point was supported by Cameron and Rideout (2022), who showed how self-directed learning gives students responsibilities for which they may not be prepared.

The few successful examples of stacking which the interviewees reported did not use overarching frameworks. Rather, as Olcott (126-127) explained, they adopted the approach exemplified by OERu (see Mackintosh, 2017), to “bring a lot of different players together and come up with unique agreements that allow us to use this with greater transparency and more seamlessly.” Ossiannilsson (110–111) praised OERu for enabling students to “choose courses from all those places within the Consortia and then . . . go to, for example, Athabasca, to say: ‘Please issue my degree.’” Her assessment was that “it is working very, very well. However, I think it should have an even larger outreach, because not many know about it outside this community” (136–137).

Deville (Deville and Jacqmot, 252–262) reported on EVE, a similar ongoing initiative with 10 universities worldwide:

> Universities shared their own MOOCs for credit. . . . We had some dozen students from different universities. . . . The difficulties were mostly administrative, because each university has its own

> regulations for registering students. Timing was very difficult to handle (start and end dates of a semester, date of exams).

Moreover

> people are not always open to adding the new courses from outside. 'Come on, they need to follow my class, not someone else's class,' they say. It's a difficulty, so we have to convince faculties that opening their program to other universities is a good option. (267–270)

The agreements required for initiatives such as OERu and EVE have much in common with the recognition of prior learning. Ehlers (228–234) argued that this was much further advanced in North America than in Germany, even though Germany has a well-developed competence-based and publicly funded education system:

> Recognition of prior learning in Germany is, I think, institutionally quite underdeveloped. . . . In the US . . . they said 'The people who come to us can take tests and assessments, and we find out what they can do already. Then the curriculum they study for their next job profile, or their next qualification profile, only contains those things which they don't have yet.' This kind of idea in Germany is not very popular.

There was no evidence that the situation was different elsewhere in Europe, which implied a lack of existing practice on which stacking can be built.

Technical Issues

Specifications and Competences Catalogues

The interviewees were largely positive about the standards work done to support competences, competence frameworks, and micro-credentials, particularly as carried out by the European Commission. For example, Mazar (41–47) said:

> Now we have lots of other global and European standards and initiatives such as ESCO; the European Classification of Skills Competencies, Qualifications and Occupations; JRC's European Digital Competence Framework; the national and the European Qualifications Frameworks; UNESCO frameworks such as the ISCED fields of education the ISCED levels . . . these standards can greatly support the transparency and portability of digitally signed verifiable credentials.

Similarly, Deville (Deville and Jacqmot, 128–129) singled out the European Commission's contribution to "the very important component, which is an electronic seal, the digital equivalent of an institution's rubber stamp." Read (117–118) said "The European Commission has been doing an amazing job with Europass" while Ehlers (399–403) said "we need a framework to translate the different educational levels, and we have that through the European qualification frameworks. . . . We have the ECTS, we now have the definition of micro-credentials." Barker (144) emphasised the work of the World Wide Web Consortium on "how verifiable credentials can be used to represent educational qualifications, educational credentials."

Nevertheless, Ehlers (284–285) noted that despite this work, at the national level “there is no infrastructure of recognition. There are many qualification frameworks, but there’s nothing which has the status of serving as a reference, which is legally proven or guaranteed.”

In a similar vein, Barker identified the problem that representations of competences for different professions in different countries vary from country to country in their cultures and technical standards, adding that “it’s about meta-models rather than models now, about how you map what’s represented in Standard A into what’s represented in Standard B” (Barker, 271–273). Other interviewees had more fundamental concerns that too great an insistence on specifications and standards might constrain practice. Olcott (129–132) argued that:

> Europe is trying to go down the road with micro-credentials of coming up with one great big flavour that works for everyone. I think they’re making a mistake. I think you’ll have to make it so broad that it just won’t be flexible enough to deal with the diversity within each of the countries.

Similarly, Deville (354) doubted the need to develop a specification for learning pathways. “If we develop a protocol for this, that could kill many initiatives. I would like to let these pathways be organized, and I think evolution will drive the organisation.”

Trust and Technology

Lack of trust in credentials was identified as a major barrier, with de la Higuera (288) saying that “the system has now come to a point where nobody trusts anybody.” There was a consensus that two approaches could lay the foundation to address this. First, the evidence for learning must be explicit, and the standards described in the previous section can support this. Olcott (89–90) proposed that trust could be built “by engaging all key stakeholders in the creation and implementation of competency levels and skills certification criteria.” Similarly, Deville (383–385) argued that:

> The trust should be in the credit system. I don’t care where the learning outcomes have been obtained, I just want them to be there. Of course, it’s nice to have an effective OER and learning pathway and so on, but the trust must be in the assessment for the credit.

Mazar (265–273) highlighted the documentation of assessment methods. “Not all assessments are equal. . . . If the assessment is well enough described to show the credential viewer or verifier how trustworthy and believable the credential is, that would definitely support trust.”

Second, the identity of the issuing institution must be verifiable, and this is one of the functions of the digital infrastructure for micro-credentials. The interviewees were largely positive about the technical infrastructure developed by the European Commission for this purpose, including Europass and eSeals, which Read referred to as a “before and after in the question of the certification of open education, micro-credentials, digital micro-credentials, etc.” Mazar (50) stressed the importance of the legally binding eIDAS European standard for e-signatures, and Arnold (302–307) explained how

> the ECCOE project is based on the European Commission solution for European digital credentials for learning, and so the whole argument of our trust there is based on it coming from the European Commission, so it is trustworthy. But all these different trust mechanisms have built-in authentication checks, validation checks, and transparency. 'This credential has been issued by so and so, for this reason, it has been stamped here and it is valid and it hasn't been tampered with.'

However, none of the interviewees mentioned any other emerging technologies that might transform practice, or the need for them. Barker (253–257), whose work has a strong technical focus, said "the technologies are there. What's required is the . . . capacity to use the technologies. That doesn't mean the technologies don't still need developing but they will be developed as soon as there is the capacity to use them."

Similarly, Olcott (221) argued that digital transformation "is not about technology, it's about business models." De la Higuera (473–474) commented that "people are looking for technical solutions. It's not about technical solutions, not for the moment." As a full professor who specialises in artificial intelligence (AI), he was sceptical about the hopes for AI to provide automated assessment of learning obtained through OER and emphasised its tendency to embed existing poor practices. "If anything, AI proves that we're evaluating syntax and shallow semantics" (de la Higuera, 383–384).

On the same topic of making the most of existing technologies, Campbell (212–213) said that in Edinburgh University there is no OER repository because "we view the Web as our repository, and our strategy is to put resources where other people can most usefully find them."

Deville (401–405) took the opposite position, arguing that:

> We were able to convince people to contribute because it was a university repository. If we had only proposed putting the OERs on some European repository, I don't know if we would get the same motivation. Having clear visibility for individual contributions is important. But on the other hand, it's very important to be seen by the whole world, which means that our repository must be also integrated within larger repositories through harvesting.

Olcott (178–17) also favoured the use of repositories, but for a different reason, arguing that repositories enable institutions to maintain "the functions of good management and leadership" needed to run micro-credentials. Similar issues arose concerning MOOCs, which can either be hosted by the institution using their own learning management system or outsourced to one of the MOOC providers.

Business Issues

Recruitment

For learners, it is clearly important that their credentials, and the skills and knowledge which they document, are recognised by employers, and the interviewees recognised that this is a strong argument for competence-based education as a means for empowering learners through OER-based micro-credentials.

However, interviewees disagreed on the degree to which this approach could provide a basis for automated or semi-automated recruitment. For example, Mazar (239–247) was enthusiastic:

> There are so many applications for any job that human resource management systems will have to use some kind of algorithm to scan curriculum vitae and credentials for the candidate's suitability for the vacancy. If the data is structured enough and available in a digital machine-readable format, that would probably support the credential holder to prove their fitness for the vacancy. . . . I'm quite convinced that, sooner or later, this . . . would benefit citizens who have digital credentials.

In contrast, de la Higuera (183–187) was sceptical about this prospect:

> I can't see how I am going to be convinced by somebody who's going to arrive and say, 'Well, you know, I've had this, this and this and this certified by all these blobs.' I will give that person a chance. I would say: 'You've done a lot. Come into my office, let's talk about it,' and I would try to pinpoint some of those pieces of knowledge that you should have gathered through that.

Business Models

As noted above, in learning with OER it cannot be assumed that the same teams or institutions will be responsible for pedagogic materials, their design, and for assessments. This has implications for institutions' business processes, which led some interviewees to argue strongly that the two functions should be separated, while others gave no counter examples. Campbell described how

> alongside the OER service, where I work, in Edinburgh we have another service altogether called the online course production service. They are the team that build our MOOCs and free short online courses. Both services work together to ensure the majority of these courses are designed to be open by default.

Deville (385–391) stressed that

> we are very explicit on a clear separation between the platform where we provide open material, and any kind of system to do the assessment and to give credits. This should not be mixed, essentially because the marginal cost is zero for the openness and it's nonzero for credits, so it should be organized in a totally different way. We want a learning pathway to be as open as possible, but as soon as we are dealing with assessment, then it cannot be fully open. It is just technically impossible.

Deville and Jacqmot shared their work on forms of collaboration between institutions (Jacqmot et al., 2020), which articulated institutions' operations in open education into four quadrants: (a) the provision of content, (b) learning pathways, (c) interactions with teachers or peers, and (d) assessment. As Deville (369–376) discussed, the marginal cost is zero for quadrants (a) and (b) and non-zero for (c) and (d), consequently resulting in contrasting economic conditions. Various collaboration models can be derived delegating different quadrants, usually cumulatively ascending from (a) to (d). Olcott (103–104) stressed that for progress to be made "you must bring the key stakeholders to the table. Unless everyone agrees on what constitutes quality and competencies that demonstrated minimum skill levels . . . consensus building is first and foremost.” However, Jacqmot (140–163) warned that unbundling educational services is no simple matter:

> On both sides, on the side of assessment and on the side of OER, we have to define very precisely the learning outcomes that are developed. . . . I’m not sure it’s obvious how to tackle the outcomes when you are conceiving and producing the OER and the assessment in different parts of the world, and if we can hope that those two will be aligned.

Read (356–360) suggested that a friend-of-a-friend model might be a solution to dealing with this complexity:

> If for example, institution A respects institution B and the quality of their courses, and institution B respects institution C and the quality of their courses, then automatically institution A would accept courses from institution C. . . . When you move up to large agglomerations of educational organizations then you begin to see, maybe, light at the end of tunnel.

The interviewees all acknowledged that the alignment of learning materials with competence requirements, as well as the creation of learning paths and activities to assess learning achievement required funding, as do any teaching activities. Different models were proposed for this.

First, students can pay for courses. Olcott (436–452) argued that when working with OER it was reasonable for universities to charge for the design of courses, creation of learning paths for training and non-credit courses, and particularly for assessment. The cost of micro-credentials remains unclear. “In very technical areas they won’t be cheap. . . . It is a laborious and detailed process that requires very talented assessment people” (Olcott 441–451). Arnold (392–394) agreed that charging for assessment was to be expected, adding that “for some things you actually pay . . . 500 pounds to get the credential, because there’s a formal exam involved, or . . . identity verification of the person.” Read agreed, but cautioned that care should be taken when charging for access to MOOC content. Deville (308–311) argued that unless the sector can “demonstrate the added value of teachers’ interactions with students,” there is a danger that education will become dominated by online providers who “will just provide materials and credits, all the data will be recorded, and everything will be ‘free.’” Similarly, de la Higuera (172–173) identified the danger of offers to “click on a few buttons and then you get a micro-credential.” Such concerns about undermining the quality of existing educational procedures inevitably constitute a brake on institutions and teachers working with micro-credentials in connection with OER.

Second, institutions could decide to subsidise some open credentials because, as Deville argued “if you want to sell something, you have to show the client that what you are selling really has value” (297-298). This approach could generate a stream of future students. It could also align with a university’s mission. For example, Campbell (467–468) described how “Edinburgh University’s current mission and vision statement is about sharing knowledge to make the world a better place.”

Third, there was a strong consensus that there is a need for support from European states and the European Commission. As Read (172–173) argued: "if they want to have open education, open certification, etc., then they have to give us funds to make it possible." Similarly, Mazar (226–227) called for more national or European funding because "I don't think, realistically speaking, any institution would voluntarily sign up to put more effort into credentialing on a small scale." Support can also take the form of regulation that makes the publishing of open credentials more financially viable. As Santos-Hermosa argued (216–217), the state can ensure that open credentials are useful for professional accreditation, and this requires educators to engage with national quality agencies and with professional associations, a point also made by Olcott (85–86). Read gave the example of Portugal, where the government is providing funding to the Universidade Aberta, which is "trying to use digital micro-credentials and open education as a transverse mechanism for certifying everything. We're talking about firemen, policemen, everybody" (133-134). Read also saw companies as a possible source of funding, although he was alone among the interviewees in identifying this as an option.

Conclusions

These findings are based on in-depth data gathered from a relatively small number of respondents, and the results have strengths and weaknesses corresponding to this approach. We have identified themes in the discourse concerning open credentials and identified the principal issues and points of agreement and divergence. We believe that even with the small number of respondents, their expertise and high profile in the field as well as the data collection depth provide a good guide to the current state of the discourse in post-secondary education in Europe. On the other hand, no claim has been made for the relative importance of the themes nor their impact on the ground, nor were divergent opinions resolved. The principal themes and findings are summarised below. Our recommendation is simple: first, policy makers, ministries of education, and institutions should pay attention to these expert views when formulating policies and actions concerning open credentials; second, our findings should be treated as an agenda for further research with methods which can confirm or falsify our findings through more detailed case studies.

The Relationship Between OER and Alternative Open Credentials

There was a clear consensus in the interviews that any recognition of learning achieved through OER which would be of value to the learner would need to be explicitly linked to a validating institution. The mechanism for achieving this validation was discussed in terms of micro-credentials, which subsume the certification of learning achievement in MOOCs. Unlike micro-credentials, badges were seen in terms of certifications of completion or non-validated claims of learning achievement, despite the overlapping definitions of the two terms.

Assessment

Very little evidence was found of assessment materials as open content in OER. It was proposed that this is due to the additional work of preparing assessments and the institutional need to split assessment (non-zero marginal cost) from OER creation (zero marginal cost). This split also requires the careful formulation of learning objectives (often as competences) and close alignment of learning objectives in the OER, assessment, and rubrics.

Stackability

The interviews were all consistent with the statement by McGreal and Olcott (2022) that micro-credentials "may or may not apply towards a higher credential" (page 3) as opposed to the position of the European Commission (2021) that they "do not replace traditional qualifications" (page 1). However, in practice this is hard to achieve, and there are few examples of micro-credentials that are stackable across institutions. A higher level of recognition of prior learning in Europe would provide a platform for the development of stackability.

Specifications and Competence Catalogues

There was a positive perception of the quality and value of the standards and infrastructure to support competences, competence frameworks, and micro-credentials, particularly those developed by the European Commission. Practical problems remain in integrating competence frameworks, and there was a minority view that a single framework for Europe may be too restrictive. There was no call for further standardisation, for example of learning paths.

Trust

Two approaches to building trust were widely supported. First, the evidence for the learning must be explicit, and competence frameworks are a widely supported route towards this. Second, the technical infrastructure developed by the European Commission to verify the identity of the issuing institution (Europass and eSeals) was seen as a very valuable step forward. However, despite the welcome given to this infrastructure, all interviewees situated current challenges as organisational and practical, not technological.

Recruitment

All interviewees saw open micro-credentials as valuable evidence which could be examined at interviews, but they were split between those who were enthusiastic or sceptical about automated recruitment on such a basis.

Business Models

There was a consensus that the design of learning materials and of assessment should be separate organisational functions if the vision of open micro-credentials is to be realised. Expertise and funding are required to align learning materials, competence requirements, learning paths, and activities to assess learning achievement. Student payment for assessment and awards (but not for access to learning materials) was seen as acceptable and inevitable, and the fees may sometimes be substantial. Some institutions may choose to subsidise some open credentials to create a pool of students who may join other courses. There was a strong consensus that support from the European Commission and member states is essential to open micro-credentials, both in providing funding and in ensuring that open credentials are valid for professional accreditation.

Acknowledgements

This research was partially funded by the ENCORE+ project under the Erasmus + Programme supported by the European Union (Grant agreement number 621586-EPP-1-2020-1-NO-EPPKA2-KA), and by the Research Institute for Innovation & Technology in Education (UNIR iTED) at Universidad Internacional de La Rioja (UNIR).

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Athabasca University

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 25, Number 1

February – 2024

Exploring the Digital Divide in Open Education: A Comparative Analysis of Undergraduate Students

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Abstract

In the 21st century, the widespread use of information technologies has made access to technology, technology usage skills, and the quality of technology services increasingly important. However, the digital divide—defined as a lack of access to telecommunications—remains a significant issue that separates developed countries from developing countries. This study aimed to explore the digital divide in open education by comparing the digital divide levels of first term and last term or graduate students enrolled in the Anadolu University Open Education System. The study also examined how factors such as gender, age, income level, and employment status impact digital competency by comparing the digital divide scores of participants in these groups. The findings of the study suggest that first-term students have higher levels of digital competency than final-term students. The study also found that males, people aged 30–40, those with high incomes, and those working in the private sector had the highest digital competency scores. These results can be used to inform the development and implementation of open and distance learning programs to reduce the digital divide, as well as to identify specific groups that may be at a disadvantage in terms of digital competency.

Keywords: open learning, distance learning, digital divide, digital competence, open education, Turkey

Introduction

Access to technology, technology usage skills, and Internet service quality create gaps between different segments of society all around the world. This phenomenon, referred to as the digital divide, digital separation, or digital inequality, is characterized by a lack of access to telecommunications (Dasgupta et al., 2001). The US National Telecommunications and Information Administration defined the digital divide as “the gap between those who have access to information technologies and those who do not” (1999, p. 20). Meanwhile, Bagchi (2005) suggested that the digital divide is not only determined by access to technology but also by the ability to effectively use the technology. The digital divide encompasses dimensions such as technology ownership, technology use, Internet access, and socioeconomic level. Recently, as Internet access has become standard for most Western populations, research on the digital divide has begun to focus on the determinants of Internet skills, uses, and outcomes (Scheerder et al., 2017). As stated by Ilomäki et al. (2011), the concept of digital skills is frequently connected to the concept of digital divide. When studying the digital divide, researchers often focus on concepts such as digital competence and digital skills. Initially, the term digital divide was used to describe the unequal access to digital services among different social groups, as well as their varying abilities to utilize digital opportunities (Norris, 2001; van Dijk & Hacker, 2003). However, nowadays, the concept of the digital divide also highlights abilities in using digital resources.

Socioeconomic conditions can greatly affect access and use of information technologies, and these differences have become even more pronounced during the COVID-19 pandemic (OECD, 2020). One of the most important ways to address the digital divide is through mass, technology-oriented applications and open education. In the 1903 article “Democracy in Education,” Dewey highlighted the imperative of an inclusive educational system, a concept still relevant today, as the implementation of open education initiatives must address the digital divide to ensure equitable access to learning opportunities. Giebel (2013) argued that open source and, in particular, the open innovation movement provides opportunities to acquire knowledge and skills that can reduce the digital divide. Similarly, Ally and Samaka (2013) stated that open education resources can help bridge the digital divide by providing access to learning materials through mobile technology. In the case of this research, a study by Fırat and Güney (2020) found that the Anadolu University Open Education System contributes to social digital transformation in Türkiye. However, research on the effects of open and distance learning on the digital divide is limited, and further investigation with a larger number of participants, which is the focus of this research, is required.

Literature Review

There are various approaches to identifying, measuring, and comparing the digital divide across different variables. The OECD (2001) identified several variables, such as the number of computers an individual owns, Internet access opportunities, and telephone and television services. Factors that have been cited as contributing to the digital divide include gender, age, income level, lack of basic digital experience, lack of materials, lack of digital skills, lack of access for usage (van Dijk & Hacker, 2003), physical access to technology, availability of appropriate content, perceived usefulness of technology and its content (Baker & Panagopoulos, 2004), connectivity, freedom of access, and active computer use (Hawkins & Oblinge, 2006). The digital divide has been associated with access to and active use of IT and a range of demographic and socioeconomic characteristics: income, education, race, gender, geographic location (urban–rural), age, and political, cultural, and psychological attitudes. Gil-García and et al. (2006) and Helbig et al. (2009) proposed that the digital divide could be examined at three different levels: the differences between individuals with and without access to technology at the first level, the differences between developing countries at the second level, and consideration of people's skills in technology at the last level, in which factors such as race, gender, and origin are taken into account. In this research, the digital divide is discussed in terms of four different demographic characteristics: gender, age, income level, and employment status.

While technology-supported education systems provide important opportunities, such as equal access to education for all, the digital divide caused by socioeconomic differences can pose a significant problem. The digital divide in education is not only about access to technology but is also related to competence and skill in using computers, technology, and the Internet (van Dijk, 2006). Therefore, simply increasing the number of computer and Internet users will not be sufficient to reduce the digital divide. Madhubhashini (2022) found that students at the Open University of Sri Lanka faced challenges during the COVID-19 pandemic due to both personal factors, such as information technology (IT) literacy and infrastructure, technical issues, health issues, and financial issues, as well as institutional factors, such as inadequate support from the supportive divisions, unreliable online platforms, and lack of resources and IT infrastructure. Similarly, Lembani et al. (2020) pointed out the digital divide between urban and rural distance learning students in South Africa for the same courses. Helsper (2010) similarly stated that Internet access is unevenly distributed among people from different demographic backgrounds such as age, gender, socioeconomic status, ethnicity, and geography. Öktem, et al. (2021) argued that socio-economic conditions such as access, equality, relatively low education and income levels prevent technology use. According to Bozkurt and Sharma (2020), many people are unable to take advantage of educational opportunities due to the digital divide. Victor (2010) argued that the digital divide should also be taken into account when designing courses. Journell (2007) suggested that developing e-learning activities and digital literacy will reduce the gap. Block (2010) emphasized the need for administrators to work on access to technology, which is still a major barrier for many distance learners. According to Gencer and Aktan (2021), the use of IT in education was expected to be realized before the pandemic, but now is an urgent matter. Therefore, it is important to make digital reforms in education.

Various studies in the literature indicate that the digital divide is very present especially in underdeveloped and developing countries. In their study, Mathrani et al. (2022) highlighted the digital inequalities that emerged during the COVID-19 lockdown in five developing countries: India, Pakistan, Bangladesh, Nepal, and Afghanistan. The research revealed that structural issues such as lack of access to digital media and supporting services, contributed to these inequalities. Additionally, the study found that female students are disproportionately affected by the digital divide, with cultural practices and gendered discriminatory rules exacerbating the issue. For example, female students reported experiencing more stress due to added household responsibilities, which negatively impacts their agency and ability to fully realize their learning potential. In their study, Liebenberg et al. (2020) examined the access to and use of IT among students at the University of South Africa (Unisa). Their findings confirmed that access to digital technologies is complex and that it is important to consider how access and skills can both amplify and perpetuate existing inequalities within and between countries. The primary problems are that people cannot access technologies due to financial difficulties, do not know how to use these technologies even if they have access, and do not know the benefits of technology (Öktem et al., 2021).

There have been various suggestions in the literature for addressing the digital divide among open education students. Lane (2009) discussed the concept of openness in higher education, specifically in relation to digital technologies and open education resources. Lane (2009) highlighted the potential for these technologies to increase access to education, but also noted that issues such as lack of access to technology and necessary skills can create or widen digital divides. Lane (2009) suggested that intermediaries, such as teachers, may be needed to help bridge these divides through the use of open education resources. Chaklader et al. (2013) proposed the use of a village wireless LAN, a low-cost network infrastructure solution for digital communication, information dissemination, and education. Wang and Huang (2022) suggested using IT for open education for elderly students. Arslan (2022) advised using educational television for inclusive education. Samancioglu et al. (2022) emphasized the need for information and strategic skills, even among academics, to bridge the digital divide.

In their research, Cruz-Jesus et al. (2016) addressed the relationship between education and the digital divide among members of the EU-28. Their findings highlighted the importance of assessing internal gaps in addition to cross-country analysis when addressing the relationship between education and the digital divide, as even the most digitally developed countries have internal divides, and using only aggregated data would probably cause losing some important insights. The research of Volungevičienė et al. (2020) demonstrated that open online learning should serve as a solution for curriculum change in higher education to respond to digital and network society learning needs. These studies suggest that open education can help reduce the digital divide, but it is important to consider gaps within countries when analyzing the relationship between education and the digital divide.

The literature review has highlighted the importance of understanding and addressing the digital divide in education. The digital divide is a complex phenomenon that encompasses dimensions such as technology ownership, technology use, Internet access, and socioeconomics. Studies have shown that the digital divide in education is not only about access to technology but also related to competence and skill in using technology. Factors such as gender, age, income level, and employment status play a role in the digital divide. Literature has suggested that open and distance learning can be an effective way to reduce the divide. However, research on the effects of these methods on the digital divide is limited and requires further investigation with a larger number of participants. Sims, Vidgen, and Powell (2008) also emphasized that the digital divide is not being adequately addressed by higher education institutions. Such investigations will help to understand the landscape of the digital divide among open education students and examine the effect of open education on the divide. This study addresses these limitations and contributes to the understanding of the digital divide in open education and the development of effective strategies to reduce it, ensuring equal access and success in education for all students.

Current Investigation

This research aims to explore the digital divide in open education. The digital divide is a problem in itself. However, while open education has significant potential to help overcome this problem, studies investigating the effects of open education on the digital divide are limited. For this purpose, digital competency scores of first term and last term or graduate students studying at Anadolu University Open Education System were compared in terms of demographic characteristics. The research questions were as follows:

1. How do digital divide levels of Open Education System students differ according to their gender, age, income level, and employment status (unemployed, public sector, private sector, retired)?

2. Is there a statistically significant difference in the digital divide levels of Open Education System students in their first and last terms?

Method

Participants

The participants were students enrolled in undergraduate and associate degree programs at the Anadolu University Open Education System. A total of 10,320 students participated in the study; however, data from 2,374 participants were excluded from the analysis because their responses were identical on all scale items or because they failed to specify their program type and study term. The final sample size used in the analysis was 7,945 students. Table 1 shows a breakdown of the demographic data of participants.

Table 1

Demographic Background of Participants (After Data Cleaning)

Characteristic	Grouping	*n*	%
Age	Under 30	3,647	46
	30–40	2,476	31
	Over 40	1,821	23
Gender	Female	3,184	40
	Male	4,761	60
Term	First term	3,224	41
	Last term	2,824	36
	Intermediate term	1,897	24
Degree	Associate	4,393	55
	Undergraduate	3,552	45
Income level	Low	2,420	31
	Middle	5,175	65
	High	350	4
Employment status	Unemployed	2,408	30
	Public sector	1,988	25
	Private sector	3,263	41
	Retired	286	4

Note. N = 7,945.

As seen in Table 1, 46% of participants were under 30, and 31% of participants were between the ages of 30 and 40; 60% of participants were male. While the rate of participants in the first term was 41%, the rate of the participants in the last term was 36%. For income levels, rather than numerical income data, participants were asked to provide categorical data as low, medium, and high. Middle-income level participants were the highest rate at 65%. In terms of employment status, the highest proportion of participants were in the private sector (41%). Full-time students who are not employed in any paid job are included in the unemployed group.

Ethical Considerations

The research was conducted in accordance with the ethical principles of the American Psychological Association. The participants were informed about the research and the scale used in the study, and their consent was obtained. The data collected in the research was kept confidential and used only for this research. The participants were also informed that they could withdraw at any time without giving any reason.

Data Collection Tools

A quantitative data collection tool known as the Digital Competency Scale was used in this research. The scale, developed by Akkoyunlu et al. (2010), was designed to measure the digital divide level of university students and consists of 45 items, all of which are measured on a 7-point Likert scale. The four sub-factors of the scale are digital competency, technical access, motivation, and awareness. During their research, Akkoyunlu et al. applied the scale to 761 students enrolled in the final year of Hacettepe University's Faculty of Education. Cronbach's alpha coefficient, to measure reliability, was calculated as 0.83. Cronbach's alpha coefficients were calculated for the reliability of the 45-item scale and were found to be 0.86 for the whole scale, 0.94 for the first sub-dimension, 0.84 for the second, 0.78 for the third, and 0.81 for the fourth. The results of the study by Akkoyunlu et al. showed that the scale could be used as a valid and reliable measurement tool.

Data Collection Process

Permission to use the scale was obtained, and the items were then transferred to a Google Forms survey for administration. The data collection tool consisted of two parts: the first part included the 45 scale items, and the second part included demographic questions related to age, gender, income level, and employment status. The survey was distributed through the Open Education System's online platform. It was available to students from the beginning of July until mid-September.

Data Analysis

The collected data were analyzed with IBM SPSS Statistics (Version 24.0). In the analysis, descriptive statistics, *t*-test, and analysis of variance (ANOVA) were used to answer the research questions. The reliability of the scale used in the study was tested with the Cronbach's alpha coefficient, and the coefficient was found to be 0.94. This coefficient indicates that the scale had a high level of reliability.

Results

Means and standard deviations were analyzed according to the 4 sub-factors of the scale: digital competence, technical access, motivation, and awareness. It was found that the Open Education System students had a high level of awareness with a mean of 49.69 and a standard deviation of 14.416. Similarly, students' levels of motivation ($\bar{X}$ = 53.27; *SD* = 16.304) and digital competence ($\bar{X}$ = 80.58; *SD* = 26.576) were high. Finally, students were found to have a moderate level of technical access with a mean of 44.49 and a standard deviation of 15.754.

Comparison of Digital Divide Levels of First and Last Term Students

To compare the digital competencies of students by terms of their semesters, semester information was collected as "first term," "intermediate term," and "last term." The one-way ANOVA test was used to compare the scale scores according to the term. A significant difference resulted [$F_{(2, 7942)} = 4.511$, $p = .011 < 0.05$], as indicated in Table 2.

Table 2

One-Way ANOVA Statistics Comparing Digital Divide Levels Within and Between Participant Groups by Term

Source of variance	*SS*	*df*	*MS*	*F*	*p*
Between groups	40454.934	2	20227.467	4.511	.011*
Within groups	35612790.880	7942	4484.109		
Total	35653245.810	7944			

Note. ANOVA = analysis of variance.

*p < .05.

A Tukey post hoc test was used to determine between which groups this significant difference occurred and to make comparisons between groups. The Tukey comparisons are shown in Table 3. There was a statistically significant difference only between the first and last term groups.

Table 3

Tukey Post Hoc Test Comparing Groups

Term	*n*	*M*	*SD*	*p*
First	3,224	230	63.7	.008*
Last	2,824	225	70.4	
First	3,224	230	63.7	.483
Intermediate	1,897	228	67.0	
Last	2,824	225	70.4	.299
Intermediate	1,897	228	67.0	

Note. N = 7,945.

*p < .05.

In the subgroup analyses made with the Tukey test, it was seen that there was a statistically significant difference in favor of the first term only when comparing the first and last term ($\bar{X}_{\text{(first term)}} = 230 > \bar{X}_{\text{(last term)}} = 225$, $p = .008 < .05$). In other subgroup analyses, there was no statistically significant difference between the groups ($p = .483$, $p = .299 > .05$). This finding, contrary to expectations, shows that students who have just started at the Open Education System have more digital competence than students in the last semester.

Comparison of Digital Divide Levels by Demographic Characteristics

This section presents the findings for the first research question. The digital competence scale scores are compared according to each of the demographic characteristics collected in this research.

Comparison by Gender

In order to compare the digital competency scores of participants according to their gender, an independent two-sample *t*-test was used. Results are shown in Table 4.

Table 4

Independent t*-Test Comparing Digital Divide Levels by Gender*

Gender	*n*	*M*	*SD*	*p*
Female	3,184	225	69.2	0.003*
Male	4,761	230	65.4	

Note. N = 7,945.
*$p < .05$.

When female and male participants were compared, digital competence scale results were found to reach statistical significance in favor of males ($\bar{X} = 230 > \bar{X} = 225$, $p = 0.003 < 0.05$). The result shows that digital competencies of male participants were higher than those of female participants.

Comparison by Age

A one-way ANOVA test was used to compare the digital competence scores of participants according to age. The findings are given in Table 5.

Table 5

One-Way ANOVA Statistics Comparing Between and Within Participant Groups by Age

Source of variance	*SS*	*df*	*MS*	*F*	*p*
Between groups	26401.883	2	13200.941	2.943	.053
Within groups	35626843.930	7942	4485.878		
Total	35653245.810	7944			

Note. ANOVA = analysis of variance.

A Tukey test was used to make comparisons between groups. The comparisons are shown in Table 6.

Table 6

Tukey Post Hoc Test Comparing Groups

Age	*n*	*M*	*SD*	*p*
under 30	3,467	228	69.2	.310
30–40	2,476	230	65.9	
under 30	3,467	228	69.2	.416
over 40	1,821	225	63.8	
30–40	2,476	230	65.9	.043*
over 40	1,821	225	63.8	

Note. N = 7,945.
*$p < .05$.

When we compared participants by age, we found a statistically significant difference between the groups in terms of digital competence ($F_{(2)} = 2.943$, $p = .053 < .05$). In the subgroup analyses made with the Tukey test, we found a significant difference only between participants aged 30–40 and those over 40, in favor of those aged 30–40 ($\bar{X}_{(30–40)} = 230 > \bar{X}_{(\text{over } 40)} = 225$, $p = .043 < .05$). No significant difference was found in other subgroup analyses ($p = .310$, $p = .416 > .05$).

It is noteworthy that the averages of the first and last term comparisons ($\bar{X}_{(\text{first term})} = 230$, $\bar{X}_{(\text{last term})} = 225$) and the averages of students aged 30–40 and over 40 ($\bar{X}_{(30\text{-}40)} = 230$, $\bar{X}_{(\text{over } 40)} = 225$) are the same. The reason for this may be that age is related to whether a student is in first or last term.

Comparison by Income Level

A one-way ANOVA test was used to compare the digital competence scores of the participants according to their income level: low, middle, and high. The results are given in Table 7.

Table 7

One-Way ANOVA Statistics Comparing Digital Divide Levels Within and Between Participant Groups by Income Level

Source of variance	*SS*	*df*	*MS*	*F*	*p*
Between groups	251779.141	2	125889.571	28.242	.000*
Within groups	35401466.670	7942	4457.500		
Total	35653245.810	7944			

Note. ANOVA = analysis of variance.
*p < .001.

A statistically significant difference was found between the digital competence scores of participants according to their income ($F_{(2)} = 28,242$, $p = < .001$). The Tukey test was then used post hoc to determine between which groups this difference occurred and to compare groups. Tukey group comparisons are displayed in Table 8.

Table 8

Tukey Post Hoc Test Comparing Income Levels

Income level	*n*	*M*	*SD*	*p*
Low	2,420	220	69.5	.001*
Middle	5,175	231	66.0	
Low	2,420	220	69.5	.001*
High	350	240	57.7	
Middle	5,175	231	66.0	.039*
High	350	240	57.7	

Note. *N* = 7,945.
*p = < .05.

We found a statistically significant difference in each of the subgroup analyses made with the Tukey test. There is a significant difference between participants with low and middle incomes, in favor of those with middle incomes ($\bar{X}_{(middle)}$ = 231 > $\bar{X}_{(low}$ = 220, p = .001 < .05). There is also a significant difference in favor of those with high incomes ($\bar{X}_{(high)}$ = 240 > $\bar{X}_{(low)}$ = 220, p = .001 < .05) among participants with low and high incomes. Finally, there is additionally a significant difference between high and middle income students in terms of digital competence scores ($\bar{X}_{(high)}$ = 240 > $\bar{X}_{(middle)}$ = 231, p = .039 < .05). This finding shows that as income level increases, digital competence also increases, and therefore, the digital divide decreases. This is an expected finding.

Comparison by Working Status

A one-way ANOVA test was used to compare the digital competency scores of participants according to their employment status: employed in the private sector; employed in the public sector; unemployed or retired. The results of the one-way ANOVA test are given in Table 9.

Table 9

One-Way ANOVA Statistics Comparing Digital Divide Levels Within and Between Participant Groups by Working Status

Source of variance	*SS*	*df*	*MS*	*F*	*p*
Between groups	129473.325	3	43157.775	9.648	.000*
Within groups	35523772.490	7941	4473.463		
Total	35653245.810	7944			

Note. ANOVA = analysis of variance.

*p = < .001.

A statistically significant difference was found between the digital competence scores of participants according to their employment status ($F_{(2)}$ = 9.648, p = .000 < .05). The Tukey test was used post hoc to determine between which groups this significant difference occurred and to make comparisons between groups. Tukey group comparisons are presented in Table 10.

Table 10

Tukey Post Hoc Test Comparing Groups

Working status	*n*	*M*	*SD*	*p*
Unemployed	2,408	225	69.9	.998
Public sector	1,988	225	69.7	
Unemployed	2,408	225	69.9	.001*
Private sector	3,263	233	63.3	
Unemployed	2,408	225	69.9	.100
Retired	286	224	60.2	
Public sector	1,988	225	69.7	.001*
Private sector	3,263	233	63.3	
Public sector	1,988	225	69.7	.998

Retired	286	224	60.2	
Private sector	3,263	233	63.3	.152
Retired	286	224	60.2	

Note. N = 7,945.

$^{*}p < .05$.

In the subgroup analyses made with the Tukey test, there is a significant difference between participants who work in the private sector and those who are unemployed, in favor of those working in the private sector ($\bar{X}_{\text{(private sector)}} = 233 > \bar{X}_{\text{(unemployed)}} = 225$, $p = .001 < .05$). Also, there was a significant difference between private and public sector working students ($\bar{X}_{\text{(private sector)}} = 233 > \bar{X}_{\text{(public sector)}} = 225$, $p = .001 < .05$). In other subgroup analyses, there was no statistically significant difference between the groups ($p = .998$, $p = .100$, $p = .998$, $p = .152$, all > .05) in terms of digital competence scores.

Discussion

The findings of this research are presented separately for each research question.

As for the first research question, the digital divide levels of Open Education System students were compared according to demographic characteristics including gender, age, income level, and employment status. The comparison by gender showed that male participants had higher digital competency levels than female participants. Antonio and Tuffley (2014) noted that women in developing countries have significantly lower levels of technology participation than men. The comparison by income level revealed that those with high incomes had lower digital divide scores and those with low incomes had higher digital divide scores. The United Nations (2012) and the World Bank (2016) have acknowledged that income level is a fundamental component of digital inequality and that reducing income inequality is expected to narrow the digital divide (Richmond & Triplett, 2017). As stated by Rodriguez and Wilson (2000), there is a strong relationship between the per capita income of countries and the level of IT use. In the comparison of participants' digital competence by work status, it was found that students employed in the private sector had the highest digital competency scores, followed by those working in the public sector, and last, those who were not working. All in all, as stated by DiMaggio et al. (2007), factors that affect the digital divide include region and location, income, education, ethnicity, age, gender, family structure, and employment status. In addition, Blank and Groselj (2014) stated that most of the differences are due to age, education level, and working status. Differences in access to IT are related to individuals and their characteristics such as income and education level, employment, age, gender, and ethnicity (van Dijk, 2012).

In response to the second research question, the digital divide levels of first term students were found to be lower than those of last-term students, contrary to expectations. This may be due to the fact that the proportion of younger students in the first term is higher, and their use of technology is therefore more prevalent. This is supported by the findings of the comparison of age groups, which showed that the digital divide levels of students aged over 40 were higher than those of students aged 30–40. The United Nations (2012) has noted that the digital divide is related to age and that age is one of the most significant factors in the adoption of IT. As technology becomes increasingly pervasive, the underuse of IT by older individuals remains observable (Niehaves & Plattfaut, 2014). This age-related digital divide highlights that many older people are less likely to use Internet-based services (Niehaves & Plattfaut, 2014).

As Hynes (2021) emphasized, it is true that ICT connects people better. In building and maintaining relationships that are essential to our overall well-being and happiness, the benefits of this type of hyperconnection are undeniable. However, digital technologies may also divide society because of location, gender, ethnicity, or income, and it is probable that some people will continue to be left behind.

Conclusions

This research found that the digital divide levels of first term Open Education System students were lower than those of last-term students, which was contrary to expectations. This is likely due to the higher proportion of younger students in the first term who have greater access to and proficiency in technology. The comparison by age groups also revealed that students aged 30–40 had significantly higher digital competencies than those aged 40 and over.

We have found that the digital divide levels of Open Education System students vary according to demographic characteristics such as gender, age, income level, and employment status. The comparison by gender revealed that male participants had higher digital competencies than female participants, which is consistent with previous research that has shown that men have greater access and proficiency in technology than women. The comparison by income level found that those with higher incomes had lower digital divide scores, while those with lower incomes had higher digital divide scores. This supports the notion that income level is a significant factor in digital inequality and that a higher economic status leads to a reduction in the digital divide.

Finally, the comparison by employment status found that students working in the private sector had the highest digital competency scores, followed by those working in the public sector, and lastly, those who were not working. This suggests that employment status is a demographic feature that affects the digital divide and that those working in the private sector have the greatest access to digital technologies and proficiency in using them. Based on the research findings and current knowledge in the literature, it was concluded that working status is a demographic feature that affects the digital divide. In addition, it was concluded that the most advantageous group in terms of access to digital technologies and competence are those who work in the private sector, and the most disadvantaged group is unemployed persons.

The results of this study are limited to the digital competency scale scores of 7,945 university students studying in the Anadolu University Open Education System. The data was collected online. While the self-assessment approach to competency provides valuable insights, its limitations include susceptibility to biased self-assessments, potential divergence from objective measures, susceptibility to variability based on individual factors, and its inability to fully capture complex competencies that are better assessed through external observation or standardized testing. Also, during the course of this research, it was discovered that there is a lack of studies that provide a global comparison of the digital divide by country, region, or level of development. The literature is limited to local or bilateral comparisons. It is recommended that international organizations conduct comprehensive studies in this direction.

Recommendations

The following are recommendations for future research:

- development of new digital divide scales that take into account the latest technologies, such as mobile technology and mobile Internet usage, in order to provide more up-to-date data collection tools for future research,
- conducting comprehensive research in other universities that provide open education services, in order to compare digital competence levels across institutions,
- making comparisons between students studying face-to-face and those in the open education system to determine the digital divide levels across different characteristics,
- investigating how the digital divide varies across different levels of education, and
- examining the impact of programs such as Refreshment University, which is offered at Anadolu University to adults over the age of 60, on the digital divide.

Within the parameters of this study, the following are suggestions for future applications:

- implementing digital-competency supportive activities and programs, such as Anadolu University's Refreshment University, to address the digital divide among older students,
- providing training and support for public sector employees to improve their digital competency scores and reduce the digital divide in this group,
- developing projects to address the digital divide experienced by low-income individuals, such as providing affordable Internet access and training programs, and
- organizing digital competency-supportive activities, programs, and projects targeted toward women through social media to address the gender-based digital divide.

To effectively pursue both these sets of recommendations, it is critical for researchers and educators to build strong collaborative partnerships with relevant public institutions and stakeholders. Collaborative efforts can significantly enhance the feasibility and impact of the proposed initiatives, from the development of new digital divide metrics and cross-institutional research to addressing the digital divide among older students, public sector workers, low-income individuals, and women. These partnerships will facilitate access to the datasets, funding sources, and expertise needed to conduct large-scale, multi-agency studies and to implement tailored training programs, support initiatives, affordable Internet access projects, and gender-inclusive digital literacy activities.

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International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 25, Number 1

February – 2024

Exploring Online Physical Education Teaching: What Have We Done and What Have We Learnt?

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Abstract

Engaging with physical education teachers who were compelled to integrate technology into their lessons during the COVID-19 pandemic is crucial to understanding how the pandemic has presented this 'new normal' circumstance. It is vital to gain insight into the initial experiences of physical education (PE) teachers who transitioned to online physical education (OLPE) teaching, as well as to identify potential areas for improvement in the future. This study investigated the perspectives of secondary school PE teachers on OLPE teaching during the COVID-19 lockdown, their professional development, online training opportunities and future perceptions. Using a mixed-methods approach, this study analysed data from 35 secondary school PE teachers in Fiji, using Google Forms to collect quantitative data and semi-structured interviews for qualitative data. The quantitative data was categorized by age, gender, school setting, qualifications, and teaching experience, while the qualitative data was analysed by themes. The study found that teachers struggled with OLPE due to lack of preparedness, poor Internet connectivity, and lack of emphasis on PE during lockdown. Despite their readiness, integrating technology remains challenging due to a lack of incentives, limited support, and fear of the unknown. The study emphasises the vital importance of technology in creating engaging and relevant PE experiences and recommends the provision of specialised resources, personalised curriculum guidance, and a change in teacher training institutions' paradigms to incorporate contemporary technological applications in PE.

Keywords: online physical education (OLPE), physical education (PE), physical education teachers (PETs), professional development (PD)

Exploring Online Physical Education Teaching: What Have We Done and What Have We Learnt?

Technological integration has opened up new avenues for innovative teaching approaches in recent years, resulting in a significant shift in the educational landscape. One notable shift that has occurred in the field of physical education (PE) is the increasing prevalence of online instruction. Global events, like the COVID-19 pandemic, have presented unprecedented challenges that have accelerated the adoption of remote learning and forced educators to reconsider conventional methods of teaching PE in virtual environments. COVID-19 had a significant impact on many facets of human life in every nation worldwide (Bacher-Hicks et al., 2021; Pokhrel & Chhetri, 2021; Raaper & Brown, 2020; Wargadinata et al., 2020). After COVID-19 was declared a global pandemic in March 2020, Fiji prioritized health and safety. The second community outbreak of the pandemic began in April 2021 and prompted the Fijian government to implement more anti-pandemic initiatives. As a precaution against the spread of the COVID-19 virus, schools were closed in Fiji as children and teachers were advised to refrain from contact with one another. From April 2020 to June 30, 2020, and beginning again in April 2021, the Ministry of Education (MOE) released a group of measures to help ease the learning process for students of all ages and provide learning opportunities with public health guidelines.

Several studies have been conducted to investigate the impact of COVID-19 on school-closure and the well-being of children and adolescents (Okuyama et al., 2021; Rundle et al., 2020; Stanistreet et al., 2021; Velde et al., 2021). These studies have consistently found that the COVID-19 pandemic drastically reduced many people's physical activity behaviours and affected how PE was delivered in schools. However, little focus has been directed towards teachers' professional development and training in online learning in the Fijian context. Therefore, it is important to understand the perspective of teachers and plan for the future. Consequently, the purpose of this study was threefold. First, the study investigated teachers' experiences in online physical education (OLPE) teaching during the COVID-19 lockdown. Second, it examined the effect of teachers' professional development in online physical education delivery during the lockdown. Finally, the study explored teachers' views on offering OLPE in the future.

Literature Review

Integrating PE into the online teaching landscape has introduced a distinctive and complex shift in perspective for educators worldwide. Amidst the COVID-19 pandemic, the sudden closure of educational institutions and the need to maintain social distance necessitated that physical education teachers (PETs) promptly readjust their pedagogical approaches (Bozkurt et al., 2020). The fundamental essence of physical education, deeply rooted in physical activity, team sports, and interactive games, presented an immediate challenge in an online learning environment (Pangrazi & Beighle, 2019). However, educators sought innovative approaches, leveraging technology to overcome the divide (Tan et al., 2021). According to Ersöz and Yenilmez (2022), the use of virtual sessions, live-streamed workouts, and curated fitness apps played a crucial role in facilitating the participation of students in physical activities while confined to their homes.

The limitations and low priority of PE in the educational system at this time were particularly difficult for PETs. PE remained marginalized "because there was no exam" (Bacchus, 2000, p. 54). According to Dorovolomo and Hammond (2005), certain schools actively teach PE and organize intramural and interscholastic sports. However, some schools continue to disregard PE. The top five barriers to teaching PE in schools were "lack of equipment and facilities, improper attire, a poor attitude towards PE by the school, and large class size" (Dorovolomo & Hammond, 2005, pp. 39–40). Richards et al. (2018) also agreed that PE was a traditionally marginalized subject. Hardman (2005) stated that school PE was at risk worldwide because of the decreased importance of timetabled classes, decreased funding, and lowered subject status. As a result, authorities have continually undervalued and marginalized the subject. Stirling and Belk (2002) and Wright et al. (2005) expressed similar sentiments. Other challenges faced by traditional PE classes, according to Lawson (2018); as cited in Webster et al. (2021), were "equity and access, such as language barriers, funding limitations, and inadequate physical spaces for participation" (p. 328). Promoting movement, encouraging organized thinking, expressing feelings, and expanding understanding—all these are enhanced by participation in a quality physical education (QPE) program, which is essential to childrens' overall development (Nancy & Jannine, 2015). However, the pandemic has impacted equally to a well-rounded and inclusive curriculum, which is the foundation of QPE (Aguinaldo et al., 2022).

Stanistreet et al. (2021) asserted that researchers have discovered similar significant effects of school closures and restrictions on learners, where the sudden shift to online learning interrupted education worldwide. The MOE in Fiji responded constructively to these challenges. Unfortunately, the lack of financial and technological assistance, remoteness, connectivity, devices, and pedagogical resources hindered the continuity of the learning process (Chand et al., 2022). The pandemic disproportionately affected populations with fewer resources and has prompted long overdue reflection on structural inequality and how it affects educational opportunities (Stanistreet et al., 2021), for small island states like Fiji in particular. Understanding the existing scenario of lockdowns and limited mobility, and contemplating the adverse effects of the virus, have generated significant thought and discussion, much of it directed at how PE programmes can improve students' health and well-being. Consequently, this virus presented educators worldwide with new and unanticipated issues in teaching PE.

Technology is the only way to connect students to PE and physical activity (PA) during times like these. According to Hanski (2016, cited in Gallagher, 2020) "technology helps students become physically active and fit by transforming their sedentary lifestyles into more active lifestyles" (p. 4). A substantial body of evidence suggests that, when combined with appropriate pedagogical practices, digital technologies can be effectively integrated to improve the learning process for PE students (Bodsworth & Goodyear, 2017; Casey et al., 2017). Moreover, a recent study has shown that high school students had a more positive outlook on their online learning experience when compared to face-to-face programs (Williams et al., 2020). However, more data regarding student retention and attrition rates in OLPE is required. Examining barriers to students' online learning will assist in foreseeing the early warning signs for OLPE programs (Goad et al., 2021).

As emphasized by the United Nations' sustainable development goals, OLPE is one example of how quality mass education (QME) must be produced and delivered in a variety of settings and contexts (UNESCO, 2016). Online education has evolved as a feasible way to achieve QME, support quality student learning, and provide increased access to students who previously struggled in traditional face-to-face schooling (Sun & Chen, 2016). However, recent studies have illuminated the need for effective teaching strategies and pedagogies to help teachers cope with online learning (Backman & Barker, 2020; Ferdig et al., 2020; Filiz & Konukman, 2020; Varea & González-Calvo, 2021).

Despite concerted efforts, online PE has encountered multiple obstacles. A significant challenge was unequal distribution of technology and insufficient space in students' homes for PE. The lack of face-to-face supervision made it more challenging to offer tailored advice and criticism, which affected motivation and skill development (Wong et al., 2021). Moreover, the shift towards OLPE teaching highlighted the need for educators to enhance their skills and engage in ongoing professional development (Johnson & Norris, 2021). Educators actively participated in training programs that prioritized integrating technology, digital pedagogy, and innovative teaching methodologies. According to Ohara (2023), using collaborative networks and platforms significantly facilitated knowledge exchange among instructors.

OLPE has become a high priority (Daum & Buschner, 2012). With sedentary practices imposed by COVID-19 restrictions, OLPE offered an ideal setting for addressing public health issues (Sallis et al., 2012; Sallis & McKenzie, 1991). The closure of recreational centres and gyms, and the two-metre physical distance requirement, created unique challenges for students who needed to be physically active and gain health-related fitness benefits (Dunton et al., 2020). With these challenges defined as the new normal, emphasis shifted to the capacity of PE and PA to save lives.

Theoretical Framework

Transformative learning and self-determination theories formed the theoretical framework for this study. Transformative learning theory has suggested that one's worldview and perspectives change over time due to critical reflection, experience, and development (Mezirow, 1997). "Transformational learning involves evaluating, questioning, validating, and modifying one's worldview" (Cranton, 2006, p. 23). Engaging with PE teachers who were forced to learn on the job during the pandemic was crucial for understanding (a) how the pandemic created a new normal situation and (b) teachers' initial experiences in transitioning to OLPE teaching. Transformational learning involves actively constructing new perspectives after critically reflecting on prior beliefs, values, or feelings (Zull, 2006). Many studies have used this theory to investigate how online teaching can alter traditional pedagogical models, modify interaction dynamics between teachers and students, and encourage greater student participation (Baran et al., 2013; Macdonald, 2002).

Self-determination theory has emphasized intrinsic motivation, extrinsic motivation, and amotivation in students and teachers in learning (Ryan & Deci, 2017). Students' motivation has been significantly impacted by the desire for autonomy, competence, and relatedness, especially in the demanding online setting with constrained resources, diversions at home, and diminished interpersonal interactions (Murcia et al., 2009). Teachers' motivation has been subject to factors such as student engagement, obstacles to using technology, and the need for ongoing training and support. To tackle these challenges, practical strategies based on self-determination theory can be implemented, prioritizing student autonomy, enhancing competence, and promoting social connectedness through interactive virtual platforms and collaborative activities. By integrating these strategies, it has become possible to stimulate motivation in both students and teachers, creating an environment conducive to meaningful engagement and sustained participation in OLPE.

Research Questions

The following research questions guided this study:

1. What were teachers' experiences in online physical education (OLPE) teaching during the COVID-19 lockdown?

2. How did professional development or training sessions assist teachers with OLPE teaching during the lockdown?

3. What were the teachers' perceptions of OLPE teaching in the future?

Methodology

Participants

The study focused on 35 secondary school PE teachers in Fiji who were actively engaged in online teaching during the COVID-19 lockdowns in 2020 and 2021. The participants were invited through professional and social networks using convenience sampling and snowballing techniques. The snowballing method allowed for a more diverse sample. The study ensured the inclusion of participants from various school settings across Fiji through a randomized selection process. A consent form was included with the survey, detailing inclusion criteria, purpose of the study, time required, and participants' right to withdraw. PETs employed in Fijian secondary or high schools were included. Participants answered open-ended and online survey questions.

Instrumentation

This mixed-methods study collected quantitative data using an integrated Web application (Google Forms) designed to gather demographic information and responses to closed-ended questions on teachers' experiences in OLPE during the COVID-19 school lockdowns. Complementing the quantitative data, qualitative insights were obtained through in-depth participant interviews. The interviews incorporated open-ended questions, such as What are your views on OLPE teaching? And How did the professional development sessions enhance OLPE teaching methods? Additionally, participants were encouraged to reflect on what they learned from the experience and how it will help them improve OLPE teaching in the future.

Data Analysis

The study used IBM SPSS (Version 25) for statistical analysis of demographic variables and participant feedback; NVivo 14 was used for qualitative data analysis of interview transcripts. This method preserved data integrity and transparency while identifying key themes and patterns (Morison & Moir, 1998; Richards & Richards, 1994). The analysis allowed for a systematic exploration of participants' perspectives and experiences regarding OLPE teaching during COVID-19 school lockdowns, leading to a comprehensive understanding of teachers' experiences.

Results and Discussion

The purpose of the study was to find out (a) how PE teachers used OLPE during the COVID-19 lockdown; (b) what opportunities there were for professional development (PD) and online skill-building workshops; and (c) how PE teachers feel about OLPE in the future and how they would share what they had learned.

Demographics

The sample comprised 22 (62.9%) males and 13 (37.1%) females. Participants represented diverse demographics (Table 1). The largest proportion of the participants were between 31 and 40 years of age (37.1%), while the smallest percentage was between the ages of 51 to 60 (11.4%). School settings ranged from urban (60%), suburban (14.3%), rural (20%), and maritime (5.7%) schools. All the teachers were qualified to teach PE, and most had more than 15 years of teaching experience.

Table 1

Frequencies for Demographic Variables

Category	Variable	Frequency	Percent	Cumulative percent
Gender	Male	22	62.9	62.9
	Female	13	37.1	100.0
Age	21–30	8	22.9	22.9
	31–40	13	37.1	60.0
	41–50	10	28.6	88.6
	51–60	4	11.4	100.0
School setting	Urban	14	40.0	40.0
	Suburban	8	22.9	62.9
	Rural	8	22.9	85.7
	Maritime	5	14.3	100.0
Qualification in PE	Diploma	14	40.0	40.0
	Bachelor	17	48.6	88.6
	Postgraduate	4	11.4	100.0
Teaching experience	1–5 years	10	28.6	28.6
	6–10 years	6	17.1	45.7
	11–15 years	6	17.1	62.9
	Over 15 years	13	37.1	100.0

Teachers' Experiences in OLPE Teaching During Lockdown

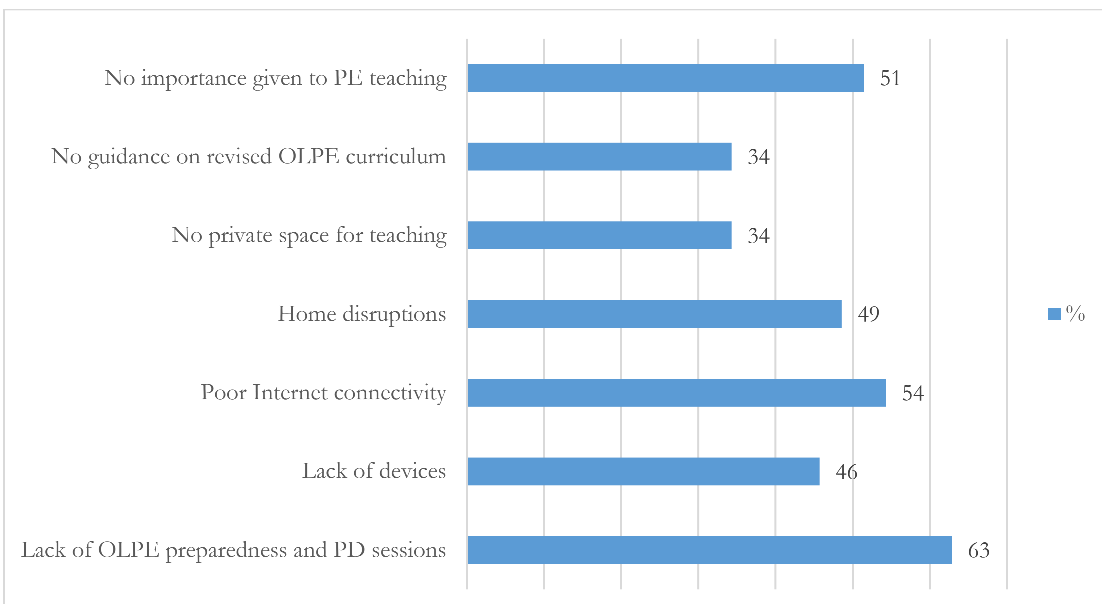
Teacher experiences in online teaching were no different to those apparent in other research (Stanistreet et al., 2021); however, this study also analysed perspectives on OLPE teaching during lockdowns by teachers' gender, age, school setting, qualifications, and teaching experience. Participant's OLPE teaching experiences included (a) challenges faced by teachers; (b) their readiness to teach online; (c) teacher-student online engagement; (d) teacher-parent consultation on OLPE; (e) assignments and feedback; and (f) teacher OLPE effectiveness. Similar findings have been shared by Daum (2012), Daum and Buschner (2014) and Williams (2013) focusing on various aspects of OLPE and teacher experiences.

Challenges Faced in OLPE Teaching

As shown in Figure 1, there were no significant differences in the challenges teachers faced according to their age, gender, school setting, and qualifications. However, the collective list of challenges indicated that a lack of OLPE preparation and professional development sessions was the most significant challenge (63%) faced by PE teachers, followed by poor Internet connectivity (54%), no importance given to PE teaching (51%), and home disruptions (49%). Other challenges included the lack of devices (46%), no private space for teaching (34%), and the failure of curriculum advisors to guide the revised OLPE curriculum (34%). Chand et al. (2022) discussed similar challenges in the Fijian context. Konukman et al. (2022) also raised similar opinions on the difficulties of OLPE teaching by school type regarding the lack of proper home equipment and the absence of digital resources.

Figure 1

Challenges Faced in OLPE Teaching



Most participants (69.7%) indicated they were prepared to teach PE online, which mirrored Konukman et al. (2022) who found that many teachers were not worried about this. Even so, the challenges they experienced hindered their teaching. It has been suggested that technology assists students by providing meaningful PE and PA learning experiences, despite most PE teachers finding it difficult to implement (SHAPE America, 2020). The findings of this study were consistent with Hill and Valdez-Garcia (2020), who identified that students' behaviour and learning progress could be tracked through new applications. PE teachers must focus on technologies specific to their subject.

With PE being a marginalized subject, its teachers were left alone to figure out how to implement quality PE without support (Richards et al., 2018). It was reasonable to assume that the pandemic further isolated PE teachers and forced them to make decisions influencing student learning outcomes. It was important to understanding the role of technology and the support it offered to make OLPE teaching possible during this time so that technology did not become more of a "distraction but rather a support or resource" (Gallagher, 2020, p. 4). For example, as one of the participants remarked, "understanding the possibilities and challenges helps us make a difference in students' learning experiences" (participant 13).

Consistent with the findings of earlier studies, this study found several barriers teachers encountered. These included fear of the unknown, and teaching in a physically and socially distanced manner where student participation could not be forced; teachers were unsure if the needs of learners were met (Centeio et al., 2021). Furthermore, a lack of awareness of how to integrate technology, few incentives to use technology, insufficient time due to high-stakes testing, difficulties managing a classroom when students were using computers, and lack of technical support were other barriers to integrating technology in the classroom (Hill & Valdez-Garcia, 2020). Despite the many calls for integrating technology in the teaching and learning process with the widespread Internet access in schools, technology integration has not kept pace with developments outside classrooms and schools (Jones et al., 2017). According to Wyant et al. (2015), teacher reluctance was due to their belief that technology cannot enhance PE teaching when it is already a marginalized subject and not worth their time and associated costs.

Readiness to Teach Online

The readiness and acceptance of online learning are predicated on the belief that computer technology will improve student performance (Davis et al., 1989). In evaluating teachers' readiness to teach online, Table 2 shows that males were slightly better prepared to teach OLPE than were females. Age, school experience, and qualifications were also indicators of online teaching readiness. However, it was clear that teachers in urban (85.7%) and suburban (62.5%) settings were more prepared to teach online than were those in rural (37.5%) and maritime (40%) settings. This finding was supported by Chand et al. (2022) and Mercier et al. (2021), who found that rural teachers (including maritime teachers) in particular faced more technological challenges, which hindered their preparedness to teach online. Konukman et al. (2022) also shared that the difficulties of OLPE teaching depended on the type of school. Some lacked proper equipment, had limited Internet access, and had connectivity issues with devices. Similar results in terms of OLPE teaching by gender were noted wherein female PETs were less concerned with OLPE teaching compared to males.

Table 2

Teacher Readiness for OLPE Teaching During COVID-19 Lockdown

Category	Variable	Yes	No	Total
Gender	Male	16 (72.7%)	6 (27.3%)	22
	Female	9 (69.2%)	4 (30.8%)	13
Age	21–30	6 (75%)	2 (25%)	8
	31–40	9 (69.2%)	4 (30.8%)	13
	41–50	7 (70%)	3 ((30%)	10
	51–60	3 (75%)	1 (25%)	4
School setting	Urban	12 (85.7%)	2 (14.3%)	14
	Suburban	5 (62.5%)	3 (37.5%)	8
	Rural	3 (37.5%)	5 (62.5%)	8
	Maritime	2 (40%)	3 (60%)	5
Teaching Experience	1–5 years	7 (70%)	3 (30%)	10
	6–10 years	3 (50%)	3 (50%)	6
	11–15 years	6 (100%)	0 (0%)	6
	Over 15 years	9 (69.2%)	4 (30.8%)	13
Qualification in PE	Diploma	11 (78.6)	3 (21.4%)	14
	Bachelor	12 (70.6)	5 (29.4%)	17
	Postgraduate	2 (50%)	2 (50%)	4

Teacher-Student Online Engagement

Table 3 provides an overview of the consistency of teacher-student interaction in online classes. Our study revealed that OLPE was effective in fostering student independence, but it also required more teacher-student interaction. Consistent with Daum and Buschner (2012) and Williams (2013), female teachers preferred a one-to-one approach, while male PETs believed OLPE instruction was better suited for fostering independence. Younger age groups showed no consistent involvement, but all those aged 51 to 60 engaged with their students. Urban schools had more consistent engagement than did suburban, rural, and maritime schools. Higher qualifications had little effect on teacher and student engagement (Table 2). However, teachers with over 15 years of experience engaged with their students online more effectively. Similar to Bryan and Solmon (2012), these findings suggested that OLPE teaching encourages independent study, but students must be able to practice using technological tools and platforms.

Table 3

Teacher-Student Online Engagement

Category	Variable	Yes	No	Total
Gender	Male	11	11	22
	Female	5	8	13
Age	21–30	2	6	8
	31–40	5	8	13
	41–50	5	5	10
	51–60	4	0	4
School setting	Urban	11	3	14
	Suburban	3	5	8
	Rural	1	7	8
	Maritime	1	4	5
Teaching experience	1–5 years	5	5	10
	6–10 years	1	5	6
	11–15 years	3	3	6
	Over 15 years	7	6	13
Qualification in PE	Diploma	8	6	14
	Bachelor	7	10	17
	Postgraduate	1	3	4

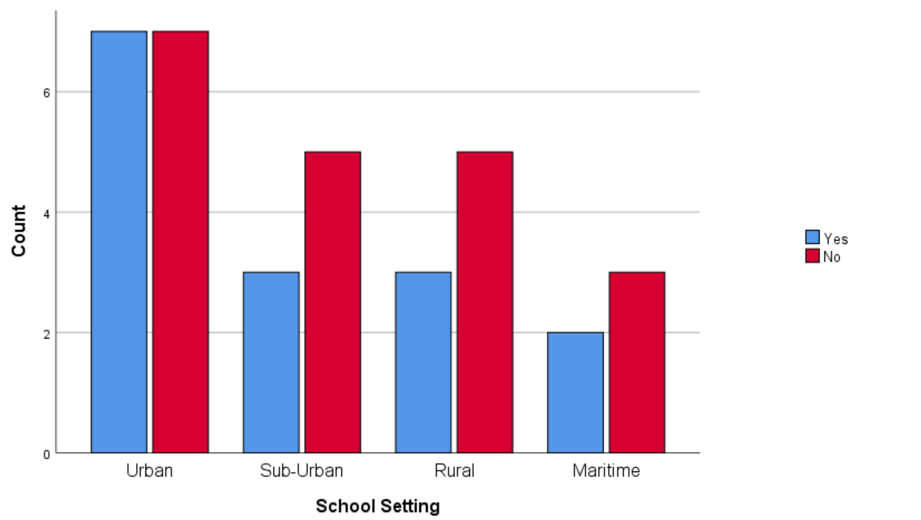
Teacher Consultation With Parents

Understanding and recognizing parental roles and support during home-based online learning was essential for teaching and acquiring knowledge. Among the participants in our study, 54.3% acknowledged that they did not consult with parents. Despite this, 45.7% of teachers could converse with parents or guardians about students' online activities.

Regarding age, it was evident that consultations with parents were more common among those aged 21 to 30 (62.5%) than in the three older age categories, which had higher percentages of no consultation. Parental consultation did not differ significantly by gender. However, males had a higher rate of teacher-parent consultation (45.5%) than did females (38.5%). PE teachers' qualifications and experience did not significantly influence parent consultation; however, a slightly greater proportion of those with a bachelor's degree consulted more frequently than those with 1 to 5 years of teaching experience. The analysis of school settings also revealed that some teachers were unable to consult with parents; teachers in urban schools (50%) engaged in more consultation hours than those in suburban (37.5%), rural (37.5%), and maritime (40%) schools.

Figure 2

Teacher-Parent Consultation



With students learning at home, parental involvement in their children's education became crucial. A two-way consultation was suggested, where parents could consult without waiting on teachers. As participant 12 shared:

> Parents should monitor their children at home and determine if their child is attending the online class. In order for the child to be able to learn, parents and teachers must communicate so that a solution can be reached regarding the child's academic performance, attendance, and Internet connectivity.

Assignments and Feedback

Teachers selected a combination of online assignment submission and feedback platforms. Most teachers (80%) chose Zoom as their primary platform, preferring that students present their assignments online and receive immediate feedback. Moreover, 28.6% chose the Moodle platform. In addition, some teachers used e-mail (25.7%), Google Meet (14.3%), and Viber/Messenger (2.9%) for communication. Our findings disclosed that a few teachers attempted to explore additional online tools like Seesaw. However, some students still preferred delivering and collecting hard copies of their assignments.

Table 4

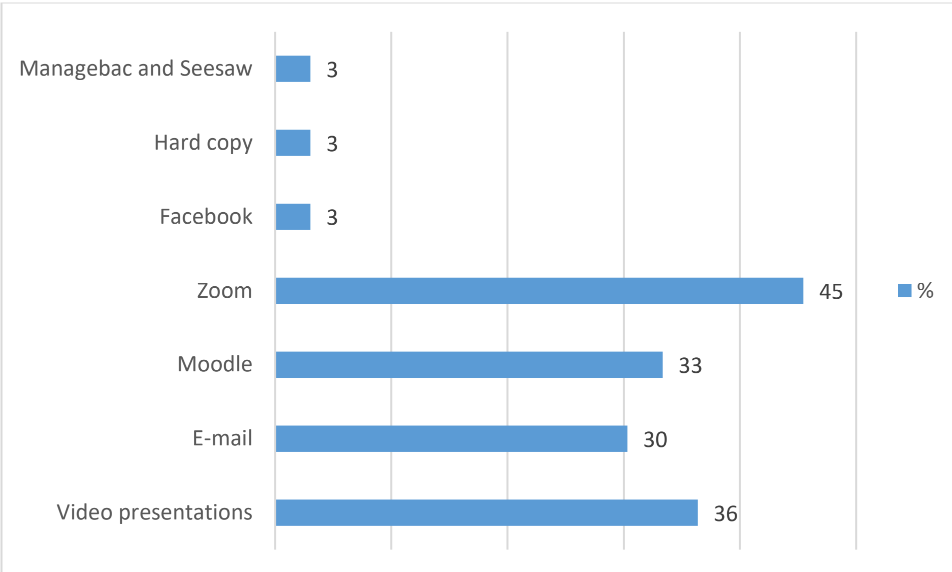
Teacher-Preferred OLPE Assignment and Feedback Platforms

Platform	Response	Frequency	Percent	Cumulative percent
E-mail	Yes	9	25.7	25.7
	No	26	74.3	100.0
Zoom	Yes	28	80.0	80.0
	No	7	20.0	100.0
Google Meet	Yes	5	14.3	14.3
	No	30	85.7	100.0
Viber/Messenger	Yes	1	2.9	2.9
	No	34	97.1	100.0
Moodle	Yes	10	28.6	28.6
	No	25	71.4	100.0

During the discussion, teachers also reflected on what online platforms their students preferred for assignment submissions and feedback. Regarding assignment presentations and receiving performance feedback, 45% of students still preferred synchronous online learning via Zoom. Additionally, students were enthusiastic to complete video assignments (36%). Some (33%) indicated they were familiar with and preferred the Moodle platform, while 30% indicated they were more comfortable with e-mail. Additionally, 3% of students mentioned Facebook, Managebac, and Seesaw as learning platforms. Surprisingly, 3% of students favoured paper-based (hard copy) assessments with feedback.

Figure 3

Teacher Audit of Students' Online Learning Platform Preferences



Over 81% of teachers were able to provide evaluation feedback to students who successfully submitted assignments. This was only possible for students with Internet-capable devices. Teachers also discussed the devices students used in online classes and for grading. Most students made calls using smartphones, laptops, desktop computers, and conventional cellphones.

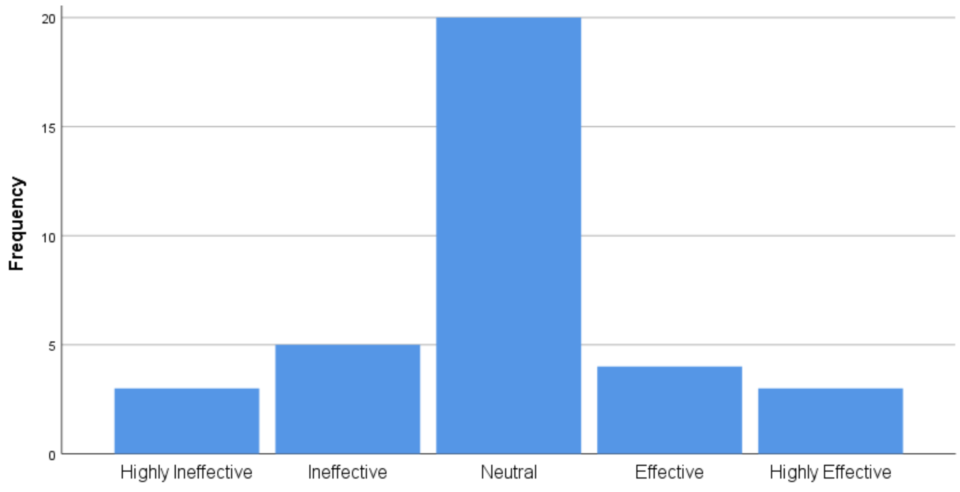
Most teachers also explored alternative OLPE teaching methodologies from other online sources. This indicated that teachers were aware of their students' learning and assignment submission limitations and attempted to assist them. User-friendly online platforms, such as Zoom, Blackboard, Canvas, and Google Meet (O'Brien et al., 2020; Quezada et al., 2020), Seesaw and Google Classrooms (Cruickshank et al., 2021), Flipgrid and YouTube, were easily accessed through a phone or tablet computer, allowing for quick engagement of students in learning new concepts and enhancing skills (Centeio et al., 2021). However, other researchers have suggested that effective use of these online platforms depends on PE teachers' ability to engage students creatively through effective implementation of synchronous online meetings, good time management skills, and the provision of ample real-world examples and meaningful feedback (Daum & Buschner, 2014; Oliver et al., 2009; Williams, 2013).

Teacher OLPE Effectiveness

Teachers were asked to evaluate their OLPE teaching effectiveness on a scale from one to five (Figure 4). Most teachers (57.1%) placed themselves in the middle of the scale, at three.

Figure 4

Teacher-Effectiveness Scale



Chan et al. (2021) shared similar sentiments: teachers perceived the effectiveness of their OLPE teaching to be low and challenging, and their workload increased as a result of lesson preparation and curriculum restructuring, as well as their efforts to meet parents' and principals' expectations. All this resulted in increased stress. On the other hand, an overwhelming majority of teachers (87.88%) indicated that they would be prepared to teach online if a repeat lockdown were imminent, provided they were assisted with Internet connectivity, devices, professional developments in the use of technology, and a PE curriculum that could be delivered online. However, some evidence has indicated that online education has reduced students' interest in learning (NASPE, 2007, as cited in Kooiman et al., 2017). In this case, it is imperative for PETs to enhance their students' socio-emotional development within the scope of OLPE teaching (Tison et al., 2020) due to the restrictions students face. Activities must be developed to improve interactions between teachers and students.

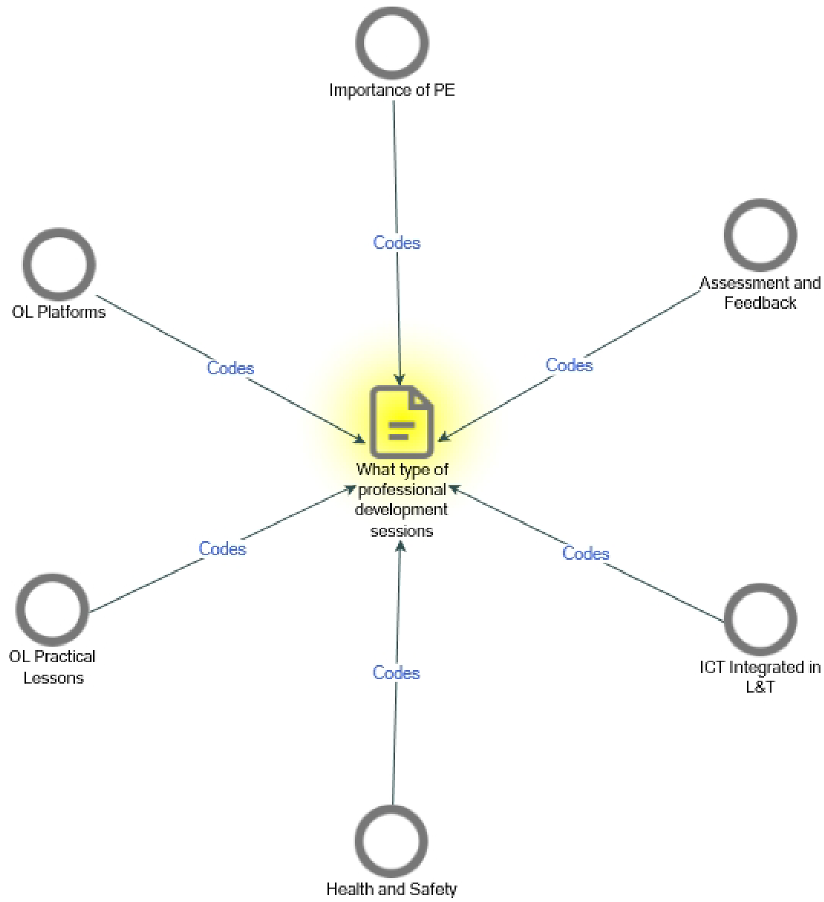
Professional Development Sessions

According to the teachers, their school leaders gave them opportunities to learn more about online learning, but these opportunities differed significantly from school to school. While most teachers (51.52%) stated that neither schools nor the MOE provided professional development sessions, 48.48% reported they were provided the opportunity to participate in PD sessions.

In addition, the interviews with teachers revealed that they required additional instruction and enhancement in OLPE. They believed the MOE and school principals would enhance PD sessions and offer workshops to help teachers improve their OLPE skills. Figure 5 illustrates the results of asking teachers about what types of professional development sessions or topics would help them teach better online. The highest demand for professional development centred on enhancing knowledge and skills in online platforms as well as ICT-integrated instruction and learning. PE, online assessment and feedback, and how to improve the online practical skills lesson were also seen as essential for enhancing health and safety-related knowledge and skills. To assist in this, the curriculum content delivered via OLPE teaching needed to be efficient and exciting to improve students' interest in the lessons. It is, therefore, important for teachers that the MOE offer the necessary support to keep teachers from becoming exhausted and losing motivation (Konukman et al., 2022).

Figure 5

Types of Professional Development Sessions Needed (Coding)



To make remote learning possible, it is necessary to understand and evaluate the significance of technology. This can be accomplished via online webinars and hands-on training. This is also supported by SHAPE America's (2020) demand for more effective online training for PETs. Regarding the need to learn more about online teaching platforms, teachers offered the following reflections. "I need to learn more about OLPE and what other ways and means I can use to teach, as well as what other online resources, apps, and tools are available to make teaching physical education relevant and enjoyable" (participant 9). "I believe computer literacy is essential. Students must be able to utilize applications and create their own YouTube, Canva, PowerPoint, and Google Slides" (participant 23).

Before the pandemic, prior studies indicated that PETs felt unprepared to use technology (Casey et al., 2017). Kim et al. (2021) discovered that PETs struggled due to a lack of access to technology, technological knowledge, training and time to learn, as well as a gap between knowing technology and applying it into online teaching. The following response illustrated teachers' concerns regarding the use of ICT in the learning and teaching process. "It is crucial to conduct professional development on the effectiveness of technology in instruction and learning. I am aware of the available technologies, but I am unable to use them. Perhaps this will make my classes more engaging" (participant 4).

There has been much debate about the need for additional PD, so teachers must remain current with technological advancements. OLPE can make use of (a) cameras, active video games, and wearable devices that record and monitor movement; (b) sports-specific software and apps; (c) video analysis tools; and (d) health-related applications (Casey et al., 2017; McCaughtry et al., 2008). Two teachers reflected on this requirement:

> Utilize alternative methods when physical presence is unattainable. Technology is here to stay, and numerous advances have been made over the years; however, physical education teachers are still struggling to keep up. We must learn more about the tools and applications that can help us teach what is pertinent (participant 19).

In addition, participant 14 noted that "technology, the Internet, and online services are indispensable. Most of my students are exposed to this, so teachers must collaborate with them to enhance student learning outcomes."

PETs require content-specific PD to provide their students with quality PE experiences. With the assistance of the government and school leaders, the MOE must provide the necessary support. These include providing online teaching kits and concrete teaching guides to PETs to develop innovative and interactive online lessons for their students to acquire motor skills and maintain their levels of physical activity (Chan et al., 2021). By fostering the use of smart apps designed to deliver content and receive feedback, educational bodies and their supporting organizations must take advantage of the opportunity to equip PE teachers better to promote OLPE instruction (Gobbi et al., 2020).

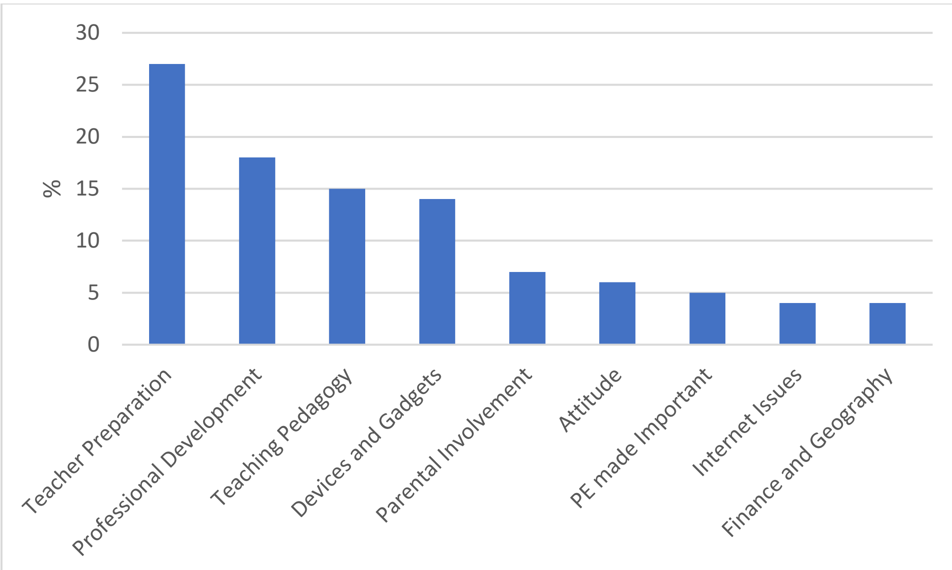
Lessons Learnt and Teachers' Perceptions of OLPE Teaching in the Future

The pandemic forced the implementation of online education, and teachers could not avoid using ICT. The percentage coverage of the lessons learned is coded below (Figure 6). The most significant percentage of coverage of the lessons learned came from reflections on teachers' preparation (27%). Despite the mandatory implementation of online learning in their schools, participants reported that teaching students remains challenging. "Given the social context of our students, the year's notes must be disseminated in advance, with explanation and application if time permits. Otherwise, virtual learning is ineffective because not all students have access to technology" (participant 15). "Students are only interested in outdoor activities and have no interest in OLPE teaching" (participant 33).

As a result of COVID-19 pandemic lockdowns in the Pacific and the area's current state of vulnerability, the situation has "given us Pacific people new challenges to rethink, reimagine, and recreate lives and sustainable futures" (Nabobo-Baba, 2021, p. 3). Most teachers are optimistic about the role of ICT innovations in enhancing the learning and teaching process, as illustrated by participant 16. " Improvised techniques and methods must be developed and taught to teachers and students for learning to continue during lockdowns. Professional development in OLPE is crucial and should be consistently pursued to prepare teachers."

Figure 6

Lessons Learnt



The vast majority of teachers considered OLPE teaching strategies to be an enormous challenge. When coupled with technological challenges and a rapid shift away from the conventional mode of teaching towards a more virtual realm, ongoing professional development sessions on the efficient use of technology in the virtual PE classroom have been beneficial (Centeio et al., 2021). It is necessary to bring about a shift in attitudes and misconceptions towards PE. PETs must recognize that a person's capacity to maintain physical, social, and mental health is the most crucial factor in living comfortably in their environment. Sadly, one teacher shared that "physical education is not as essential as it once was; PE classes are not taken seriously by school administrators or considered a core subject. Physical education classes are diminishing" (participant 1).

Despite this, the OLPE curriculum has emphasized the desire to continue working diligently so that the subject receives the attention it deserves through technological innovations.

> Teach students engaging topics that spark their interest, particularly when the subject is insignificant in schools and communities. Utilize technology to create this distinction and use it to complement student abilities. TikTok videos are becoming the norm for sharing knowledge and emotions. Utilize social media to disseminate information and make an impact. Interesting apps are available to calculate physical movements and measure wellness; use them (participant 10).

Teaching PE beyond classroom walls and playgrounds reintroduces students to new learning spaces and, with new technologies, enables them to think and learn in innovative ways. However, as technology advances, the digital divide between those who have access and those who do not will persist, resulting in children falling behind (Kang, 2016). "When integrating technology into lessons, it is necessary to be culturally aware and sensitive and to troubleshoot related issues" (Centeio, 2017, p. 12).

Conclusion

This study revealed that technological competence in OLPE teaching is independent of factors such as age, gender, qualifications, and teaching experience. However, due to technological accessibility, the school environment significantly influenced the efficacy of OLPE teaching. Teachers must acquire new skills and be familiar with online platforms to enhance OLPE teaching pedagogies. Prioritized workshops, upskilling opportunities, and teachers' interests determine their readiness to teach OLPE. The Ministry of Education and schools must recognize the importance of online instruction in the post-pandemic period and the increasing technological dependence of learners.

Engagement between students and teachers, and consultations with parents, are essential for the success of OLPE. The ministry should (a) provide all schools and teachers with technology for effective online teaching and learning, (b) improve Internet connectivity, and (c) provide resources, PD, workshops, and an OLPE curriculum guide. Teacher training institutions also play a crucial role in providing online platforms and pedagogies for training and learning.

This study's practical implications supported an emphasis on focused professional development efforts to improve technological proficiency in OLPE. Institutional support, lessons learned during the pandemic, and regular professional development sessions are essential. The mixed-methods strategy provided a comprehensive picture of OLPE teaching experiences, but the study's small sample size and focus on Fiji limited generalizability. Future research should examine broader geographical contexts and long-term effects of professional development on OLPE practices.

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International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 25, Number 1

February – 2024

Book Review: *Digital Teaching, Learning and Assessment: The Way Forward*

Editors: Upasana Gitanjali Singh, Chenicheri Sid Nair, and Susana Gonçalves (Chandos Publishing, 2023, 302 pages) ISBN 978-0-323-95500-3

Reviewed by: S.K. Pulist, *Indira Gandhi National Open University, India*

The pandemic has enabled digital learning to take a prominent place in the educational ecosystem. Educational institutions across the globe have adopted a digital environment for carrying out teaching and learning during COVID-19. The level of such academic experience has varied from institution to institution. Teachers and researchers have been documenting their experiences and insights to learn and decide the shape of the future educational ecosystem vis-à-vis the role of information and communications technology. This book is an effort that not only revisits the challenges and difficulties faced by the higher education system but also leaves us with the thought of building a future-ready ecosystem capable of both meeting the educational requirements of the 21st century and overcoming any physical barriers between the teacher and the taught.

Through 14 chapters, the book presents a glimpse into the educational experiences acquired during the COVID-19 pandemic and focuses on the digital teaching and learning ecosystems that evolved in ten countries: Australia, Denmark, India, Italy, New Zealand, Oman, South Africa, Sweden, United States of America, and Zimbabwe. The individual chapters reflect on their experiences and explore possibilities for the higher education system to meet future challenges and requirements hitherto unknown.

Chapter 1, "Supporting virtual student research opportunities: The Holistic Foundry Undergraduate Engaged Learners program experience," reflects on the development and implementation of the Holistic Foundry Undergraduate Engaged Learners (FUEL) program—a fully virtual research and monitoring program for undergraduate students in the United States. The program follows a two-pronged approach: virtual and hybrid. The authors present evidence of the effectiveness of FUEL and put forth best practices from the program. The experiment is replicable in a normal situation. Chapter 2, "Digital education for a resilient new normal using artificial intelligence—Applications, challenges, and way forward," focuses on different technologies used in the digital education ecosystem. These technologies are the Internet of Things, artificial intelligence, machine learning, deep learning, and virtual reality. A paradigm shift has taken place which has completely changed the form of higher education. These technologies influence various aspects of teaching and learning, monitoring, feedback, and assessment in ways different than ever before. The chapter presents a case for equitable use of these technologies coupled with strengths, weaknesses, challenges, and opportunities. The authors refer to some of the Government of India's digital initiatives such as eVidya, DIKSHA, SWAYAM, ePathshala, etc.

In Chapter 3, “Endured understanding of learning in online assessments: COVID-19 pandemic and beyond,” the author presents a case of a sustained understanding of learning during the pandemic. It is important to design a sustainable digital learning ecosystem for the future. The digital learning system throws open a plethora of opportunities for online assessment. Moreover, the digital platform provides an opportunity for learners to engage in sustained understanding. The author emphasizes the need for a multi-dimensional instructional design as a response to the requirements of the post COVID-19 era. Taking technology as a tool, the online learning domain should consider the learning experiences of students as the availability of digital resources and their capacity are crucial for the effectiveness of the digital ecosystem. Chapter 4, “Transformative course design practices to develop inclusive online world language teacher education environments from a critical digital pedagogy perspective”, advocates for the use of design thinking to understand user needs and design a sustainable and effective learning ecosystem. The author uses the term “design justice” to describe an inclusive language teacher education program for an online environment. “Design justice focuses on the ways that race, class, gender, and disability structure both information asymmetries and variance in user product needs” (Costanza-Chock, 2020, p.78).

Chapter 5, “New teaching and learning strategies during the COVID-19 pandemic: Implications for the new normal,” presents the reflections of the authors on the swift transition from conventional teaching to remote teaching during the first COVID-19 wave in New Zealand. This not only resulted in the reshaping of instructional delivery mechanisms at the institutional level but also necessitated a major twist in assessment strategies. The COVID-19 pandemic created an urgent requirement to understand systemic needs and their potential and follow an integrated approach for tweaking the processes of instructional delivery, monitoring, feedback, and assessment with the intervention of digital technologies. This has significant implications for the design and delivery of a future-ready higher education system. In Chapter 6, “Birley Place: A digital community to enhance student learning,” the authors focus on a digital community, Birley Place, created to enrich the learning experiences of students of, especially, health and social care programs in Manchester, United Kingdom. This is an online digital community meant for collaborative skill development at personal and professional levels. The online participants can digitally explore the community map and visit residents. This way, they can interact and understand the indicators that impact their socioeconomic life. The chapter presents a thematic analysis of the data collected from the community based on authentic place-based learning, digital place-based learning, opportunities for collaboration, and flexibility and convenience. The results show amazing benefits to the students in the form of flexibility and accessibility to the virtual environment for learning.

Chapter 7, “Assessment: Higher education institutions’ innovative online assessment methods beyond the era of the COVID-19 pandemic,” presents a critical appraisal of the methods of teaching, learning, and assessment adopted by educational institutions. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method was adopted for this study. The authors summed up the discussion under three themes: learning and assessment in higher education institutions; innovative formative assessment adopted in higher education institutions during and post the COVID-19 pandemic; and summative assessments currently adopted and their future use in higher education institutions. The authors advocate for extensive use of technology for implementing different forms of assessment. Chapter 8, “Formative assessment in hybrid learning environments,” presents a framework for the implementation of online formative assessment. The framework for designing an online formative assessment system also supports a self-regulatory mechanism for a hybrid learning environment. This framework can facilitate the implementation of innovative teaching and learning strategies resulting in the development of an effective online formative assessment mechanism.

Chapter 9, "Student experience of online exams in professional programs: Current issues and future trends," examines innovative approaches to online examination. It investigates the benefits of the online examination system while studying issues and challenges. In a nutshell, the chapter presents the perceptions and experiences of students using different online assessment strategies. Three types of online examinations, i.e., non-invigilated, Zoom invigilated, and live invigilated, were used in the study. Based on the findings, the authors make recommendations on the long-term sustainability and viability of online assessment systems. Chapter 10, "E-textbook pedagogy in teacher education beyond the COVID-19 era," investigates the potential benefits of e-textbooks in digital learning environments as compared to print textbooks in the face-to-face environment. In the digital environment, e-textbooks are easy to integrate with teaching and learning activities. The whole environment becomes interactive, promising aspects of personalized learning. The study used the Technology Acceptance Model to make sense of the experiences of participants. The findings revealed that participants were not very excited to replace their reading material with e-books. Factors such as Internet self-efficacy, perceived usefulness, facilitating conditions, and cost had a great impact on migration to e-textbooks.

In Chapter 11, "The death of the massification of education and the birth of personalized learning in higher education," the authors examine the online behavior and preferences of students during the unplanned emergency remote teaching and learning in South Africa. The findings helped the authors in developing a new approach to pedagogy, factoring in the principles of universal design for learning. Integration of active learning, personalized learning, and problem-based learning, among others, are part of the new approach. Chapter 12, "New online delivery methods beyond the era of the pandemic: Varied blended models to meet the COVID-19 challenges," evaluates the effects of the new modalities of remote teaching developed to combat the challenges of the COVID-19 situation in Uzbekistan. The author advocates for using a blended learning model for the effective delivery of academic programs. Some changes at the policy level might be required to assimilate the half-and-half model of blended learning into the higher education ecosystem.

Chapter 13, "Digital teaching and learning: The future of ophthalmology education," examines two new online teaching platforms developed to meet the challenges of the COVID-19 situation. The first was developed for students of pregraduate and undergraduate programs. This platform was developed to enhance the exposure of students to the different domains of ophthalmology. The second platform was "Virtual Ophthalmology Rotation", developed for medical students to continue their ophthalmic education in virtual and hybrid environments. In Chapter 14, "Online education which connects: Adopting technology to support feminist pedagogy—A reflective case study," the author (also one of the editors of the book) examines the gender digital divide in higher education in South Africa. She proposes a new model to bridge the divide and advocates adopting a blended mode of teaching, learning, and assessment in higher education. The creation of social spaces and trust-building among female students would enhance the effectiveness of the use of online platforms collaboratively, according to the author.

On the whole, the book provides deep insights into the challenges faced by the higher education system during the pandemic. It also provides a way to handle such disruptions in future and make the best use of the situation in the interest of the higher education system and the student community. It is a must-read for educators, instructional designers, and educational administrators who are engaged in blended, hybrid, and virtual modes of learning and frequently face different technological challenges.

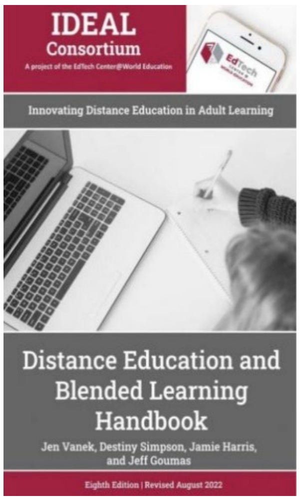
Reference

Costanza-Chock, S. (2020). *Design justice: Community-led practices to build the worlds we need*. MIT Press.

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 25, Number 1

February – 2024

Book Review: IDEAL Distance Education and Blended Learning Handbook, 8th Edition



Authors: Jen Vanek, Destiny Simpson, Jamie Harris, and Jeff Goumas (EdTech Books, 2022)
https://edtechbooks.org/ideal_dl_handbook

Reviewed by: Jarwati, *First Education Center*

The eighth edition of IDEAL Consortium's *Distance Education and Blended Learning Handbook* offers guidelines and tools to assist programs in implementing HyFlex, blended learning, and distance education. The book draws on reports from programs all around the US, as well as information from the National Reporting System for Adult Education, which demonstrates a notable rise in the use of distance education and reporting requirements for blended learning and distance education program.

The book, which is based on recent and historical research, policy directives, and effective practices compiled by the IDEAL Consortium, tackles both administrative and instructional difficulties. It provides readers with tools for constructing a proactive strategy to improve learning and increase capacity in a sustainable way.

Blended learning and distance learning are introduced in Chapter 1, which is about "Setting the Stage" and which also discusses the terminology used in the field. In this chapter, the authors also discuss synchronous and asynchronous online learning, as well as other forms of distance education. The crucial subject of recruitment is covered in Chapter 2, which instructs readers on how to find and recruit students for their program. Knowing the target audience and comprehending their wants and interests is crucial, according to the authors. This chapter offer methods for publicizing programs and enlisting pupils through associations with other organizations and word-of-mouth. Chapter 3 focuses on evaluating students' readiness for distance and blended learning and identifying the support they require to succeed. In order to provide equal access to adult education services and technology, the authors stress the significance of evaluating students' technological proficiency and skill gaps. Additionally, they propose techniques for boosting students' online learning and offering entirely remote options for intake tasks. The goal of Chapter 4 is the orientation of students to prepare them for success. The authors provide suggestions for designing orientations that equip students with the skills and information necessary for a successful learning experience. They emphasise the importance of teaching digital literacy and building students' digital resilience. These are just a few of the strategies the authors suggest for providing completely remote orientation options, along with video classes, online manuals, and virtual Q&A sessions. The initial four chapters of the *Handbook* demonstrate the need for learner-centeredness in distance education programs.

Instruction and the qualities of effective teaching are discussed in Chapter 5. The authors investigate how various education methods, such as distance learning, blended learning, and HyFlex, influence teacher participation and provide stimulating and encouraging feedback on students' work. Along with standards-aligned teacher-created courses, they also explore crowdsourcing and open educational resources. Based on instructional goals and circumstances, the authors offer methods for choosing relevant resources, such as proprietary online curricula and other learning and communication technology.

Chapter 6 emphasises the topic of assessment and monitoring of student improvement. The writers look at the numerous roles that assessment might play, including diagnostic, formative, and summative evaluation. Additionally, they provide guidance on how to include distance learners in the National Reporting System for Adult Education and how to use data to improve instruction and student learning outcomes, as well as a range of strategies for assessing learners' progress. The administrative challenges of creating and maintaining remote education programs are examined in Chapter 7. For the purpose of fostering innovation, the authors advocate using a pilot strategy and cultivating an experimental culture. They place a strong emphasis on tracking statistics, the effectiveness of online education programs, and the relationship between distance learning and the Workforce Innovation and Opportunity Act's priority of adult education objectives. This chapter offers strategies for resolving typical administrative issues like funding, staffing, and career development for teachers.

A reflective exercise that is intended to aid instructors and administrators in planning and implementing a new distance education program or bettering an existing one is included at the end of each chapter. These exercises give readers a chance to put the concepts and tactics discussed in the chapter to use in their own contexts.

For educators and administrators intending to create and administer remote learning and blended learning programs, the *IDEAL Distance Education and Blended Learning Handbook* offers helpful and action-oriented advice. One of the book's greatest assets is its practical treatment of all the important areas of distance and blended learning, including recruitment, student readiness, orientation, training, assessment, and administrative difficulties. In order to provide evidence-based advice on successful tactics and approaches, the *Handbook* draws on research and best practices in distance and blended learning. The book is simple to grasp and navigate because of the writing's clarity and accessibility, and each chapter includes reflective exercises that can be used to develop new programs or enhance current ones.

The *Handbook* could have used more case studies to illustrate how the techniques and methods covered in the book are used in actual contexts by partner institutions in the IDEAL Consortium. Furthermore, it may be noted that the *Handbook* is not about any particular tools or technologies. It provides strategic guidance and advice for planning and implementing distance education programs. It is especially targeted to the members of the Consortium, although others could also benefit from their experiences. Overall, the *Handbook* provides good guidance for quality distance education in a post-pandemic learning ecosystem.

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Volume 25, Number 1

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Book Review: How Education Works: Teaching, Technology, and Technique

Author: Jon Dron (AU Press, Athabasca, AB, 2023, 287 pages). Open Online Edition: https://www.aupress.ca/books/120320-how-education-works/ (Paperback Purchase Edition: ISBN:9781771993838)

Reviewed by: Jenni Hayman, Royal Roads University, Victoria, British Columbia

Jon Dron's 2023 book *How Education Works* is a 287-page learning experience about the ins and outs of what technology, technique, teaching, and learning are (and are not) from his perspective. The author provides insight and specific instructions for educators and learners on how they might act as co-participants for mutual learning benefit as they encounter hard and soft systems, processes, methods, technologies, and pedagogies for education. His discussion of the types, benefits, and challenges of hard and soft paradigms related to learning represents a valuable contribution to critical thinking in post-secondary system contexts. He proposes a theory of education as an orchestrated technological phenomenon of co-participation. His opening mantra (as he names it) for the book is "…what we do (the tools, methods, principles, etc. for doing it) is far less significant than the way that we do it (the technique)" (p. 3).

My interest (and context for reading this book) was as a college-level post-secondary administrator responsible for online asynchronous program design and delivery. In my role, I oversee the quality of curriculum and course design as well as professional development and mentoring for online asynchronous faculty. As a long-time instructional design practitioner and teacher, I primarily focus on the use of technologies for teaching and learning. I ordered a print copy of the book so I could explore it in depth and write in the margins. On the back cover of the book, Dron opened with a primary question: "How can researchers and practitioners in education usefully understand technology, education, and their relationship to improve teaching practice?" This question confirmed that this book was for me—but is also intended for educators (including students) of all kinds. I made a lot of notes, underlined many passages and sentences, folded many corners, and added stars.

Dron's current position is Associate Dean, Learning and Assessment in the Faculty of Science and Technology at Athabasca University in Athabasca, Alberta, Canada. This book is part of his body of work, which includes more than 150 academic publications. As you might expect of a technology-interested education researcher, Dron has a current and relevant web page: https://jondron.ca/. There, you can learn more about his interests and perspectives and explore his body of work.

All chapters in the book are grounded in current and relevant literature about learning, technologies, and systems. Based on Brian Arthur's 2009 work, *The Nature of Technology*, Dron defines technology in a simple way as "…organizing stuff to do stuff" (p. 35). He further uses Arthur's definition of technology as "…an orchestration of phenomenon to our use" (Arthur, 2009, p. 53). I liked the inclusion of Arthur's orchestration as a concept throughout Dron's work. The eclectic citations and references used throughout *How Education Works* represent a buffet of further exploration where chapter topics and concepts might be of personal interest. Dron successfully presents ideas, arguments, and theory drawing on well-established and emerging knowledge of teaching practice and technologies that are enmeshed in everything we currently know and learn about our world.

In Part I, the preliminary chapters of the book, Dron focuses on descriptions and multidisciplinary definitions of technology and technique and relevant elements of complexity theory that present a cognitive pathway for the reader. The lessons in these chapters are focused on challenging the concepts related to systems and experiences in human cognition and technologies—especially in formal learning. I admit that I resisted some of his premises vocally and repeatedly. My margin notes included several iterations of "That's not a technology, it's a tool!" and "Still not a technology, that's a method, or process, or, yup, that is still a tool." As an education reader, I felt there would likely be a positive connection between the veracity of my responses and the value of the learning—and so there was.

In Part II of the book, Dron focuses on education and technologies and begins to frame the concepts presented in Part I for specific education contexts. He uses theories and literacies as a guide. The primary theory of the book—a model of teaching, technologies, and techniques as a means of co-participation for learning—is described. The use of literature and Dron's personal experiences of teaching and learning support further focus on the core elements of how education works from his perspective. He describes his co-participation theory as follows:

> In this model, teaching is seen as a massively distributed technology in which we are all teachers of ourselves and others, in which our technologies are not just the means but also parts of ends, machines that form part of our cognition within our individual minds, beyond our minds and bodies, and tangibly interwingled with the minds of others." (pp. 123–124)

I enjoyed learning the word "interwingled" and look forward to borrowing it.

In Part III and the epilogue of the book, Dron shares elements of effective teaching and learning practice using Part I premises, anecdotes, and examples to come full circle on his theory. He emphasizes how a model of co-participation, through a mix of contextually informed hard and soft approaches to learning, might be enacted in practice. In key moments throughout the book, the limitations of current, predominantly hard, and restrictive models of teaching and credentialing are highlighted. Dron proposes that teachers consider a contextual mix of hard and soft technologies and pedagogies as they enact their everyday work—whether or not they feel they have power to change deeply entrenched systems.

Given current COVID-19-related conversations and emerging research on technology-mediated education experiences, this book represents an important contribution to conversations about technologies and learning in a time when the affordances of technologies for learning have been prioritized in education system practice. Also, considering the rapid and recent emergence of generative AI tools and education leaders' reactions (including some panic), this book is a timely contribution for reasonable and calm reflection on teaching and assessment.

The strengths of the book (a book is a technology, of course) include the author's familiarity with and use of current and relevant research to support his theory and models, the design of the parts and chapters to move the reader through a scaffolded experience of complex concepts, and a consistent focus on what the author presents as foundational for effective teaching. The primary concept, Dron's co-participation theory, states that effective teaching is passionate, caring, and grounded in observation and response patterns where individual actions and reactions of learners as teachers and teachers as learners means that no learning experience can ever be the same from one individual to another. There are few, if any, weaknesses in the writing or design. I wanted to hear more about co-participation in practice as a pragmatic practitioner, but that's just me and my experience of the book was unique. As a human, I often want to be comforted by certainties and prescriptions. There are few such comforts in this work. There are well-researched premises and considerations that will need to be applied and experienced as successes, failures, and lessons learned in context. In the same way that Dron's descriptions of technologies, knowledge, learning, and learners emphasize deep connectedness, this book should not be isolated from his body of work. There are many related writing and sharing opportunities to be discovered in his open, reflective practice.

The contribution to the field of education that this book makes—as a learning technology that educators can experience in their own ways—is deep and meaningful. It is not an easy read. It challenges the reader to let go of assumptions and well-established education research paradigms to consider new ways of enacting research and practice. The co-participation theory and model of the work are applicable to PreK-12, post-secondary, community, and corporate learning, and they are modality agnostic. Anywhere that teaching and learning take place—which is everywhere and constantly—practitioners can benefit from consideration of Dron's ideas. I highly recommend reading and exploring this book either in print or digital (open and no-cost) format.

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International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 25, Number 1

February – 2024

Role of AI in Blended Learning: A Systematic Literature Review

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Abstract

As blended learning moved toward a new phase during the COVID-19 pandemic, advancements in artificial intelligence (AI) technology provided opportunities to develop more diverse and dynamic blended learning. This systematic review focused on publications related to the use of AI applications in blended learning. The original studies from January 2007 to October 2023 were extracted from the Google Scholar, ERIC, and Web of Science databases. Finally, 30 empirical studies under the inclusion criteria were reviewed based on two conceptual frameworks: four key challenges of blended learning and three roles of AI. We found that AI applications have been used mainly for the online asynchronous individual learning component in blended learning; little work has been conducted on AI applications that help connect online activities with classroom-based offline activities. Many studies have identified the role of AI as a direct mediator to help control flexibility and autonomy of students in blended learning. However, abundant studies have also identified AI as a supplementary assistant using advanced learning analytics technologies that promote effective interactions with students and facilitate the learning process. Finally, the fewest number of studies have explored the role of AI as a new subject such as use as pedagogical agents or robots. Considering the advancements of generative AI technologies, we expect more research on AI in blended learning. The findings of this study suggested that future studies should guide teachers and their smart AI partner to implement blended learning more effectively.

Keywords: blended learning, artificial intelligence, systematic review, AI in education

Role of AI in Blended Learning: A Systematic Literature Review

Blended learning, which integrates face-to-face learning and online instruction (Graham et al., 2013), has become an increasingly popular learning format. Many scholars have predicted that blended learning will become the primary instructional approach in the post-COVID-19 era. Mali and Lim (2021) reported that blended learning was perceived more positively during the COVID-19 pandemic. It provided flexibility in learning and often compensated for the weaknesses of online learning, such as the lack of immediate feedback from the instructor, the lack of social presence, and low learning engagement (Boelens et al., 2017; Heo et al., 2022; Martin et al., 2022; Wang & Huang, 2018; Zydney et al., 2019). Although blended learning is not a new instructional approach, online learning experiences during the pandemic enabled educators and scholars to take a fresh look at the potential and power of blended learning as an effective instructional approach.

While many researchers have identified the effectiveness and efficiency of blended learning, Boelens et al.'s (2017) systematic review identified four challenges in blended learning: (a) incorporating flexibility, (b) stimulating interaction, (c) facilitating students' learning processes, and (d) fostering an affective learning climate. Despite the effectiveness of blended learning compared to fully online courses, this systematic review highlighted the many challenges and obstacles that still exist with blended learning. On the other hand, Dziuban et al. (2018) pointed out that information communication and technologies (ICT) have made it possible to implement the online learning component of blended learning. Beyond the use of ICT for blended learning, scholars have predicted that artificial intelligence (AI) including learning analytics (LA) techniques, an intelligent tutoring system, and automated essay scoring, will be increasingly adopted in blended learning in the future (Dziuban et al., 2018; Floridi, 2014; Norberg, 2017). Balfour (2013) also predicted that these AI applications will help instructors use their time and resources more efficiently and wisely by reducing their repetitive or recurring tasks. In addition, if AI is properly applied to blended learning, the need for and expense of teaching assistants and technology support personnel for implementing blended learning may no longer be an issue (Zydney et al., 2019). Hwang et al. (2015) emphasized the important role of artificial intelligence in flipped learning as a potential research issue for making flipped learning more effectively.

In the late fall of 2022, the emergence of ChatGPT (generative pre-trained transformer) introduced by OpenAI gained unprecedented attention in society as well as in education (Adiguzel et al., 2023; Halaweh, 2023; Yu, 2023). The use of ChatGPT in education is expected to become a potential tool to support students' personalized learning and to enhance students' engagement in the setting of blended learning (Alshahrani, 2023). Despite the increasing academic interests about the potential of ChatGPT, few scholarly works are currently available in education because it takes time to examine the role of ChatGPT after its extensive application for several years.

With the increasing interest in AI in education (AIEd), numerous systematic literature reviews (SLR) have been published in the past two to three years. While many studies have illustrated general research trends (Chen et al., 2020; Chen et al., 2022; Guan et al., 2020; Li et al., 2022; Song & Wang, 2020; Tahiru, 2021), several examples have emphasized the balance between technology-based applications and theory-based practices. Although many studies have been conducted on AI applications in BL, few systematic reviews have exclusively focused on this topic. Therefore, we conducted a systematic review and provided an overview of the AI applications that can be used in blended learning. As a framework, we used Boelens et al.'s (2017) challenges in blended learning as well as the three roles of AI proposed by Xu and Ouyang (2021). Based on the research findings, we have provided suggestions for applying AI in blended learning formats to enhance the effectiveness and efficiency of blended learning.

Theoretical Framework

Blended Learning

Blended learning refers to a combination of multiple instructional approaches in various dimensions, to find the optimal teaching and learning approach. However, considerable research has emphasized the ambiguity of the term blended learning and its complex nature (Oliver & Trigwell, 2005). Thus, numerous studies have attempted to clarify the various concepts (Caner, 2012; Cronje, 2020; Driscoll, 2002; Friesen, 2012), develop several models (Graham et al., 2013), and categorize the cases of blended learning (Graham, 2006; Horn & Staker, 2014; Margulieux et al., 2016; Park et al., 2016; Singh, 2003).

Blended learning has been defined in different contexts (e.g., ranging from K–12 to higher education) and with different focuses (e.g., formal vs. informal learning), but it can be roughly divided into three phases. In the early phase, when blended learning emerged as a new concept, scholars highlighted the combination of face-to-face (traditional) instruction and computer-mediated (online) activities as the dominant perception of blended learning (Graham, 2006). The second phase was typified by various combinations of modalities, delivery media, pedagogical approaches, instructional technologies, and job tasks, all to answer the question: What is blended? (Driscoll, 2002; Mantyla, 2001; Singh, 2003). The third phase has been characterized by a mix and selection of activities that are thoughtfully integrated in a way to complement each other based on the strengths and weakness of each component (Garrison & Kanuka, 2004; Singh, 2003).

Some scholars have simply recapped the ever changing and evolving definitions of blended learning (Caner, 2012; Friesen, 2012; Hrastinski, 2019), but many scholars have attempted to connect the types of blended learning with practices in the real world (Horn & Staker, 2014; Margulieux et al., 2016). Since blended learning allows limitless combinations, the types of blended learning vary depending on (a) what is blended, (b) in what proportion they are blended, (c) how many instructional components are blended, and (d) in what order they are blended. Allen et al. (2007) classified blended learning into four categories based on the proportion of online learning from traditional (none), Web-facilitated (below 30%), blended learning (between 30% and 79%), to mostly online learning (above 80%). Horn and Stalker (2014) suggested four types of blended learning in the context of K-12 education: (a) the rotation model, (b) the flex model, (c) the self-blending model, and (d) the enriched-virtual model. Among these models, the rotation model was further divided into four types: (a) station-rotation, (b) lab-rotation, (c) flipped learning, and (d) individual rotation. Based on the taxonomy by Horn and Stalker as well as other definitions, Caner (2011) provided a decision tree to determine whether a course is blended or is another type. Margulieux et al. (2016) defined diverse cases combining aspects of face-to-face and online instruction in the context of higher education and categorized them into the mixed instructional experience taxonomy.

Many researchers have conducted systematic reviews and meta-analyses of blended learning to synthesize the findings of the increasing number of studies that have examined the effects of blended learning. Bernard et al. (2014) reviewed 96 studies which compared the effectiveness of blended leaning in higher education. Their meta-analysis indicated that the blended learning conditions exceeded the classroom instruction conditions in terms of learning achievement in higher education (g = .334) and the computer support and presence of one or more interaction treatments enhanced student achievement. Boelens et al. (2017) conducted a systematic review that identified four key challenges when implementing blended learning. The first challenge is that blended learning designers must determine the appropriate amount of learner flexibility and how to incorporate flexibility in blended learning. Zydney et al. (2020) and Boelens et al. (2017) asserted that one of the strengths of blended learning is to give learners flexibility in terms of time, location, learning pace, and learning path. The second challenge is that giving learners more flexibility leads to more autonomy for learners (e.g., high transactional distance), but it reduces the social interaction between the instructor and learners or among learners. Hence, in blended learning, instructors need to stimulate and maintain interaction among learners, and between instructors and learners. Boelens et al. (2017) also emphasized the significance of two-way communication between instructors and learners in blended learning despite the physical separation in the online portion of a course. The third challenge is how to facilitate learning processes in a blended environment. To provide learners with abundant learning autonomy and flexibility, blended learning requires that learners be able to self-regulate. However, not all learners are equipped with sufficient self-regulation skills. Thus, for successful blended learning, it is necessary to help these students succeed. The last challenge of blended learning is the need to address the affective aspects of learning, such as learning satisfaction, motivation, engagement, as well as prevent feelings of isolation, as was the main concern in early distance learning (Gunawardena & Zittle, 1997). Examples of instructional strategies to support affective aspects of learning include enhancing instructors' teaching presence and social presence (Garrison, 2016; Wang & Huang, 2018).

The COVID-19 outbreak accelerated the growth of blended learning. Despite the massive and incalculable damage of the pandemic, one positive outcome was increased opportunities for educational change (Zhao, 2020) and extension of virtual learning (Hoofman & Secord, 2021). However, the quantitative expansion of online learning packages delivered to students' homes, as well as face-to-face learning replaced by video conferencing, both revealed the qualitative limitations of blended learning (Mali & Lim, 2021). Although the sudden change to online learning forced educators and students to adjust and change the status quo, it was still necessary that the components of blended learning be thoughtfully selected and integrated. Thus, educators and designers should carefully re-consider the challenges of blended learning (Boelens et al., 2017) to design effective approaches and conditions.

Artificial Intelligence in Education (AIEd)

As AI programs and applications have flourished, empirical research on their effects has been conducted across diverse domains, including education (Crompton et al., 2022). Systematic literature reviews of AIEd have reflected the significant growth in the application of AI in education and scholarly interest in the trends and patterns of using AI in education. For over 20 years, data-driven studies have also highlighted the increasing number of publications in the field and recent dramatic growth (Chen et al., 2020; Chen et al., 2022; Guan et al., 2020; Li et al., 2022; Song & Wang, 2020; Tahiru, 2021; Xu & Ouyang, 2021). Chen et al. (2020; 2022) investigated the publication trends including major conferences and journals, influential institutions and researchers, leading countries, frequently cited papers, and research topics. Hwang et al. (2022) identified the distribution of the main research areas, research topics, roles of AI in online learning, and the adoption of AI algorithms. Guan et al. (2020) extended the focus of trends to the major paradigms in the history of AIEd literature. Li et al. (2022) analyzed keywords of studies by using CiteSpace software, and highlighted the most prevalent topics of AIEd research as data mining, virtual reality (VR), agents, intelligent tutoring system (ITS), and online learning. Song and Wang (2020) also applied bibliometric analysis and organized the publication trends into five clusters including ITS, learning system, student-centered learning, labelled training data, and pedagogy. Tahiru (2021) focused on the adoption of AI in education including opportunities, benefits, and challenges through a lens of the technological-organisational-environmental framework.

A large cluster of AIEd studies has focused on personalization for individual learners. In particular, the literature has shown that one of AI's major contributions is its capacity to assess individual students' performance (AlKhuzaey et al., 2021; González-Calatayud et al., 2021; Kurdi et al., 2020) and predict their learning outcomes (Arizmendi et al., 2022) for personalized learning (Bhutoria, 2022; Hashim et al., 2022). González-Calatayud et al. (2021) reviewed 22 papers that demonstrated how educators used AI to assess learners. They noted that formative evaluation has been one of the main uses of AI, such as automatic grading of students' work. In an early AIEd study, du Boulay (2016) mentioned that the AIEd field has existed for about 40 years and the most common application in AIEd has been ITS. Given that it is difficult to explain the AIEd field without referring to the ITS (Holmes et al., 2019), many scholars have conducted SLRs of ITS (Mousavinasab et al., 2021). Mousavinasab et al. (2021) conducted a systematic review with 53 papers and reported that (a) ITS was mostly applied in computer science; (b) the most dominantly applied AI techniques were action-condition rule-based reasoning, data mining, and Bayesian networks; and (c) AI techniques have made it possible to provide adaptive guidance and instruction as well as evaluating learners.

Systematic reviews on AIEd-related topics (e.g., AI applications or learning analytics) have been conducted on e-learning (Tang et al., 2021), blended learning (Bergdahl et al., 2020), and collaborative learning (Tan et al., 2022). Tang et al. (2021) analyzed trends in AI-supported e-learning based on 86 core papers and found that most studies focused on the development and applications of ITS, and AI has been used to facilitate assessment and evaluation in e-learning contexts. Bergdahl et al. (2020) focused on learning analytics (LA) approaches in blended learning and highlighted three themes based on 70 selected papers. They indicated that LA approaches have helped educators (a) understand and predict learners' performance, (b) identify students' behaviors and profiles, and (c) explore and improve the learning environment. Tan et al. (2022) also reviewed 41 studies on using AI for collaborative learning. They identified nine AI techniques (i.e., clustering, ensemble, regression algorithms, deep learning, decision trees, natural language processing, instance-based, fuzzy logic, and agents) for three main purposes for AI applications, namely discovering, learning, and reasoning.

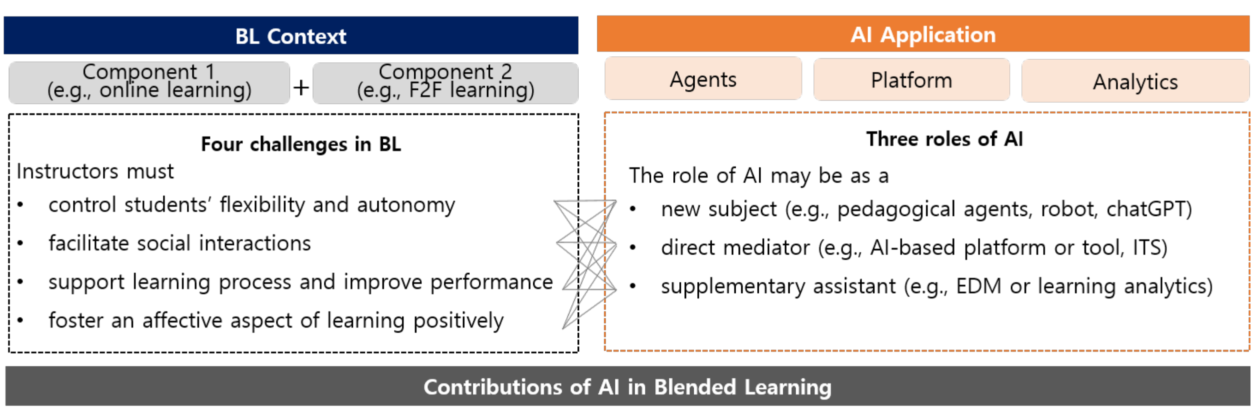
SLRs in AIEd have also been conducted according to different target learners. Since AI technology has been applied in diverse education sectors, SLRs on AIEd have been conducted in diverse contexts including higher education (Chu et al., 2021; Gera & Chadha, 2021), K-12 education (Crompton et al., 2022), and teacher education (Celik et al., 2022). Chu et al. (2021) reviewed 50 AI studies in higher education and reported that the most researched theme was predicting learners' status (e.g., dropout and retention, student models, academic achievement). Gera and Chadha (2021) focused on demographic and thematic trends of AI in higher education in 29 articles. They suggested future research to increase geographical variety, adopt advanced algorithmic approaches, and personalize learning. Crompton et al. (2022) reviewed 169 studies that used AI technology in K-12 education and found three main themes of AIEd applications: pedagogies (e.g., gaming, personalization), administration (e.g., diagnostic tools), and subject content.

Language learning and mathematics are the major subject areas that have frequently utilized AI technologies in education. In terms of the general trends in AIEd, Chen et al. (2020) found that existing educational software with AI technology integration has been mostly developed for mathematics and language learning. This trend has also been supported by other systematic reviews on AIEd that have identified the major areas as language learning (Du, 2021; Liang et al., 2021) and mathematics education (bin Mohamed et al., 2022; Hwang & Tu, 2021). These reviews indicated that using a neural network model has been the dominant method. Liang et al (2021) reported that the primary applications of language learning include writing, reading, and vocabulary acquisition, which are mostly adopted by ITS and natural language processing (NLP). Du (2021), who conducted a bibliometric analysis, added that a neural network has been a dominant method to train machines to learn, read, write, listen to, speak, and assess language. Hwang and Tu (2021) also conducted a bibliometric analysis with 43 articles to identify the trends of AI in mathematics education. They highlighted that AI technology has great potential to promote students' mathematics learning, especially to diagnose learning problems, provide instant feedback, and provide information to help teachers improve learning designs.

In sum, AI applications have contributed as agents, platforms, and analytics in diverse contexts within different disciplines. In a wide perspective, Xu and Ouyang (2021) categorized such roles of AI as (a) a new subject, (b) a direct mediator, and (c) a supplementary assistant to influence instructor-student, student-self, and student-student relationships. In adopting this framework, as shown in Figure 1, this study focused on the empirical studies that presented the contributions of AI to overcome the challenges in blended learning described in the previous section.

Figure 1

Conceptual Framework for This Study



Method

The purpose of this paper was to conduct a systematic review to synthesize the research findings on AI applications in blended learning. This systematic review followed Cooper's (1988) guidelines for conducting a systematic review. The publication period was from January 2007 to October 2023 given that Zawacki-Richter et al.'s (2018) systematic review found that research on AI applications in higher education started increasing in 2007. The three research questions guiding this research were as follows:

1. What are the research trends related to AI applications in blended learning?
2. What is the role of AI applications in blended learning?
3. How can AI applications help mitigate the challenges of blended learning?

Inclusion and Exclusion Criteria

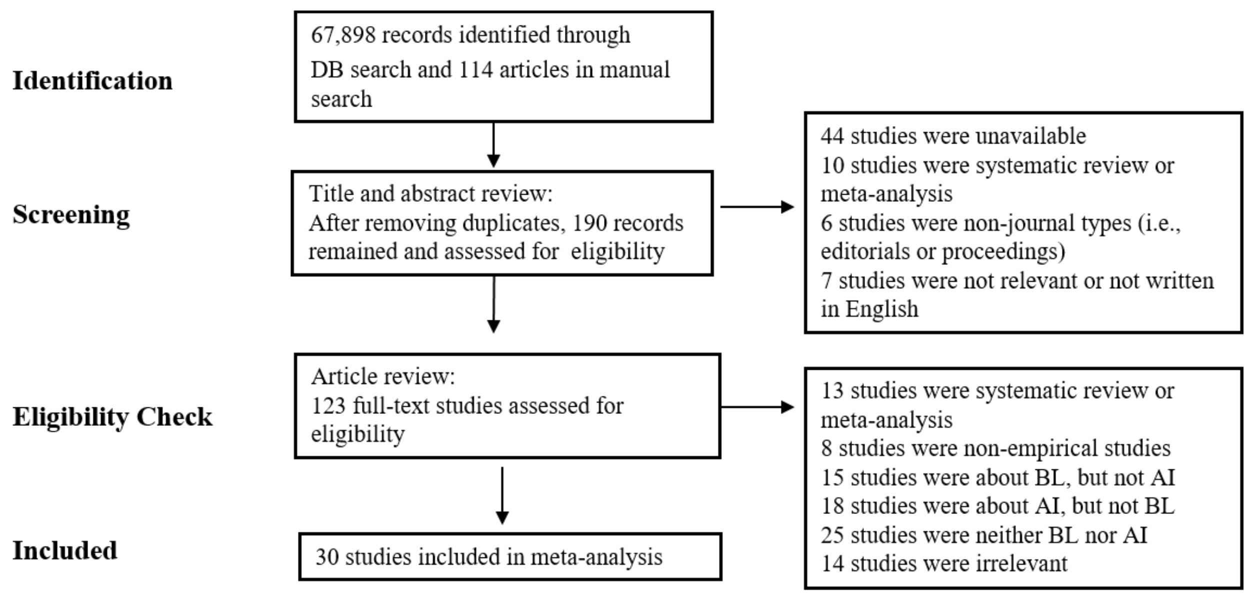
We set the following inclusion criteria to search for eligible studies that (a) discussed AI applications; (b) were confined to blended learning; (c) were empirical studies including quantitative, mixed-method, or qualitative methodologies; (d) were written in English; (e) were peer-reviewed journal articles; and (f) were published between January 2007 and October 2023. Regarding the first inclusion criteria, we did not place limits on the proportion of online learning whereas Müller and Mildenberger's (2021) systematic review defined blended learning as "a course that blends online and classroom learning, with a proportion of between 30 and 79 per cent of the content delivered online" (p.3). We excluded non-empirical studies including conceptual papers and meta-analysis, and systematic reviews. Conference proceedings and technical reports were also excluded.

Search Databases, Strategies, and Process

The keywords we used to search for eligible studies were combinations of blended learning and artificial intelligence (or intelligent). We also included synonyms for blended learning including hybrid learning, flipped learning, and inverted learning, as well as another word for artificial intelligence, namely AIEd. The literature search process included a computer-based database search and manual search. The computer-based database search included Google Scholar, Education Resources Information Center (ERIC), and Web of Science. As an additional step, we conducted manual searches in relevant journals related to educational technology and artificial intelligence in education, including (a) *Computers & Education*, (b) *Educational Technology Research & Development*, (c) *British Journal of Educational Technology*, and (d) *Interactive Learning Environments*. From our computer-based database search findings, we found that these journals produced more studies relevant to our research than did other journals. We conducted the manual search to ensure we did not miss any eligible studies. Figure 2 illustrates the literature search and exclusion process using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).

Figure 2

Search and Exclusion Process



From the 30 eligible studies, we extracted information on the (a) types of blended learning, (b) types of learners, (c) learning domains and disciplines, (d) AI applications, and (e) publication details (see Table 1). The authors first developed the coding scheme based on the research questions using Excel. Separately, the two authors manually coded by filling in the Excel spreadsheet. After completing the initial coding, they discussed any disagreement on the initial coding results, including eligibility, missing data, and ambiguous data (i.e., room for interpretation). Finally, the authors cross-checked each other's coding and corrected inaccurately coded items through a series of discussions until they reached a consensus.

Table 1

Coding Information for Systematic Literature Review

Category	Coding information
Type of blended learning	Flipped learning, blended learning
Target learners	Kindergarteners, elementary, middle and high schools, undergraduates, graduates, adult learners
Learning discipline	Math, English, IT, and others
Research design	Experimental, quasi-experimental, correlational, qualitative research
Roles of AI	AI as a new subject, a direct mediator, supplementary assistant

Contribution of AI in BL	Flexibility and autonomy, interactions between instructors and students, supports of learning processes and performances, affective aspects of learning
Publication details	Title, author, year, journal name

Results and Discussion

This section discusses the research trends related to AI applications in the context of blended learning, the roles of AI in blended learning, and the contributions of AI applications for BL.

Research Trends Related to AI in Blended Learning

In this study, we explored how AI applications have been used in the context of blended learning by analyzing 30 relevant studies. In terms of the types of blended learning, 11 studies (36.7%) identified the context of study as blended learning and seven studies (23.3%) described it as flipped learning (see Table 2). Although flipped learning is a type of blended learning, it is distinctive since the cases involve online activities first followed by face-to-face (F2F) classroom activities. As another unique case, Méndez and González (2013) coined the term reactive blended learning to highlight the reactive feature of AI technology as applied in blended learning. Fang, Lippert, et al. (2021) referred to it as hybrid intervention since their research practice consisted of a human teacher-led session and auto tutor session. Although the context studied by Ng and Chu (2021) was online learning only instead of blended learning, we considered it blended learning since the practices were a combination of asynchronous learning and F2F synchronous learning. Finally, nine studies (30.0%) did not specify the research context. However, we assumed that those studies were conducted in a blended learning context since the two components of instructional methods included online learning and F2F classroom learning.

We further analyzed how AI technologies have been applied between the two components of blended learning. In 23 studies (76.7%), AI technologies were only applied in the online asynchronous learning portion of the class. In the other seven studies (23.3%), the use of AI technology was found in both the online and offline classroom environments. For example, Lechuga and Doroudi (2022) developed group formation algorithms for classroom-based collaboration activities based on the learning data from the intelligent tutoring system ALEKS. Ameloot et al. (2022) used learning analytics in blended learning to connect students' online activity with the offline workshop.

In terms of research contexts, 20 studies (66.7%) were conducted in higher education, and six studies (20.0%) targeted K–12 students. The remaining studies were in teacher education (10.0%) and lifelong learning contexts (3.3%). The proportion of learning disciplines were diverse, including (a) language learning, (b) computer science or engineering, (c) educational technology or multimedia, (d) natural sciences, (e) physics, (f) electronic engineering, (g) marketing, (h) art, (i) music, and (j) extracurricular activities. The research methods of the selected papers were as follows: quasi-experimental or experimental research (n = 12, 40.0%), quantitative research (n = 8, 26.7%), and design and developmental research (n = 5, 16.7%). A small portion of studies incorporated a qualitative approach, mixed methods, or case study.

Table 2

Research Backgrounds of the Selected Papers

Research background	*n*	%
Type of blended learning		
Blended learning	11	36.7
Reactive learning	1	3.3
Flipped learning	7	23.3
Hybrid learning	1	3.3
Online learning	1	3.3
Not specified	9	30.0
Application of AI		
Online	23	76.7
Both online and offline	7	23.3
Research context		
K–12	6	20.0
Higher education	20	66.7
Teacher education	3	10.0
Lifelong learning	1	3.3
Learning discipline		
Computer science/Programming	5	16.7
Ed tech/Multimedia	4	13.3
Language/Literacy	6	20.0
Mathematics/Statistics	4	13.3
Natural sciences/Physics	2	6.7
Marketing	1	3.3
Electronic engineering	3	10.0
Dance/Art/Music	1	3.3
Extracurricular activities	2	6.7
Not specified	5	16.7
Research method		
Design and development	5	16.7
Quasi-experimental/Experimental	12	40.0
Quantitative	8	26.7
Qualitative	2	6.7
Mixed methods	2	6.7
Case study	1	3.3

Role of AI

According to Xu and Ouyang (2021), AI has three distinctive roles. We adopted this framework and reviewed the role of AI in the selected papers. The results of the analysis are summarized in Table 3.

The category of AI as a new subject indicated that AI replaced (or did the work of) teachers or instructors, students, or peers. Examples are pedagogical agents for learning or social robots with bionic and human-like (i.e., anthropomorphic) characteristics. While Xu and Ouyang's (2021) review indicated the role of AI as a tutor, tutee, or peer in this category, we could not find any case where AI played the role of tutee or peer role in our selected studies. Four (16.7%) of the 30 studies presented AI as a guide or a pedagogical agent. For example, in Whatley (2004) study, AI identified students and provided tutoring using a rule based on what they liked or disliked and whether or not they were able to participate in tutoring. In another case, IBM's Watson Tone analyzer was used for students to conduct social listening (Dingus & Black, 2021). In three studies, AI, in the form of a chatbot with a natural language processing (NLP) feature, guided students' language learning and had conversations with them (Annamalai et al., 2023; Lin & Mubarok, 2021; Neo, 2022).

The category of AI as a direct mediator means that AI plays the role of directly bridging the constructs in the educational system. An AI-based platform such as an ITS and interactive learning environment supports the whole process of instruction and learning. AI-based tools such as automatic grading software or translation tools can partially meet the demands of instruction and learning. Participants in the educational process (e.g., instructors, students, parents) choose either an AI-based platform or AI-based tool to meet their instructional demands or learning purposes. In this study, we found that a large proportion of studies (n = 12, 40.0%) fell into this category. In these cases, AI was a technology-integrated platform to support students' self-paced learning during automated lesson generation (Yang et al., 2013), intelligent tutoring (Phillips et al., 2020), multimedia guide on modern art (Chatzara et al., 2019), and ChatGPT (Sanchez-Ruiz, 2023).

Another common role of AI is related to assessment and feedback. For example, Chen et al. (2018) developed a checkable answer feature and immediate simple corrective feedback tool that was integrated in the edX platform. Troussas et al. (2020) developed a mobile game-based learning application that assessed and advanced students' programming knowledge. AI has also functioned as a tool to provide teachers and instructors with practical assistance such as automated question generation (Lu et al., 2021), a question-posing system (Hwang et al., 2020), Moodle-based quiz module (Jia et al., 2012), and online writing tutorial to correct paraphrasing and citations (Liu et al., 2013).

AI as a supplementary assistant indirectly influences educational participants. For example, learning analytics (LA) and educational data mining (EDM) allow instructors and students to better understand and predict learning based on their learning behaviors, characteristics, and learning patterns in instructional and learning processes. We identified six cases (20.0%) in the selected articles. For example, machine learning classification models were used to improve students' academic performance using a multimodal learning analytics approach (Liao & Wu, 2022). AI-enabled personalized video recommendations stimulated students' learning motivation and engagement (Huang et al., 2023). LA approaches have been incorporated to diagnose and intervene in student activities (Van Leeuwen, 2019) and provide personalized feedback messages based on an algorithm combining the comments related to individual students' activities (Pardo et al., 2019). As a result, LA influences students' self-regulated learning behaviors (Montgomery et al., 2019) and learning performance (Liao & Wu, 2022). The review of the selected studies indicated that a supplementary assistant role has been combined with AI's first role (new subject) and second role AI (direct mediator). For example, in Tran and Meacheam (2020), in the Moodle LMS, the AI-based platform played a role as a supplementary assistant by supporting instructors' decision making in the LA report. Fang, Lippert, et al. (2021) also contended that Autotutor was not only a pedagogical agent but also a conversation-based intelligent tutoring system that supported analytics.

Table 3

Role of AI in the Selected Studies

Role of AI	*n*	%
AI works as a new subject (e.g., pedagogical agent, robot, ChatGPT)	5	16.7
AI works as a direct mediator (e.g., AI-based platform or tool)	12	40.0
AI works as a supplementary assistant (e.g., EDM or learning analytics)	6	20.0
AI works as both a direct mediator and a supplementary assistant	4	10.0
AI works as both a new subject and a supplementary assistant	3	13.3

Contributions of AI in Blended Learning

To address our third research question, we analyzed the studies according to the four major blended learning challenges that Boelens et al. (2017) identified. Specifically, we reviewed the selected studies in terms of how AI technology helped mitigate these challenges (See Table 4).

The first challenge concerned students' flexibility and autonomy in blended learning. While flexibility is a strength, since students can learn at their preferred time and place, too much autonomy without self-regulation may negatively affect learning. Consequently, BL designers may find it difficult to determine the appropriate amount of flexibility and autonomy students should be given. We believe that AI can help instructors control students' autonomy. In the literature, we found that AI was a direct mediator to provide personalized instruction and scaffolding for individual learners (Lechuga & Doroudi, 2022; Phillips et al., 2020). More specifically, an online learning system powered by AI technology assigned repetitive practice (Lu et al., 2021), provided real-time alerts and feedback to prompt students to participate in daily or weekly discussions (Jovanović et al., 2017; Liao & Wu, 2022), and increased the probability of students achieving learning mastery (Phillips et al., 2020). Further, ChatGPT helped students get easy access to vast information and quick assistance based on their individual needs with the power of natural language processing (Sanchez-Ruiz et al., 2023). As a supplementary assistant, AI helped facilitate class administration and orchestration by tracking students' learning process, classroom dynamics, and goal achievement (Mavrikis et al., 2019). Another positive contribution was that the adoption of AI decreased teachers' workload and saved time (Lechuga & Doroudi, 2022; Lin & Mubarok, 2021). As a result, teachers focused more on helping students and customizing course content to improve the quality of blended learning.

The second challenge is that giving learners more flexibility leads to more autonomy for learners, but it reduces the social interaction between the instructor and learners or among learners. Therefore, blended learning designers need to connect students' individual online learning to collaborative classroom learning. The literature on flipped learning has strongly emphasized the need for connection (Bergmann & Sams, 2014; Straw et al., 2015; Talbert, 2017), and we found that AI can serve as an assistant to support collaborative learning practices (Lechuga & Doroudi, 2022). For example, AI helped teachers create student groups or cohorts (Lechuga & Doroudi, 2022), provided meaningful feedback automatically to large student cohorts (Pardo et al., 2019), and classified clusters of learners so the instructor could adjust the learning environment based on their abilities and characteristics (Fang, Lippert, et al., 2021). In another case, machine learning models helped classify students' discussion content to determine if they were course relevant in an online discussion activity of blended learning using a problem-based learning pedagogy (Liao & Wu, 2022). A typical learning analytics report also encouraged teachers to start interacting with certain students and when intervention was needed (Van Leeuwen, 2019).

The third challenge is a concern about how to facilitate learning processes in a blended learning environment, as this requires learners to self-regulate. We explored how AI applications helped change students' learning process and improved their performance. Several studies found that AI helped beginning learners enhance domain-specific knowledge and skills, such as programming language (Lu et al., 2021), dance movements (Yang et al., 2013), and English-speaking skills (Lin & Mubarok, 2021). The analytic feature of AI has also helped predict students' learning achievement. In a series of studies by Méndez and González (2010, 2013) presented a mechanism on how ControlWeb (i.e., a tool to support learning) analyzed students' behavior and controlled assignment loads to maximize their performance, participation, and motivation. As a unique case, Hwang et al. (2020) developed a concept mapping-based question-posing system that allowed students to observe plants on-site, provided question-posing activities at a shallow level and then at a deep level, and synthesized knowledge of plants. Other studies also found that AI technologies supported individual learners' vocabulary acquisition and assessment (Jia et al., 2012). In addition, it supported students' learning performance as well as critical thinking in a peer assessment activity that called for commenting on peers' work (Fang, Chang, et al., 2021).

The last challenge in implementing blended learning is the need to address the affective aspects of learning, such as satisfaction, motivation, and engagement, as well as prevent feelings of isolation. A few studies revealed affective aspects as additional or partial affordances of incorporating AI in blended learning. For example, Lin and Mubarok (2021) pointed out that their mind map-guided AI chatbot promoted students' English speaking skills in a relaxed manner. Huang et al. (2023) also highlighted that AI-enabled personalized video recommendations stimulated students' learning motivation and engagement. In Jovanović et al. (2017), the learning analytics of an online activity, which was designed as lecture preparation, motivated students to change their learning strategy. As well, AI technology designed with gamification, (e.g., a badge system; Troussas et al., 2020) stimulated students' learning engagement and collaboration.

Table 4

Contributions of AI in Blended Learning

Challenges in BL	Contributions of AI
Control students' flexibility and autonomy	• Provide personalized instruction and scaffolding (Liao & Wu, 2022; Phillips et al., 2020) • Provide easy access to vast information and quick assistance based on individual needs (Sanchez-Ruiz et al., 2023), repetitive practice (Lu et al., 2021), and increase mastery of learning (Phillips et al., 2020) • Provide real-time alerts or feedback so students can better participate in daily and weekly discussions (Jovanović et al., 2017; Liao & Wu, 2022) • Augment the school experience (Chatzara et al., 2019) • Help class administration (Phillips et al., 2020) and orchestration through student tracking, classroom dynamics, and goal achievement (Mavrikis et al., 2019) • Help instructors customize course content, monitor students' learning progress (Phillips et al., 2020), decrease teachers' workload and save time (Lechuga & Doroudi, 2022; Lin & Mubarok, 2021)
Facilitate interactions between instructor and student, and/or students	• Help teachers form groups of students and identify the content appropriate for differentiated instruction (Lechuga & Doroudi, 2022) • Support instructors to provide meaningful feedback to large student cohorts (Pardo et al., 2019) • Classify clusters of learners and adjust the learning environment to learners' abilities and characteristics (Fang, Lippert, et al., 2021) • Support various collaborative learning practices (Lechuga & Doroudi, 2022) • Classify students' discussion content to determine relevance to the course (Liao & Wu, 2022) • Encourage teachers to start interaction with students, and inform teachers when intervention might be needed (Van Leeuwen, 2019)
Change learning processes and improving performances	• Help beginning learners enhance domain-specific knowledge and skills (e.g., programming language, dance movements, speaking English; Lin & Mubarok, 2021; Lu et al., 2021; Yang et al., 2013)

	• Predict students' behavior and control assignment loads to maximize performance, participation, and motivation (Méndez & González, 2010) • Provide question-posing activities at shallow and deep levels, and help synthesize knowledge (Hwang et al., 2020) • Allow individualized vocabulary acquisition and assessment so students improve reading and listening comprehension (Jia et al., 2012) • Impact students' performance and critical thinking through peer assessment and commenting on peers' work (Fang, Chang, et al., 2021)
Foster affective aspects of learning positively	• Make students more relaxed (Lin & Mubarok, 2021), and engaged (Huang et al., 2023) • Support students' competence, autonomy, relatedness (Annamalai et al., 2023) • Cluster students based on their learning behavior and nudge students to change their learning strategy (Jovanović et al., 2017) • Incorporate motivational strategies with a badge system (Troussas et al., 2020)

Limitations and Suggestions for Future Research

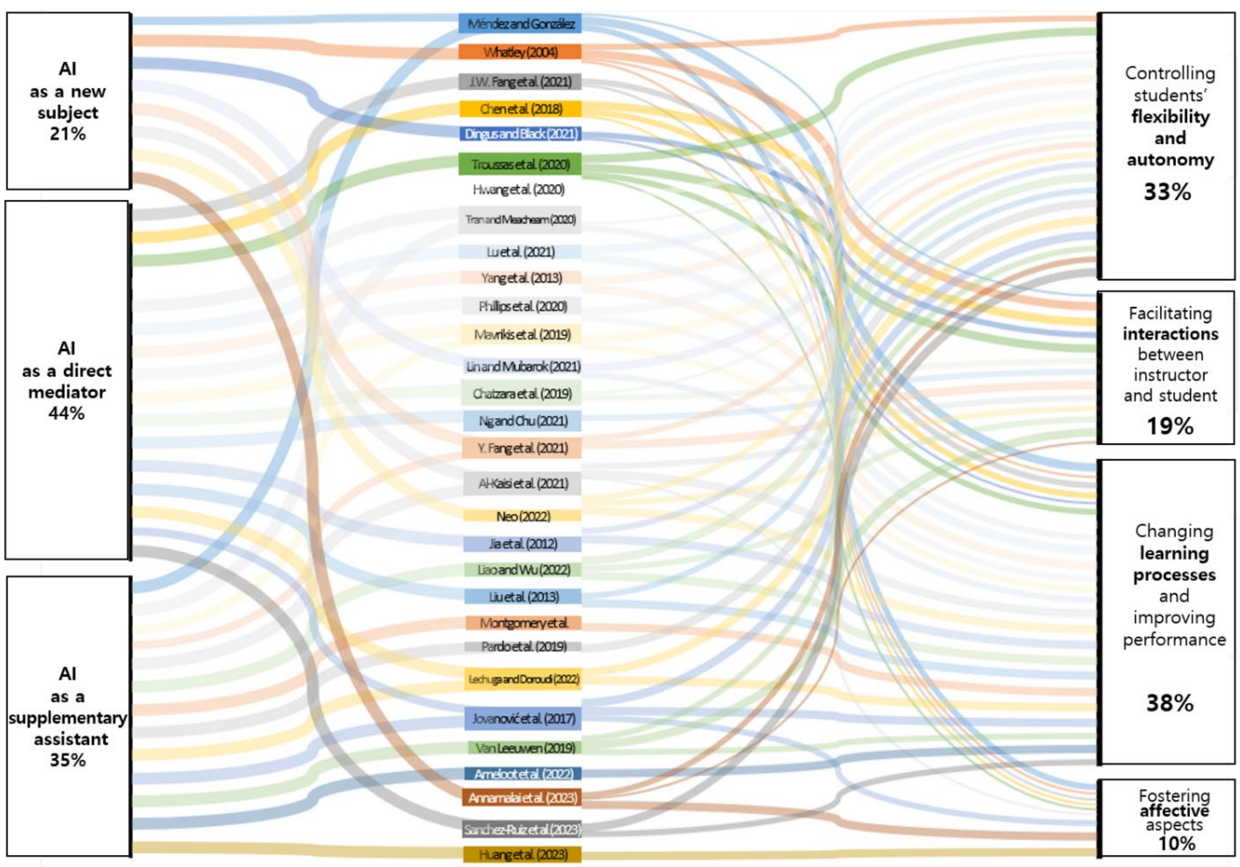
It is important to acknowledge the limitations of this literature review on the use of AI in blended learning in order to help readers understand how to better use AI and to provide meaningful suggestions for extending this research area. Since the scope of this research only analyzed the applications of AI in blended learning, only 30 articles were examined in our systematic review. However, given the growing interest in AI research in education, it is expected that more studies will examine AI applications for blended learning and will be included in follow-up studies. Above all, since ChatGPT was launched on November 30, 2022, scholars have noted drastic changes in teaching and learning, and expect the use of AI to move into uncharted territory. A generative AI such as ChatGPT offers a range of potential benefits for blended learning in terms of content generation, student engagement and motivation, and personalized learning (Alshahrani, 2023). Despite the increasing interest of ChatGPT in education, the lack of exploration of ChatGPT in the scope of this study is a limitation of this paper. We encourage future researchers to extend this study dealing with this generative AI in the context of blended learning.

Conclusion and Implications

This systematic literature review of studies examining the use of AI in blended learning explored how AI applications can help instructors and designers implement blended learning more effectively. We examined 30 journal articles in the domain of AI and blended learning to determine how AI helps advance blended learning practices. Figure 3 presents the connections of each article to the role of AI and the challenges of blended learning based on the description in the Appendix. The major research findings provide the following implications for the design and implementation of effective blended learning and for the future research directions of the use of AI in BL.

Figure 3

Sankey Diagram Showing Roles of AI for the Advances of Blended Learning



The first implication is that AI applications have been used mainly for the online individual learning component in blended learning, and, specifically, in an asynchronous mode. Contrary to our expectation, very few studies have focused on the connection between online and offline activities in blended learning using AI applications. A few exemplar studies (Lechuga & Doroudi, 2022; Whatley, 2004) explored the contribution of AI applications to group formation for the classroom-based collaboration and to connect students' online individual learning and offline activities. This systematic review also revealed that few cases explored how to use AI to enhance F2F classroom activities based on students' learning traces in the LMS and analytic approaches involving AI (e.g., machine learning, deep learning techniques). These applications are promising areas for future research. Bergdahl et al. (2020) conducted a systematic review found a similar result. In their research, comparatively few studies revealed how students' behaviors (e.g., video viewing patterns, resource utilization, order of activities) informed instructors on how to enhance classroom teaching and resources. Thus, future studies need to incorporate learning analytics techniques as well as AI algorithms to identify the systematic connections of diverse activities when constructing blended learning.

Another implication is related to the roles of AI. A large proportion of the studies (40%) identified the role of AI as a direct mediator. AI-based platforms or tools played a mediator role for students and helped them be more engaged in the personalized learning environment. Automated lesson generation (Yang et al., 2013), adaptive intelligent tutoring (Phillips et al., 2020), and multimedia guides (Whatley, 2004) enhanced students' autonomy by allowing them to learn in the AI-based platform or Website at their preferred time. The AI-based platform also helped instructors control students' autonomy by guiding them through tailored lessons, providing scaffolding (e.g., adjusted questions, hints, or resources), and connecting them to peers for collaboration or further discussion. Since autonomy and flexibility could negatively influence students' learning performance, an AI-based interactive system, compared to video-based lectures, would be beneficial, especially for students with low levels of self-regulation. AI-based tools that incorporated the feature of generating questions (Hwang et al., 2020; Jia et al., 2012; Lu et al., 2021) and provided immediate feedback (Liu et al., 2013) can also contribute to students' mastery of learning and deeper learning.

Studies also revealed that AI as a supplementary assistant indirectly impacted student learning. AI technologies involving educational data mining or learning analytics helped instructors or teachers decide how best to administrate and orchestrate blended learning. In around 34.7% of the studies, AI played a major role in predicting students' behavior (Méndez & González, 2010), classifying students based on their learning behavioral patterns (Jovanović et al., 2017; Liao & Wu, 2022), and providing personalized feedback (Pardo et al., 2019). These features helped teachers effectively interact with their students (Van Leeuwen, 2019) and to make changes in students' learning strategies (Jovanović et al., 2017). However, very few studies discussed how AI analytic support can help teachers prepare or revise the offline activities in a blended learning environment. One recent exception, (Lechuga & Doroudi, 2022) discussed three types of group formation algorithms based on students' learning data, which supported various pedagogical and collaborative learning practices. More practical studies are needed that present pedagogical approaches utilizing AI technologies to help teachers blend diverse learning activities and adjust activities for individual students.

The least number of studies (20.4%) discussed the role of AI as a new subject. This role, implying the replacement of agents such as teachers or instructors, is a sensitive issue from teachers' perspectives. Discussing the role of AI and human teachers is not the focus of this study, but we believe this category will be the final feature of AI in education. Future studies can explore how this new subject with bionic and anthropomorphic characteristics can be successfully combined with the roles of AI as a direct mediator and supplementary assistant. However, we only found a few cases for this review, perhaps because this study focused on blended learning. Nevertheless, several studies in this review presented the partial function as pedagogical agents (Whatley, 2004) such as a Chatbot (Annamalai et al., 2023; Lin & Mubarok, 2021; Neo, 2022), auto tutor (Fang, Lippert, et al., 2021), and voice assistant (Al-Kaisi et al., 2021), which allowed students to communicate and facilitated their learning with immediate feedback and scaffolding. It also helped teachers save time and reduce their workload. These studies indicated that this type of AI can effectively foster the affective aspects of learning. However, it should be noted that these affective aspects of AI in blended learning were discussed the least, accounting for only 10% of the studies. This suggests that future research needs to be extended by investigating not only students' learning processes or outcomes but also the affective aspects such as changes in their learning motivation, attitudes, and satisfaction. Given that we are no long in the COVID-19 pandemic, blended learning is expected to expand in scope, with growing use of AI in education. This study is a stepping stone for research and practices to design blended learning more effectively with the creative use of AI.

Acknowledgement

This study was supported by research fund from Honam University, 2022.

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Appendix

Analysis and Summary of Selected Papers

No	Citation	BL Contexts		AI Applications			Contributions of AI in BL				Target learners/ research participants	Learning discipline	Evaluation method
		Component 1	Component 2	Agent	Platform	Analytics	F	I	P	A			
1	Méndez and González (2010)	Reactive blended learning		Fuzzy Controller measuring the activity level of student in the class			Predicting students' behaviour and control assignment loads to maximize the performance, participation, and motivation				Higher Ed/ 91 undergraduate students	Electronic engineering	Quasi-experimental design with a control group
		F2F lectures	Online resources	◎		●		○	●	◎			
2	Whatley (2004)	Not specified		Guardian agent to allocate and tutor students using the rules based on what students like/dislike, and what student are good at.			Allowing students access to a project site at different times, communicating with other students and the guardian agent				Higher Ed/ 55 undergraduate students	Not specified	Development of prototype / survey and group interviews
		F2F team project	Online learning with software agents	●			◎	●	○	○			
3	Fang, Chang, et al. (2021)	Not specified		Collaborative feedback-based peer-assessment (CFPA) learning system			Impacting students' performance, self-efficacy, and critical thinking via peer assessment and commenting on peers' work				Teacher Ed/ 97 pre-service teachers	Educational technology	Quasi-experimental design with a control group
		F2F (introduction)	Online collaboration, peer assessment		●				◎	○			
4	Chen et al. (2018)	Blended learning		Checkable answer feature (CAF), a computer-based immediate simple corrective feedback tool, powered by edX platform			Providing immediate feedback so students interact with the CAF, and impacting students' study strategies and performance				Higher Ed/ 474 undergraduate students	Physics	Quantitative analysis, data mining with three data sources (demographics, tracking logs, and performance metrics)
		F2F lectures	Problem-solving with online resources		●			●	◎	○			

5	Dingus and Black (2021)	Not specified		IBM's Watson Tone Analyser conducting social listening			Enhancing students' communication skills and deepening critical thinking through AI and the role of technology via discussion				Higher Ed/ 107 undergraduate students	Marketing	Experimental design with pre-test and post survey
		Online video, interactions	F2F or online Discussion	●				◎	○				
6	Troussas et al. (2020)	Not specified		Quiz time!: a mobile game-based learning application which assess and advance students' knowledge on programming			Recommending other learners of the same or higher current knowledge level (CKL) for a balanced or challenging play. Promoting collaborative learning and incorporating motivational strategies via a badge system				Higher Ed/ 20 experts 80 undergraduate students	Computer science (C# programming)	Development research, evaluation population A (Computer science experts), population B (learners)
		F2F classroom	Online resources Mobile game		●		●	●	◎	○			
7	Hwang et al. (2020)	Not specified		Concept mapping-based question-posing system			After watching videos of target plants and observing the plants on-site, providing question-posing activities at a shallow level and deep level, and allowing them to synthesize knowledge of the plants				K–12, primary school/ 90 students	Natural science (Plants)	Quasi-experimental design with a control group
		Field trip	Online system		●		◎		●				
8	Tran and Meacheam (2020)	Flipped learning		Moodle-based LMS: (a) quiz making, (b) LA reports, (c) automating course admin, (d) 4-in-1 for flipped learning			Improving LMS users' productivity and enhancing students' learning experience via innovative use of web tech and learning analytics				Higher Ed/ instructors, learners, and administrators	NA	Development research (4 projects)
		Extended LMS	F2F classroom		●	●	◎		◎				
9	Lu et al. (2021)	Not specified		Automatic question generation (AQG) solution, a combined semantics-based and syntax-based analysis			Providing repetitive practice of short-answer questions, and enhancing students' long-term memory of course knowledge				Higher Ed/ 91 undergraduate students	Computer science (basic Python programming)	Experimental design with control group Evaluating the question and grading quality
		F2F Classroom	Online system		●		●		●				
10	Yang et al. (2013)	Blended learning		An automated lesson generation system for basic dance movements based on motion capture technology			Helping beginners learn dance in two phases: (a) learning from small, divided pieces of movement to the arranged patterns; (b) guiding students to incorporate all of the patterns in the full dance				Higher Ed/ 52 undergraduate students	Dance	Experimental design with three groups (treatment 1, 2, and control group)
		Classroom learning	Computer-mediated learning		●		●		●				

11	Phillips et al. (2020)	Blended learning		ALEKS (assessment of learning in knowledge spaces): an intelligent tutoring system for mathematics			Providing students with personalized instruction to support increased mastery, supporting class administration, instruction, customizing course content and progress monitoring				K–12/9 High schools/ 24 teachers 2494 students	Mathematics (algebra)	Experimental evaluation with 3 models (a) Integration of ALEKS by teacher (b) use of ALEKS only, (c) teacher-led (no use of ALEKS)
		Teacher instruction	Online/digital learning		●		●		◎				
12	Mavrikis et al. (2019)	Not specified		MiGen system: mathematical microworld called the eXpresserm and a teacher assistance (TA) tool			Supporting classroom orchestration through student tracking (ST), classroom dynamics (CD), and goal achievement (GA)				K–12/ 26 teachers	Mathematics (algebra)	Contextual design approach, formative evaluation
		Classroom	Online system (AI-based exploratory learning environment)		●	◎	●		◎				
13	Lin and Mubarok (2021)	Flipped learning		Mind map-guided AI Chabot			Decreasing teachers' workload, making students more relaxed, promoting students' English speaking skills, and overcoming the issues of flipped classroom for EFL (extra workload)				Higher Ed/ EFL (English as a foreign language) 50 students	English (speaking)	Quasi-experimental design with a control group
		Online resources	F2F Classroom	●			●		◎				
14	Chatzara et al. (2019)	Machine-assisted blended learning		Istoriat: a WSeb/multimedia guide on modern art			Promoting augmented schooling experience via algorithmic recognition of the painting styles and crowdsourcing-driven indirect annotation				47 undergraduate /graduate students who are interested in modern art	Modern art (inter-disciplinary course)	Developmental research, usability evaluation and UX analysis
		In-class demonstration	Self-training with crowdsource users' feedback		●		○	◎					
15	Ng and Chu (2021)	Online learning		Games (e.g., Code.org, AI for Ocean, Image stylizer, AI model trainer, Face-AI)			Extending students' experience via social media and other blended technologies during the pandemic				K–12/ 98 secondary students	Extracurricular activities	Case study investigating students' perception
		Asynchronous learning	F2F synchronous learning		●			◎					
16	Fang, Lippert, et al. (2021)	Hybrid intervention		Autotutor: a conversation-based ITS (intelligent tutoring system)			Providing learning environments that adapt to the varying abilities and characteristics of users, and				252 Adults with low reading literacy	Reading (literacy)	Quantitative research, cluster analysis

							allowing researchers classify the clusters of adults						
		Human teacher-led session	AutoTutor session (25%)	●		◎	◎	●					
17	Al-Kaisi et al. (2021)	Flipped learning		Alice: Voice assistant as an interesting interlocutor who can make interactions playful			Helping foreign students develop their pronunciation and intonation, and practice basic speech patterns				Higher Ed/ 24 undergraduate students	Language learning (Russian)	Experimental design with a control group
		Online learning with Alice	Electronic teaching aides in the classroom	●		●		◎	●	○			
18	Neo (2022)	Blended learning		Merin: a virtual learning assistant (chatbot that simulates human-like conversation with NLP feature)			Providing scaffolding and supporting asynchronous online learning, and encouraging students' engagement in content				Higher Ed/ 102 undergraduate students	Multimedia (3-point lighting in 3D modelling course)	Mixed methods
		Classroom	Online learning with a chatbot	●			◎	◎	●				
19	Jia et al. (2012)	Blended learning		Intelligent feature of the Moodle quiz module			Allowing individualized vocabulary acquisition and assessment so students improve reading and listening comprehension				K–12 (junior middle school)/ 768 students	Language learning (English vocabulary acquisition)	Experimental design with a control group
		F2F in multimedia computer lab	Online individual learning system		●		◎		●				
20	Liao and Wu (2022)	Blended learning under PBL pedagogy		ML classification models with Facebook datasets, multimodal LA on students' academic performance			Classifying student discussions into course relevant and course-irrelevant, and providing real-time alerts or personalized scaffolding to help students' learning based on their daily/ weekly peer learning engagement				Higher Ed/ 51 graduate students	Advanced statistics	Quantitative research
		On-campus/ F2F synchronous	Off-campus/ Web-based Asynchronous			●	●	◎	●				
21	Liu et al. (2013)	Not specified		Dwright: A Chinese-interface online writing tutorial for paraphrasing and citing English (ITS)			Extending knowledge to avoid plagiarism and enhancing their paraphrasing and writing skills				35 Chinese-speaking volunteering participants	English (writing)	Quantitative and qualitative analysis
		F2F class or workshop	Online writing practice		●		◎		●				
22	Montgomery et al. (2019)	Flipped learning (regular biweekly rotation of 50% online and 50% F2F)		Learning analytics approaches collecting self-			Helping instructors consider how to support students' regularity of online access and				Higher Ed/ 157	Music education	Quantitative analysis (log data by the Moodle

				regulated learning (SRL) behaviours			institutions design BL environments to support their SRL				undergraduate students	(basic music theory)	LMS and students' academic achievement)
		Online learning (theory)	F2F learning (practice)			●			●				
23	Pardo et al. (2019)	Blended learning		Personalized feedback messages based on the algorithm combining the comments related to individual students' activities			Supporting instructors in BL contexts to provide meaningful feedback to large student cohorts				Higher Ed/ 1020 undergraduate students	Computer engineering	Quantitative analysis (log data by LMS, self-reported survey, and academic performance)
		F2F classroom	Online resources (video, formative evaluation, exercise in LMS)			●	●						
24	Lechuga and Doroudi (2022)	Blended learning		3 group formation algorithms that leverage learning data from ALEKS ITS			Supporting various pedagogical and collaborative learning practices and saving teachers' time in forming groups as well as identifying content that is most appropriate for differentiated instruction				K–12/ 86 students	Algebra	Evaluating three grouping methods (within-module, curriculum-wide, reciprocal paring)
		Online learning in ALEKS	Activity in group formed by ALEKS data		●	●	●		●				
25	Jovanović et al. (2017)	Flipped learning		Lecture preparation activities: Video with MCQs (multiple-choice questions), documents with embedded MCQs			Providing students real-time feedback on their level of engagement, clustering students based on their learning behaviour; and nudging students to change their learning strategy				Higher Ed/ 290 undergraduate students	Computer engineering	Quantitative analysis (exploratory sequence analysis, clustering analysis)
		Online learning (videos with MCQs)	F2F learning (active session)		◎	●	●		●	◎			
26	Van Leeuwen (2019)	Flipped learning		LA reports for diagnosing and intervening during student activities			Encouraging teachers to start interaction with students, and informing teachers of when intervention might be needed				Teacher Ed/ 7 teachers	Designing educational materials	Qualitative analysis (teacher logbooks, interviews)
		Online materials	F2F meeting (teacher-guided practice)			●	◎	●	◎				

27	Ameloot et al. (2022)	Blended learning		LA approaches with three types of LMS data (general, content, background)			Optimizing educational processes and course design and providing extra information about particular topics that might still be unclear				Teacher Ed/ 257 students	Educational technology	Quasi-experimental intervention study, mixed method
		Online learning	Classroom-based interventions			●			●				
28	Annamalai et al., (2023)	Not Specified		Chatbots (Students choose any chatbots among Duolongo, Mondly, & Andy)			Supporting competence, autonomy, and relatedness				Higher Ed/ 25 students	English	Qualitative study with semi-structured interview
		Use of Chatbots	Classroom-based lecture	●			◎	○		●			
29	Sanchez-Ruiz et al. (2023)	Blended learning		GPT-3.5, GPT-4 problem-solving capabilities			Providing easy access to vast information, quick assistance based on individual needs and clarifying doubts				Higher Ed/ 102 first-year students	Mathematics I	Experimental design with a control group
		Autonomous learning and online knowledge assessment	In-class reinforcement using dEERs(digital educational escape rooms)		●		●		◎				
30	Huang et al. (2023	Flipped classroom		AI-enabled personalized video recommendations			Helping improve the learning performance and engagement of students with a moderate motivational level				Higher Ed	Programming	Quantitative research (survey)
		Online self-learning	F2F teaching in the classroom			●				●			

Note: The table illustrates the degree of connection among the subtypes of AI applications (agent, platform, Analytics). It utilizes ● to denote the most closely connected, ◎ for partially connected, and ○ for slightly connected cases. Additionally, concerning AI's contributions to BL in terms of F (controlling students' flexibility and autonomy), I (facilitating interactions between instructor and students, and/or students), P (changing learning process and improving performance), and A (fostering an affective aspect of learning positively), ●, ◎, and ○ are employed to represent the most closely, partially, and slightly connected scenarios, respectively.

International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 25, Number 1

February – 2024

Extracting Course Features and Learner Profiling for Course Recommendation Systems: A Comprehensive Literature Review

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Abstract

As education has evolved towards online learning, the availability of learning materials has expanded and consequently, learners' behavior in choosing resources has changed. The need to offer personalized learning experiences and content has never been greater. Research has explored methods to personalize learning paths and match learning materials with learners' profiles. Course recommendation systems have emerged as a solution to help learners select courses that suit their interests and aptitude. A comprehensive review study was required to explore the implementation of course recommender systems, with the specifics of courses and learners as the main focal points. This study provided a framework to explain and categorize data sources for course feature extraction, and described the information sources used in previous research to model learner profiles for course recommendations. This review covered articles published between 2015 and 2022 in the repositories most relevant to education and computer science. It revealed increased attention paid to combining course features from different sources. The creation of multi-dimensional learner profiles using multiple learner characteristics and implementing machine-learning-based recommenders has recently gained momentum. As well, a lack of focus on learners' micro-behaviors and learning actions to create precise models was noted in the literature. Conclusions about recent course recommendation systems development are also discussed.

Keywords: online learning, personalization, course recommender systems, course features, learner profiles

Introduction

The advancement of information and communication technology in recent decades have transformed traditional business models. Like other business sectors, the education industry has benefited from these developments, shifting from traditional classrooms to more online formats. Additionally, the COVID-19 pandemic emphasized the inevitability of transforming toward an online educational model. Although online education has been gaining popularity among students and instructors, there have been concerns about its effectiveness and efficiency in terms of learning outputs. For example, an average of less than 10% of registered MOOC participants actually complete their courses (Reparaz et al., 2020).

One of the biggest problems with e-learning platforms has been lack of personalization, defined as the tailoring of pedagogy, curriculum, and learning environments to meet learners' needs (Baguley et al., 2014). With the recent growth in Web-based educational systems, delivering learning materials based on individual learners' interests and competencies has become more challenging. E-learning systems produce a huge amount of data about students' behavior, but it is impossible to analyze it manually. The exploitation of this data to personalize learning materials and extract meaningful insights about the learning process can benefit students, instructors, and institutions (Baker et al., 2016).

Recommendation systems (RSs) initially emerged as filtering methods to help users make decisions in the case of information overload. RSs discover the preferences of different users and predict items that correlate to their needs. These systems have been heavily employed by e-retailers to increase the reach and sales of their products. In the context of online education, recommender systems help facilitate decision making for students, instructors, and even institutions. RSs have been increasingly used for learning purposes with different applications ranging from recommending learning materials, to forum threads, or even peer recommendations (Khalid et al., 2020). With a shared interest in how educational data may be used to advance both education and the science of learning, learning analytics (LA) and educational data mining (EDM) communities have grown (Berland et al., 2014). LA and EDM are interdisciplinary areas providing solutions for recommender systems such as, among others, information retrieval, visual data analytics, domain-driven data mining, social network analysis, psychopedagogy, and so on (Romero & Ventura, 2020).

One pivotal choice that students often face is deciding which courses to enroll in. Opting for the most suitable courses that align with their interests while simultaneously advancing their preparation for future career prospects is an admirable trait. The abundance of courses offered by different educational institutions makes course selection a challenging task for learners. To help learners with this decision, RSs need to be adjusted for the educational context. E-learning recommender systems share similarities with well-known recommender systems used in e-commerce in the sense that they contain users, items, and ratings. In this study, when referring to the elements of e-learning recommendation systems, courses were considered as items and while learners were viewed as users, it is important to note that they should not be equated with typical users of e-commerce systems who are typically seen as potential buyers. However, using an advanced algorithm to predict learners' perception of a recommended course is insufficient. To recommend courses with a higher probability of satisfactory completion, it is crucial to create elaborate learner models and pay attention to every detail about their static and dynamic data such as learning attitude and aptitude, background knowledge, skills, competence level, and so on (Abyaa et al. 2019).

In e-learning settings, the specific characteristics of users and items have led to proposals for different course recommendation systems (CRS) in recent years. To our knowledge, no previous study has intensively investigated learner and course characteristics and identified the features that recommender systems have considered to match courses to learners' educational profiles. In this study, we reviewed recent advancements in CRS from 2015 to 2022 in order to identify different learner characteristics and course features for use in making recommendations. As well, the literature review distinguished trends and gaps in designing and implementing course recommender systems and generated future research directions in this field.

Previous Studies on Educational Recommender Systems

With increased research attention to e-learning, the number of publications that have proposed recommendation solutions to improve e-learning has escalated. Systematic literature reviews were conducted to shed light on e-learning recommender systems from different perspectives. Klašnja-Milicevic et al. (2015) conducted a comprehensive survey of e-learning environments recommender systems, and they analyzed 160 articles to find challenges in designing recommendation systems and their usefulness for personalized recommendations. Their focus was on collaborative tagging systems to extend the capabilities of recommendation systems for better delivery of learning objects. They investigated recommenders and summarized their results separately based on (a) matrix factorization methods, (b) collaborative filtering, (c) content-based approaches, and (d) association rule mining.

Recently, some review studies have been more concerned with the perception of learners as users of e-learning recommendation systems. For example, Yago et al. (2018) analyzed the role of competencies in proposed recommendation systems to discover their strength and weaknesses. They emphasized the importance of powerful learner modeling techniques to provide adaptive learning solutions, and they assessed the coverage, robustness, adaptivity, and scalability of proposed recommendation systems. They also analyzed the method of access (i.e., Web or desktop) and whether the individual who accessed the recommendation system was a student, instructor, lecturer, or professor. Yago et al. concluded that competence-based recommenders should consider factors related to learning resources, such as the representation taxonomies, besides other common drawbacks (e.g., overspecialization or cold start). In another remarkable study, Deschênes (2020) examined the effect of learning recommendation systems on learners' agency, defined as their ability to set and follow through on their learning goals. Since learning paths restrict learners' agency more than support it, the review focused on articles that introduced recommendations for learning resources and excluded those that recommended learning paths. The review categorized the presentation methods of recommendation results and how these affected learners' satisfaction and performance. In a similar literature review, Salazar et al. (2021) investigated the relationship among recommendation systems, and learners' emotional state and decision making. They focused on research in which emotions were used as a driving force to improve recommendations in a virtual education environment. They concluded that there were four main sources of emotion extraction (i.e., body gesture, facial expression, speech, and physiological sensors) in previous research, and that the methods to extract emotional state from these sources have not been depicted in the literature. Salazar et al. argued that more work was needed to improve the personalization and consequently engagement level of students in the learning process.

Recently, machine learning techniques have gained attention as ways to analyze educational data and create recommender systems. Khanal et al. (2020) conducted a literature review to classify different machine-learning algorithms applied to e-learning recommender systems. They categorized recommendation approaches into four groups: (a) content-based, (b) collaborative filtering, (c) knowledge-based, and (d) hybrid approaches. A key aspect of the work was an analysis of the datasets used for applying machine learning algorithms and dividing datasets into test and train subsets. They listed machine learning algorithms used in previous research and showed that clustering algorithms like k-means and k-nearest neighbor were frequently used in e-learning recommendation systems. They limited their review to journal articles published from 2016 to 2018. Tarus et al. (2018) reviewed ontology-based recommendations for education published from 2005 to 2014. They classified journal articles according to year of publication, recommendation technique, and type of learning resources for recommendations. They also explained different ontology representation languages such as OWL, DL, RDF, XML, and SWRL to integrate ontology representation with other knowledge-based recommendation techniques. Tarus et al. concluded that incorporating ontologies into the recommendation process can increase the accuracy of recommendations while also helping to solve issues with cold start and data sparsity.

Khalid et al. (2020) reviewed 89 articles to identify new trends in recommendation system applications for MOOCs. They categorized MOOC recommender systems based on the (a) course subject; (b) forum threads; (c) peers; (d) learning elements; (e) MOOC provider/teacher recommendation; (f) student performance; and (g) other recommender applications. They showed that 62% of MOOC recommenders focused on course or learning element recommendations. Kahid et al. stated that from 2017 onward, researchers applied data mining, neural networks, and deep learning techniques in processing data for MOOC recommendation applications. Also, they noted that authors frequently used receiver operating characteristics, recall, and precision metrics for recommender evaluations. Uddin et al. (2021) conducted another survey on MOOCs that illustrated the unavailability of a public dataset, with social information as a major gap in designing dynamic recommendation systems for MOOCs. They categorized MOOC recommender systems into nine different technology groups—namely (a) machine learning, (b) deep learning, (c) learning analytics, (d) hybrid approaches, (e) context-sensitive, (f) collaborative filtering, (g) knowledge-based, (h) ontology-based, and (i) content-based—and showed that machine learning solutions had received more research attention during the last few years. Moreover, Guruge et al. (2021) reviewed course recommender systems by conducting a classification of papers according to the year of publication and the techniques used for course recommendations. They concluded that hybrid and data mining techniques grew in popularity among course recommenders from 2016 to 2020. Their review stated that most current studies have estimated learner preferences based on their profiles, a static and one-directional form of user representation.

Relevant literature reviews have shown two major concentrations among e-learning recommender systems. One line of research has focused on the learner's perception as the end user of recommendation; the other line has been more concerned with data mining techniques and technical solutions to predict recommendation ratings. Unlike previous literature review studies, we aimed to explore practical course recommendation proposals that emphasized personalization and solutions that considered different aspects of courses and learners. Table 1 summarizes the latest recommender systems literature reviews and the research questions they addressed. Our study investigated the latest developments in course feature extraction and learner modeling in online course recommendation applications.

Table 1

Articles Focused on e-Learning Recommendation Systems

Citation	Recommender application	Item feature extraction	User model	Recommender technique	Recommender evaluation
Deschênes (2020)	-	-	-	√	√
Guruge et al. (2021)	√	-	-	√	√
Khalid et al. (2020)	√	-	-	-	-
Khanal et al. (2020)	√	-	-	√	√
Klašnja-Milicevic et al. (2015)	-	-	√	√	-
Salazar et al. (2021)	-	-	√	√	-
Tarus et al., (2018)	√	-	-	√	-
Uddin et al. (2021)	√	-	-	√	√
Yago et al. (2018)	√	-	√	√	-
Current Study	√	√	√	-	-

Considering the two major research lines, there was a need to review the research on how proposed recommendations model learners and extract their characteristics from different perspectives. Besides extracting learner profiles, another input was the features of the items that are considered for recommendation. We focused on courses as the recommendation objects and analyzed how previous research extracted course information for the recommendation.

Search Methodology

This section explains the protocol we followed to search and select research articles for the review. Kitchenham (2004) has stated that a review protocol is essential as it defines the method to undertake the study. Primarily, we needed to identify the research goals and research questions. Recommender systems for online learning environments need to be elaborated carefully since learners remain passive to give explicit feedback. These recommendations mostly rely on the content of the items and the user behaviors collected as they use the online system. The goal of this study was to conduct an exhaustive literature review of course recommender systems. We focused only on course recommendations for students who were studying for their degrees at universities, or lifelong learners who were looking for skills helpful to their careers. We sought to answer the following two research questions.

1. Which course features were extracted and employed by recommender systems?
2. Which learner characteristics were used for creating their profiles and recommending courses?

The next step was to identify the keywords best suited for finding course recommendation systems. The literature search terms comprised words and combinations such as (a) course, (b) learning resource, (c) recommender or recommendation, (d) selection, and (e) system. Our search timeline spanned eight years from the beginning of 2015 until the end of 2022. We selected journal and conference articles from top-level electronic databases, namely (a) IEEE Xplore, (b) ACM Library, (c) Springer Link, (d) ERIC, (e) Wiley Online Library, (f) EBSCO, (g) ScienceDirect, (h) Taylor and Francis Online, (i) Scopus, and (j) Web of Science. We selected these online databases because they contain articles relevant to our literature review topic. In particular, ERIC focuses on education sciences of all kinds and their advancements. Additionally, to ensure our search was comprehensive, we checked Google Scholar for possible missing articles in the aforementioned databases. We conducted the initial search and retrieval of articles in April 2022 and updated it in April 2023. Since searching solely for keywords resulted in an immense draft of papers, we needed to restrict our search to specific phrases. Every database has its own tools and guidelines to narrow down the search results. Table 2 illustrates the search query and the number of articles for different databases.

Table 2

CRS Search Phrases and Initial Results

Search order	Database	Search phrase	Initial results
1	ACM Library	[[Title: course] OR [Title: curriculum] OR [Title: resource]] AND [Title: recommend*]	82
2	EBSCO	(course OR MOOC) AND recommend* in TI Title	127

3	ERIC	title:((course OR MOOC OR curriculum) AND (recommender OR recommendation OR recommend)) pubyearmin:2015	52
4	IEEE Xplore	(online education OR e-learning) AND (course) AND (recommender system OR recommendation)	223
5	ScienceDirect	In title: (course OR MOOC OR curriculum) AND (recommend OR recommendation OR recommender)	35
6	Scopus	(SRCTITLE ((course OR mooc) AND recommend*) OR TITLE ((course OR mooc) AND recommend*))	369
7	Springer Link	"Course" OR "MOOC" OR "Curriculum" AND Recommend*	40
8	Taylor and Francis	[Publication Title: course] OR [Publication Title: mooc]] AND [Publication Title: recommend*]	7
9	Web of Science	TI=((course OR MOOC) AND recommend*)	275
10	Wiley Online Library	"(course OR MOOC OR curriculum) AND (recommend* OR select*)" in Title	43
11	Google Scholar	allintitle: (course OR MOOC) AND (recommend OR recommender OR recommendation OR select OR selection)	297

These searches resulted in 1,546 found articles, of which 570 results were repetitive and represented in multiple databases. For example, Esteban et al. (2020) was indexed by EBSCO, ScienceDirect, WoS, and Scopus databases simultaneously. We removed the duplicate articles based on the order of their appearance in our database searches. After eliminating duplicate results, the remaining number articles equaled 976. To further refine our results, we read the abstract and introduction for each article to determine its aim, application, and research focus. We applied multiple criteria to exclude articles from further review. These exclusion rules are summarized below:

- ExCrit1: recommender system not related to the education domain or course recommendation in particular
- ExCrit2: the article does not introduce a recommender system, but recommends optimal performance or analysis in education
- ExCrit3: other review research on educational recommenders
- ExCrit4: presentations, reports, magazine covers, or thesis

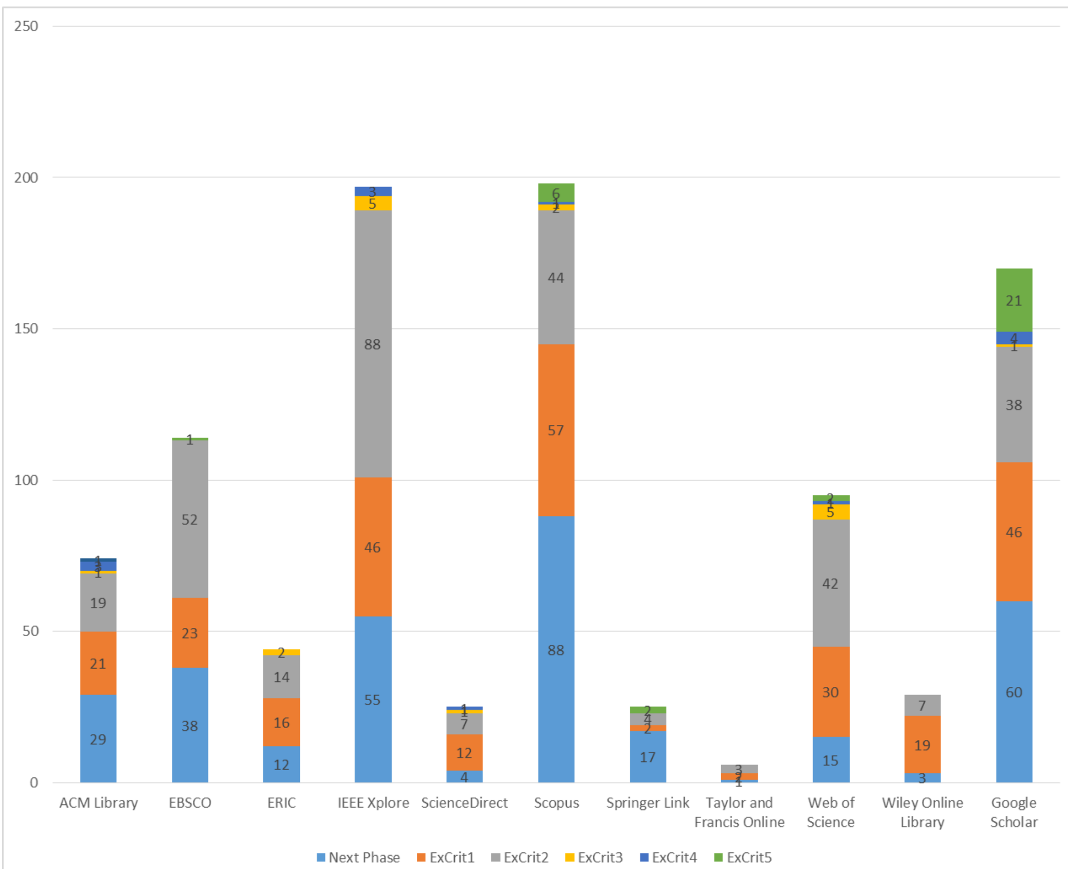
- ExCrit5: full text or abstract of the paper not available

Applying these exclusion criteria based on the content of the paper's abstract and introduction narrowed our search results to 322 for extensive study. Figure 1 shows the number of papers selected for inclusion in the next phase and the articles excluded based on the criteria explained above.

Next, we read each article thoroughly to identify those that addressed our research questions. Papers with a lack of information about any of the research questions were removed from further analysis. We focused on the research that explicitly considered courses as recommendation items and used learner information for personalization purposes.

Figure 1

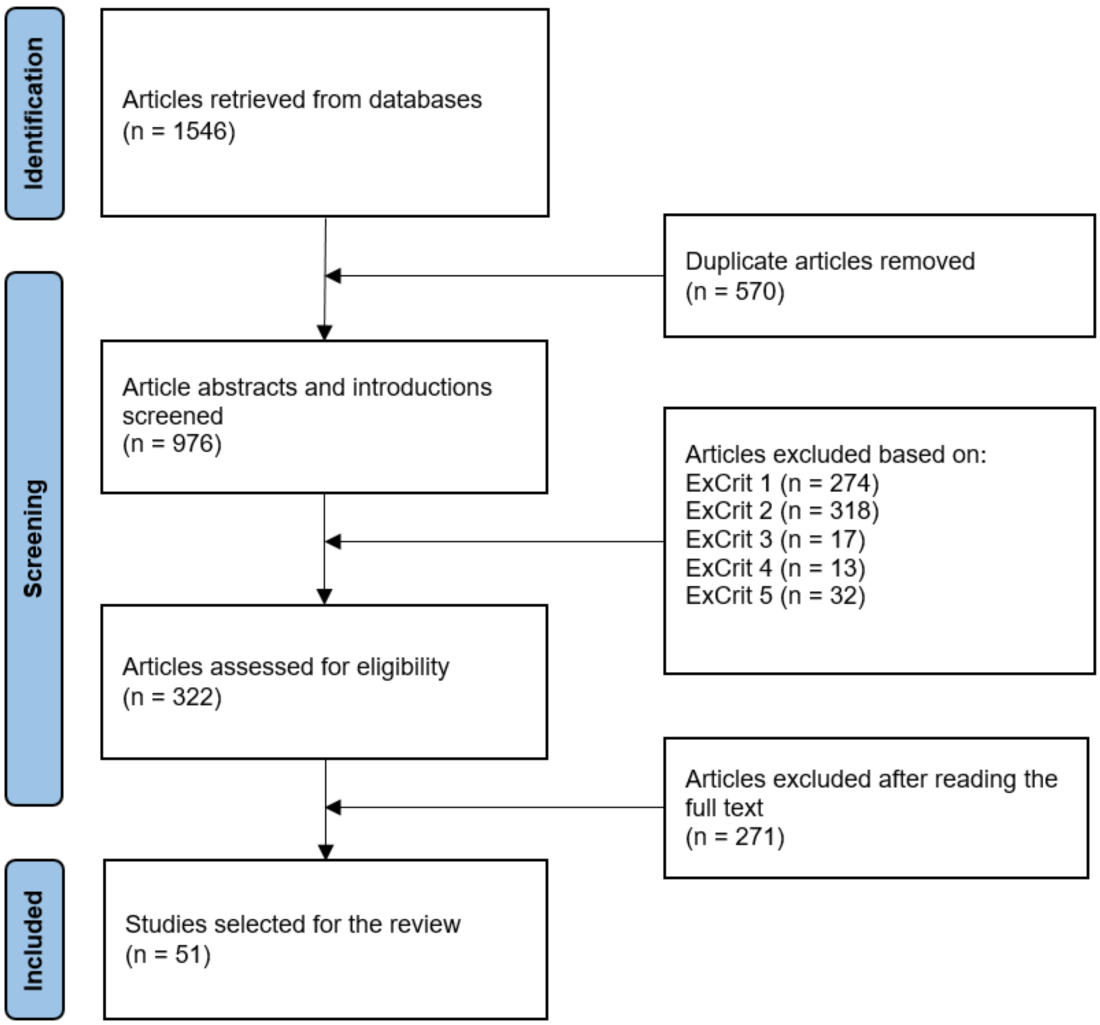
Number of Papers Included In and Excluded From Extensive Reading Phase



After this stage, we decided to include 48 articles for the course recommender literature review from 2015 until 2022. At the same time, to validate our findings, we shared the list of 322 articles and our research questions with an expert in the field to validate our findings. Expert opinion regarding the articles to be included was different on three occasions. Compared to the expert opinion, our filtering had an accuracy of 99.07%. The total number of articles in our final literature review equaled 51. Figure 2 illustrates the summary of articles selected for review, and Figure 3 shows the yearly distribution of this final list by publication type (i.e., journal or conference article).

Figure 2

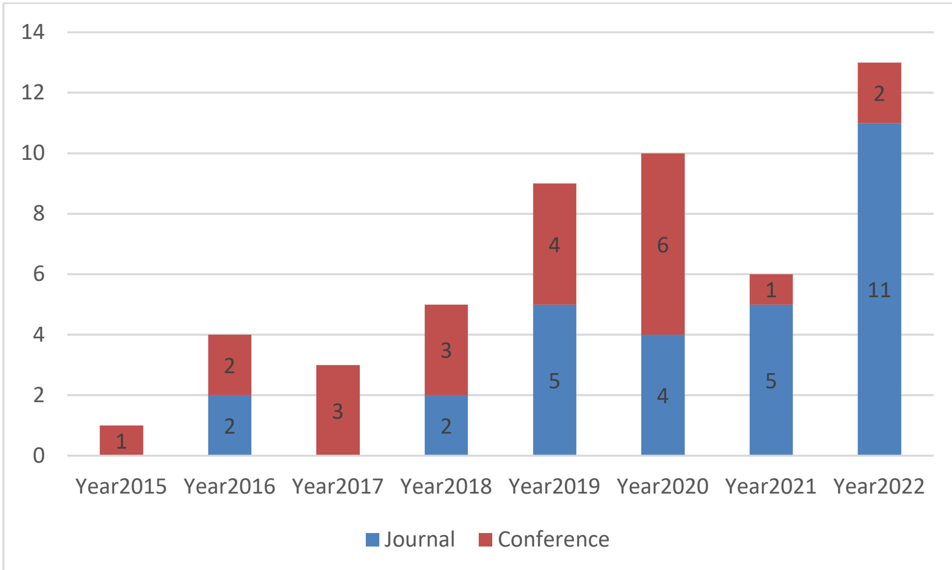
Article Selection Process Adapted From the PRISMA Flowchart



Adapted from "The PRISMA 2020 statement: an updated guideline for reporting systematic reviews," by M.J. Page, J. E. McKenzie, P. M. Bossuyt, I. Boutron, T.C. Hoffmann, C.D. Mulrow, L. Shamseer, J.M. Tetzlaff, E.A. Akl, S.E. Brennan, R. Chou, J. Glanville, J.M. Grimshaw, A. Hrobjartsson, M.M. Lalu, T. Li, E.W. Loder, E. Mayo-Wilson, S. McDonald, L.A. McGuinness, L.A. Stewart, J. Thomas, & D. Moher *BMJ 2021, 272*(71). 2021 by BMJ.

Figure 3

Article Types and Yearly Distribution



Results on Course Feature Extraction for Recommendation Systems

The two main elements of recommendation systems are users and items. In our analysis, we regarded items as courses or subjects that aligned with learners' profiles, who represented the recommendation systems' users. To recommend a course with a high possibility of matching a learner's profile, we needed to understand how research in the literature extracted learner models and course features. This section presents an overview of previous publications that provided information about the features and information related to courses in the recommendation process. We proposed a framework that classified course features into major categories, namely, (a) course correlations and prerequisites; (b) static course information (e.g., university, department, instructor, language, fee, required hours); (c) course description and covered subjects; (d) comments and ratings; (e) enrolment history; and (f) combinations of features from these categories.

Course Correlations and Prerequisites

This group of features was mainly concerned with the relation among courses in terms of academics or semantics. Course difficulty level and complementary topics also fell into this group. As an example of the first category, Jing and Tang (2017) introduced a hybrid course recommendation system that calculated the transfer probability from course A to course B based on enrollment history. They extracted prerequisite relations between courses based on these probabilities. For example, if course A is a prerequisite to enrolling in course B, the transfer probability of A to B is much higher than the transfer probability of B to A. This probability calculation was used as a weighted input for their hybrid recommendation system. Similarly, Yin et al. (2020) introduced a recommendation model that used transition probability based on the learners' enrolment history. They calculated the percentage of learners who take course A after attending course B. Additionally, they used the semantic structure of course topics and their connection to strengthen their hybrid recommendation model.

Huang et al. (2018) used an FP-growth association rule mining algorithm as part of the proposed hybrid recommendation system to find the relation between courses. Similarly, Yang et al. (2018) proposed an Apriori algorithm to find association rules among courses. They calculated the similarity between courses and integrated it into predicting learner results in a course and consequently recommending courses with the higher predicted score. Zhao et al. (2020) used concept-level relations to build course-level prerequisite relations. The method found similarity and concept-level relations with analyzing MOOC video captions to recommend which courses were better to take after a particular course. Chen et al. (2022) indicated that enrolled courses in the distant past are not as informative as recently enrolled courses. As a result, they used course enrolment sequence and course prerequisite information to construct a collaborative sequence graph for recommending relative courses.

Course Static Information

For the second category, there was an extensive range of static information sources for creating course feature models. For example, Elbadrawy and Karypis (2016) proposed grade prediction and course recommendation that exploited course subjects and levels based on the semester they were offered for degree students. Ibrahim et al. (2018) used course title, major subject, fee, university location, and even university rank to build an ontology-based course recommendation. Pardos and Jiang (2020) added course instructors and departments to the course representation of course2vec (Pardos et al., 2019), a model that represented student enrollment sequences chronologically, based on course contexts. H. Zhang et al. (2019) used the course resource library to create feature vectors with course grade, creator, and school. Xu and Zhou (2020) created multi-dimensional course features with historical data on course duration, number of video plays by learners, number of comments, and video or audio features of course content to illustrate what course factors attracted learners in online learning platforms.

Xu et al. (2021) considered hours required for course completion in addition to course subjects and instructors to build knowledge graphs. The extracted knowledge graphs found similarities among courses to combine with collaborative filtering for recommending courses. Urdaneta-Ponte et al. (2021) analyzed professional job databases and extracted information on the required skills to succeed in courses and new skills acquired after successful completion. They built related jobs for learners by using knowledge graphs and predicting the clusters that a course belonged to. Similarly, Yang and Cai (2022) used attributes such as instructor, industry, technical direction, and course form to construct a course knowledge graph. Sakboonyarat and Tantatsanawong (2022) considered information regarding the course institution, number of chapters, registration, and completion time to represent their input data for the course recommender system. These attributes were used to create course learning data groups and combined with user learning data to feed the recommendation deep neural network.

Course Description and Covered Subjects

Text mining, topic modeling, and semantic analysis of course descriptions and syllabus topics have all been used to construct course models. Ng and Linn (2017) analyzed course topics with a popular machine-learning algorithm called latent Dirichlet allocation (LDA), to identify topic distribution through a corpus of degree studies and within the course description. Similarly, Xia (2019) presented the contextual meaning of documents with vectors and calculated the similarity between learner query and course description vectors to recommend courses. Tan et al. (2020) used a long short-term memory (LSTM) network to extract course information from descriptions to predict the relevance of courses with a learner's preferences.

Pang et al. (2018) defined a distance measure by fine-graining course videos. They used video properties like knowledge point, subject, and stage of the course at which the learner watched the video. Li and Kim (2021) proposed a model that embedded courses within their subjects from sparse data and extracted a course attribute module to represent the topics each course covered. Jung et al. (2022) proposed a graph-based model that considered the inclusion of keywords in the courses and embeds it with the keywords related to learners based on their interactions with the courses. Premalatha et al. (2022) mapped course contents in the curriculum with predefined domains suggested by experts. They classified elective courses into domains and recommended them based on the learner's expertise domain.

Course Comments and Ratings

This category analyzed learners' comments and their reactions to the courses in which they were previously enrolled. Chang et al. (2016) built a quality-control mechanism to prevent recommending courses with instructors that were rated poorly by learners. Bakhshinategh et al. (2017) assessed learners' feedback with 28 sub-attributes of courses on a five-point scale. They perceived the given score as graduating values for students and used it for collaborative filtering purposes. Zhu et al. (2020) exploited learner ratings and textual comments about courses and teachers to predict their ratings for the classes they have not taken. They even analyzed learner lexical style in commenting on different courses to build learner relation networks. Likewise, to present their collaborative filtering course recommendation system, Man et al. (2022) calculated course similarities based on learners' ratings and scores.

Course Enrolment History

Most research into course recommender systems has considered learners' previous enrolments and obtained grades as the source of information to build their models. In early research, Khorasani et al. (2016) proposed a course recommending model based on historical enrollment data without considering course prerequisites or degree requirements. Al-Badarenah and Alsakran (2016) employed a clustering algorithm to build student groups based on their previous grades and find the closest group to the target student to recommend courses they succeeded in. Similarly, Bridges et al. (2018), Jiang et al. (2019), Morsy and Karypis (2019), Asadi et al. (2019), Yang and Jiang (2019), Salehudin et al. (2019), J. Zhang et al. (2019), Li et al. (2020), and Nguyen et al. (2021) focused on historical enrollment data for predicting grades and recommending courses. In another study, Ma et al. (2020) broke down learners' previous enrollment data to measure how interesting and timely a course was in order to be recommended and additionally predicted what scores learners would achieve. Guo et al. (2022) used the votes each course received to recommend items based on learner interest and to prevent the cold start problem. Wang (2022) selected the number of participants in courses and their scores to define a measure of course popularity, and used course tests and completion rates to find learners' recognition levels.

Combination of Course Features

In the literature, some research has combined different types of course-related information to extract desired features and construct their course models. Yanhui et al. (2015) used course major, category, and description similarity together with course ratings to create a group recommender system. Symeonidis and Malakoudis (2019) merged information about the skills to be covered, retrieved from the course title and description, with learner ratings. As a result, they built a course-skill matrix to fuse with the user-skill matrix to provide recommendations. Esteban et al. (2020) explained that an important factor for course recommendation is the coincidence of professors with courses learners liked in the past. Subsequently, these authors combined course professor information and knowledge area with course theoretical and practical content analysis to create course models. Cao and Chang (2020) used course static information like course department and school, together with course description word analysis, to build their recommendation systems its content-based filtering aspect.

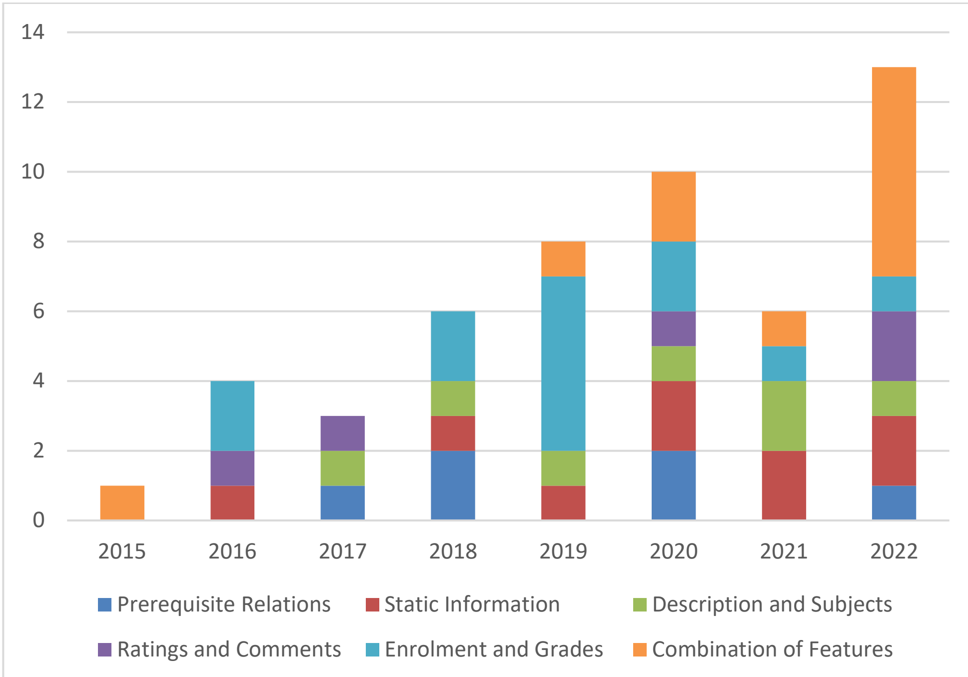
The combination of different course features to build recommendations gained more attention during the last two years of our literature review coverage. Fan et al. (2022) integrated course reviews with course descriptions in different granularity of words and sentences to find personalized learning patterns and recommend courses based on the mined patterns. Zhou et al. (2022) proposed a method to build a course knowledge graph from demographic information such as teacher and school, fused with prerequisite relations and concepts a course covered. Jiang et al. (2022) integrated course name and teacher information with the segmented introduction to calculate the frequency of subject word appearance in course descriptions.

Agarwal et al. (2022) exploited course static attributes like name, provider, duration, language, and fee along with a set of elements from course videos and reading materials, as well as course enrollment and completion rate to create course ontologies for a knowledge-based recommendation system. In a similar work, Agrawal and Deepak (2022) modeled courses based on course titles and descriptions, and then combined them with course ratings, difficulty, and learner enrolment to build a massive course ontology. Wang et al. (2022) exploited several available information types including enrollment history, prerequisite restrictions, and other contextual data such as course meeting times, instructors, and instructional methods. Ahmad et al. (2023) used information from learner interaction with courses based on enrolment data and generated a bipartite network of learners and courses. For course nodes, they used attributes from course descriptions and fields.

Figure 4 illustrates the yearly distribution of the information sources used for course modeling. In the early years covered by our review, course recommenders mainly used single sources of information. Enrolment and grades history were the main focus of the research to create rating tables for recommendations, and used predictive methods in order to calculate learners' interest and expected outcome for the courses that were not taken by them. These methods are widely used in the commerce world and ignore the different attributes of courses and learners. Our review suggested that the combination of course information resources to create course models have been investigated in the last years, and this trend will likely be a major focus in the foreseeable future. Five out of nine articles published in 2022 used a combination of course features. Still, more research is needed to combine information resources differently and create more precise course models.

Figure 4

Yearly Distribution of Course Feature Sources for Recommendation



Results on Learner Characteristics for Course Recommendation Systems

In the literature, we identified six types of major characteristics of learners for course recommenders to consider. The first category, learner static profile, consisted of static learner profile data such as identity number, name, age, occupation, and so on. The second source of information was learner ratings explicitly given to previous courses. The third type included learners' previous enrolment and performance. The fourth group of attributes was related to learner activities and their interactions with the online learning platform. The fifth feature considered for creating learner profiles was learners' skills and cognitive characteristics. The last attribute category covered learners' motivation and interests, discovered implicitly or explicitly based on their behaviors captured via their interactions with the system. This category has usually been exploited together with different learner feature resources explained in the last part of this section. This last part also includes the previous works that considered a combination of multiple attributes to create learner profiles for course recommendations.

Learner Static Profile (Demographic Information)

A learner's profile information contains static uninterpreted characteristics, such as demographic information, age, gender, and so on. Asadi et al. (2019) considered students' age, gender, high school GPA, and university entrance exam scores to create learner profiles. They created learner clusters based on the similarity of these attributes. In another work, Huang et al. (2018) proposed a course recommendation model based on learners' academic social networks and their ties with other learners.

Urdaneta-Ponte et al. (2021) proposed a lifelong learning course recommendation system that used learners' demographic information, occupational information, and skills extracted from LinkedIn. Similar to the previous work they used this information to cluster entities in order to recommend courses collaboratively. Li and Kim (2021) used static information like users' jobs, certificates, and language skills to match courses with learners' profiles. In other research, students' location, birthdate, gender, and level of education were used for MOOC recommendations (Sakboonyarat & Tantatsanawong, 2022).

Learner Ratings

Some works surveyed learners' interests and opinions directly with questionnaires or asked them to input their interests and goals textually. For example, Yanhui et al. (2015) clustered similar learners into groups based on the similarity of their preferences and ratings over previous courses. Bakhshinategh et al. (2017) assessed students' opinions about graduating attributes, defined as qualities and skills that universities aim to develop during students' time in the institution. They recommended courses based on the weighted sum of five -point ratings given by students regarding 28 graduating attributes.

In addition to information about the course in general, some studies have captured learners' opinions about details such as topics or course instructors. Through surveys, Ng and Linn (2017) asked learners about their preferences regarding the course level, desired topics, and professors' ratings. In similar research, Xia (2019) explicitly asked about learners' desired occupational positions and tried to recommend courses that supported students to be prepared for their career goals. Esteban et al. (2020) proposed a recommender system for university students majoring in computer science to choose elective courses based on their previous ratings of courses and branch of study. Zhu et al. (2020) created a model based on learners' ratings and text comments about courses, teachers, achieved grades, and supervisors. Guo et al. (2022) extracted learners' characteristics from submitted text and represented this information to build a six-dimensional learner model vector. Jiang et al. (2022) designed users' interest models based on the labels they assigned to course topics. They used this information to determine learners' preferences and their opinion about the online course quality.

Learners' Previous Enrolment and Performance

Previous research on CRS has included numerous works that relied heavily on predictive analysis of historical enrolment and grade data. These methods are based on machine learning and data analytic techniques. Khorasani et al. (2016) introduced a course recommendation model based on historical enrollment data and no prior knowledge of the course prerequisites or degree requirements. Al-Badarenah and Alsakran (2016) proposed a learner clustering method based on course grades and applied a collaborative filtering method to recommend elective courses. Bridges et al. (2018) used learners' historical grades and enrollment data to form a directed graph to show students' transition possibilities from completing one course to the next. Yang and Jiang (2019) created a learners' network based on registration and achieved score data. In the initial network, nodes represented learners, and edges between nodes meant the connected nodes enrolled in the same course before. Salehudin et al. (2019) used learners' previous enrollment data along with their grades to calculate the similarity between learners. They use this similarity to recommend courses to a target student that had not taken the courses enrolled by similar students (neighbors).

Some studies examined learners' previous scores to recommend courses for learners who were expected to perform well and acquire high marks. Yang et al. (2018) investigated learners' course performance data based on their major, gender, and grades. Jiang et al. (2019) proposed a goal-based recommendation system to predict learners' performance in upcoming courses based on their previous grades. Similarly, Morsy and Karypis (2019) introduced a grade-aware method to recommend courses in which students were expected to perform well. By learning from previous grades, they estimated the students' grades in future courses. Ma et al. (2020) studied the reasons for course selection in universities; they found that getting relatively higher grades was one of the factors that influenced learners' choices. Based on learners' previous grades, they estimated how prepared they were for the upcoming courses. In a similar work Nguyen et al. (2021) showed that students selected courses that they thought would result in a better learning outcome. They used the students' previous grades for predicting learning outcomes. Zhou et al. (2022) introduced a time-aware recommendation system that considered learners' sequential enrolment data to recommend courses that matched temporal learner interests. Premalatha et al. (2022) proposed a learner domain expertise model that analyzed the number of elective courses students completed and the grades they achieved.

A line of research in recent years has used learners' enrolment history alone to build course recommendation systems with machine learning and neural network techniques without considering learners' personal traits and features (Chen et al., 2022; Li et al., 2020; Wang et al., 2022; Zhao et al., 2020).

Learner Activities

There has been a consensus in personalized learning that learners' actions regarding different resource materials are an important factor in creating learner profiles. Most of the previous research combined learner activity data with other resources to demonstrate learner models. Pang et al. (2018) proposed adaptive MOOC recommendations that adopted learning duration as the key feature for creating learner models. Specifically, they calculated the time learners spent watching educational videos and calculated learners' similarity based on the video topics they watched. Similarly, Xu and Zhou (2020) used learners' video play and view records to determine their preferences. Agrawal and Deepak (2022) examined learners' micro-actions, such as their clicks on the online platform, to build a recommendation model. They used unique terms and investigated learners' navigation patterns.

Learner Skills and Cognitive Characteristics

Scant research has investigated learner cognitive skills or learning style directly to recommend courses. Symeonidis and Malakoudis (2019) exploited information from external resources like learner skills and matched them with the skills covered in the course topics. Agarwal et al. (2022) proposed a MOOC recommender that extracted learning styles based on the learner's navigation through a course. They used this information to build learner clusters and created recommendation lists based on cluster-based collaborative filtering methods.

Learner Interests and Combination of Characteristics

This category included various combinations of different information sources of learners' characteristics to build profiles. Some work has combined learners' interests and motivation factors, acquired implicitly or explicitly, with other learner features. Jing and Tang (2017) explored learners' navigation through learning Web pages to find the topics they were more likely to be interested in. They combined this information with learners' demographic information to find similar learners and group them together for collaborative course recommendations. In similar work, Yin et al. (2020) analyzed learners' behaviors by mining their visiting history to create an interest model. They infused the interest model information with learners' demographic data to create learner clusters and avoid the well-known cold start problem. Pardos and Jiang (2020) introduced a university course recommendation system that surveyed students about their favorite courses taken. In their research, information about students' majors, study years, and text comments on courses were used to understand learners' opinions and feed the recommendation system.

A number of studies examined the correlations among students' previous enrolments, achieved scores, and their ratings of courses. Chang et al. (2016) proposed a hybrid recommendation system that examined college students' aptitude based on their previous scores. They also used students' ratings of course instructors as a course recommendation quality control mechanism to avoid offering courses with poor instructor ratings. Tan et al. (2020) combined learners' explicit ratings with their grades to obtain their preferences. Xu et al. (2021) calculated learner's ratings and scores based on previous ratings collaboratively to build a personalized recommendation system. Fan et al. (2022) proposed a multi-attention MOOC recommender that used learners' grade records with text reviews posted after course completion. They examined word-level learner reviews and compared them with course descriptions. Man et al. (2022) argued that the recommendation systems based on students' course selection data used limited sources of data. So, to evaluate the similarity between courses, they used students' ratings in addition to data from enrolments and grades.

The combination of different learner characteristics and profiling techniques was a major academic focus in the years covered by our review. In their pioneering work, Elbadrawy and Karypis (2016) used information from students' fields of study, their academic level (year of study), and previous grades to define student groups. They showed how these groupings helped to predict grades and rank courses for recommendations. Ibrahim et al. (2018) extracted and integrated students' data from different resources, like personal information, skills, and feedback. Additionally, they used ratings to tackle the new learner problem. J. Zhang et al. (2019) measured learners' effort by calculating their video watch time. They presented learners' profiles by combining learners' enrolment and grades with their watch ratio, defined as the watch duration divided by the total duration of the video. Cao and Chang (2020) proposed a hybrid course recommendation model that took into account information like students' department, duration of the study, registration history, and certificates. In a similar work, Ahmad et al. (2023) combined learners' demographic information and educational background with their enrolment history to build a network and explore the relations between learners and courses.

Some studies made learners' interactions with the learning system the focal point of their modeling and combined this data with other learner information. For example, H. Zhang et al. (2019) used multi-dimensional learner attributes ranging from age and gender to micro-activities like online video watch time, video pauses, post replies, and problem views to create an accurate recommendation model for MOOCs. Jung et al. (2022) created knowledge graphs to integrate learners and courses through their interaction with the keyword sets. By calculating the number of learner interactions with the keywords and combining them with the enrolment history, they estimated learners' interests and skill levels. With a similar approach, Yang and Cai (2022) introduced a knowledge graph enhanced CRS that used information like learners' age, job position, industry, and knowledge level beside learner click counts on course items. Wang (2022) detailed the necessity of a complete learner model to build an accurate course recommendation system and proposed a recommendation model based on learners' emotional and psychological factors according to the educational content. The proposed method used learners' personal information like age, gender, profession, education, and research direction together with their opinion about the curriculum. Furthermore, Wang (2022) exploited the information from chapter test scores, grades, certificates, and course registration time combined with actions like last landing time, number of studied chapters, visit time, and participation in the forums. Table 3 summarizes only the literature that proposed learner profiling solutions based on combining the information sources they used.

Table 3

Articles That Combined Multiple Sources of Information About Learner Characteristics

Citation	Learner static profile	Learner ratings	Learner previous enrolment	Learner activities	Learner cognitive characteristics	Learner interests
Jing and Tang (2017)	√	-	-	-	-	√
Yin et al. (2020)	√	-	-	-	-	√
Pardos and Jiang (2020)	√	√	-	-	-	√
Chang et al. (2016)	-	√	√	-	-	-
Tan et al. (2020)	-	√	√	-	-	-
Xu et al. (2021)	-	√	√	-	-	-
Fan et al. (2022)	-	√	√	-	-	-
Man et al. (2022)	-	√	√	-	-	-
Elbadrawy and Karypis (2016)	√	-	√	-	-	-
Ibrahim et al. (2018)	√	√	-	-	√	-

H. Zhang et al. (2019)	-	-	√	√	-	-
Cao and Chang (2020)	√	-	√	-	-	-
Ahmad et al. (2023)	√	-	√	-	-	-
J. Zhang et al. (2019)	√	-	-	√	-	-
Jung et al. (2022)	-	-	√	√	-	-
Yang and Cai (2022)	√	-	-	√	-	-
Wang (2022)	√	√	√	√	-	√

Discussion

In this study, the reviewed papers were sourced from high-quality journals and conferences spanning topics from information and computer science to education and learning. The review revealed a strong emphasis on innovative course recommender system solutions that relied heavily on artificial intelligence, data mining, and big data. We observed that course recommendation systems have gained significant attention in recent years due to the increasing demand for personalized learning experiences, and as a result, we retrieved many articles for review. To include all relevant articles, this study investigated scholarly databases in the fields of computer science and education, and relied on different search methods based on keywords and multi-layer filtering to examine 976 articles. This study clearly defined exclusion and inclusion criteria. However, the initial filtering of articles based on title and abstract may have resulted in the omission of some valuable information on course features and learner modeling. Another limitation was the availability of previously published course recommender articles. Despite their relevant title and abstract, 32 papers were not accessible for full-text exploration.

It is important to note that while the field of course recommendation systems has made significant advancements, there are certain aspects that require further development and elaboration. One notable aspect is the complexity inherent in the users and items of course recommendation systems, particularly in comparison to the traditional e-commerce domain. Course recommendation systems need to go beyond simple statistical models that predict ratings and consider the multi-faceted nature of learners and course materials. In contrast to earlier literature reviews, this study sought to delve into practical course recommendation approaches that prioritized personalization while encompassing various aspects of both courses and learners. Given these prominent research directions, it was essential to examine how the proposed recommendations extracted learners' attributes and created course feature models.

To achieve successful course completion with higher grades, it is imperative that various aspects of the course, such as required hours, schedule, assignments, final exams, and overall difficulty, align with learners' profiles. Simply relying on learners' previous records is insufficient to create precise predictive models of their performances. Instead, a deeper semantic and contextual analysis of courses is necessary to match them with learner profiles, interests, and future accomplishments. Surprisingly, our review found that only Xu and Zhou (2020) focused on specific course topics and their video presentation, highlighting the need for more research in this area. Additionally, only 11 out of 51 articles combined different information sources to create course features, including six studies from the year 2022. This trend indicates that the research community has only recently addressed this issue; in the future, we can expect an increase in course recommendations incorporating multi-dimensional features.

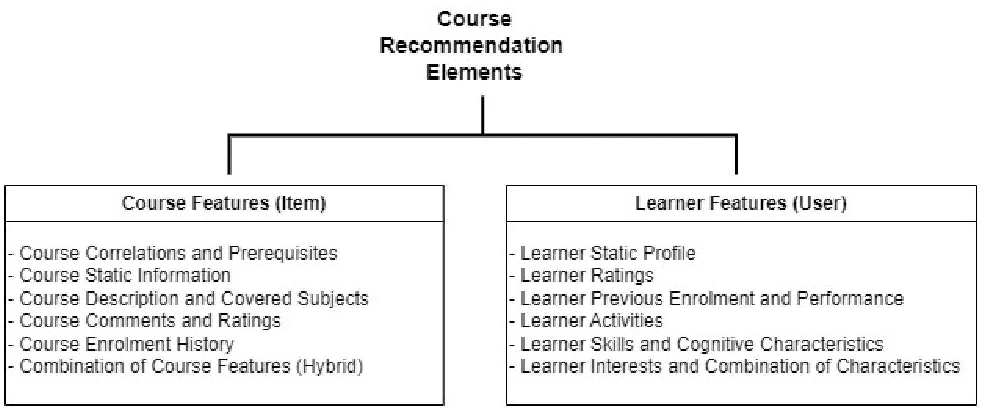
Another compelling argument can be made for introducing more elaborate learner profiles that incorporate a hybridization of different information sources. The predominant research focus thus far has been on using information from previous registrations and grades (27 articles out of 51). However, in the e-learning context, users are more specific and complex. Therefore, creating comprehensive learner profiles that consider valuable learner actions during their time in the e-learning system deserves greater attention from academia. Only three articles focused solely on learner activities, and five other articles combined this information with other learner characteristics. Still, there is not enough emphasis on the actions the learner takes in the learning process. The exploitation of different activity logs is worth investigating in order to design precise and more personalized course recommender systems.

Furthermore, our review identified only one research study that considered the combination of learner cognitive skills with other features. Moving forward, it would be beneficial to prioritize learners' cognitive skills in order to match courses to their individual levels. By incorporating cognitive skills into the recommendation process, course recommendation systems can better cater to the unique needs and abilities of learners, potentially leading to improved learning outcomes.

Figure 5 summarizes the findings of our literature review and presents a framework for classifying course features and learner models for recommendation systems.

Figure 5

Summary of Course Feature Extraction and Learner Models for Recommendation Systems



Direction for Future Work

In this literature review, we explored the field of course recommendation systems and discussed various approaches and techniques to extract course features, model learners, and design recommenders. The review revealed several important findings and highlighted the current state of research in this area.

While the field of course recommendation systems has seen significant advancements, there are important areas that warrant further exploration and refinement. Researchers should strive to develop more sophisticated models that go beyond traditional statistical approaches to consider the complexity of learners and the specificities of course materials in the e-learning context. In this line of research, there is a massive gap in measuring the effectiveness of course recommender systems in real-world online education settings. Studies have mainly measured their proposed methods with static data and made conclusions based on statistical numbers that may not represent the usefulness of recommendation systems to help learners achieve better outcomes. Moreover, integrating comprehensive learner models and prioritizing cognitive skills offer promising directions for future studies in course recommendation systems.

One of the downsides to course recommender systems is that there is no universal dataset to assess the effectiveness and accuracy of recommender systems. The availability and use of data play a crucial role in the effectiveness of course recommendation systems. During our research, we identified several data sources used for course recommendation, such as historical student data, course content information, and social interactions. Evaluating course recommendation systems poses challenges due to the absence of standardized evaluation protocols and the subjective nature of user preferences. While metrics such as precision, recall, and accuracy are commonly used, additional measures such as diversity, novelty, and serendipity are also important to capture the quality of recommendations. Also, examining learners' perceptions of the recommended courses needs to be more focused on future research.

Finally, the use of deep learning techniques, such as neural networks and natural language processing, holds promise for improving recommendation accuracy and incorporating more complex features. Additionally, the integration of context awareness, such as considering temporal dynamics and user preferences in real time, can lead to more personalized and adaptive recommendations. Course recommendation systems have demonstrated significant potential in enhancing the learning experience for students by providing personalized and relevant course suggestions. Future research should focus on developing robust and scalable recommendation algorithms, exploring innovative data sources, and refining course or learner feature engineering. By addressing these challenges, course recommendation systems can contribute to the advancement of personalized education and lifelong learning.

Acknowledgments

This work was supported by the Fundació per a la Universitat Oberta de Catalunya's (UOC) grant for doctoral thesis research.

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International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 25, Number 1

February – 2024

Creating an Open Online Educational Resource to Support Learners as They Navigate Their Studies Alongside Work and/or Family

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Abstract

As labour markets undergo rapid and profound transformations, lifelong learning is essential to ensure a responsive, competitive, and skilled workforce. Mature learners are a diverse group, but in comparison to their younger student counterparts, are more likely to have employment and/or caring responsibilities. This field note discusses the development and features of a novel online open educational resource, called *At a crossroads: Navigating work and/or family alongside study* (*At a crossroads* for brevity). The resource aimed to assist university students to both learn about the support options available to them as well as to consider how they themselves might make decisions if they experienced a conflict between their student/work/family roles. *At a crossroads* is innovative in terms of how it was developed (i.e., via survey-based research, story completion method, and consultations sessions with tertiary students) and in terms of what it is (i.e., an online interactive resource that incorporates short dramatizations, social polls, and opportunities to reflect). Our experience in developing this resource caused us to consider how making resources designed to be engaging and informative, while encouraging, positive changes, must be part of the solution. This is especially so when there is significant concern around the overall well-being of tertiary students and their course completion rates. While universities have attempted to offer a range of tools to support their students, on-demand online resources such as *At a crossroads* are easily accessed, free to use, and deliver content in an engaging manner.

Keywords: open education resource, work-family-study, mental well-being, higher education

Creating an Open Online Educational Resource to Support Learners as They Navigate Their Studies Alongside Work and/or Family

As labour markets undergo rapid and profound transformations, lifelong learning is essential to ensure a responsive, competitive, and skilled workforce. Since 2001, lifelong learning has been a key commitment for higher education institutions in Europe through the Bologna Process (Jakobi & Rusconi, 2009). Additionally, lifelong learning as a priority has been articulated through Goal 4 of the United Nation's Sustainable Development Goals to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" (United Nations, 2023, para. 1). Adult or mature learners, commonly defined as aged 25 years and older (Lodewyck, 2021), make up a substantial proportion of students in higher education. For example, they formed 34.9% of tertiary students in the 27 European Union countries in 2020 (Eurostat, 2022), 38.2% of higher education students in Australia in 2021 (Australian Government Department of Education, 2023), and 33.4% of college students in the USA in 2020 (Hanson, 2024).

Mature learners are a diverse group, but compared to their younger student counterparts, are more likely to have employment and/or caring responsibilities (Social Research and Demonstration Corporation, 2020). The possible difficulties in combining university study with paid work and/or family have been well documented in the literature. The concept of role conflict, the perceived incompatibility among roles (Greenhaus & Beutell, 1985), has been drawn upon to understand students' experiences. For example, Hammer et al.'s (1998) quantitative analysis of survey responses from 375 undergraduates at a university in the United States found that the number of dependent children of participants was associated with greater perceived conflict between family and study, and the average hours of paid work was associated with greater perceived conflict between work and study. Creed's et al. (2022) analysis of mature-age students in Australia found that congruence, or boundary management, between work and study roles was associated with reduced perceived conflict between these roles. Students' work and family commitments have also been linked to outcomes such as increased attrition (Moore & Greenland 2017; Morison & Cowley, 2017), compromised mental well-being (Giancola et al., 2009; Nicklin et al., 2019; Waterhouse et al., 2020) and lower student satisfaction (Waterhouse et al. 2022).

The *At a Crossroads'* Open Online Educational Resource

Mature learners are more likely to be studying part-time, at a distance, or be commuter students. These study modes are associated with different levels of engagement with the campus environment for these students, which in turn can result in them having difficulties accessing support. This article discusses the development of a novel online open educational resource that aimed to support students who work and/or have family responsibilities to successfully manage their studies. The resource was innovative both in terms of how it was developed (i.e., from research and through co-creation) and in terms of what it is—an interactive resource that incorporated short films, social polls, and opportunities to reflect. Called *At a crossroads: Navigating work and/or family alongside study*, the open educational resource aimed to support university students to both learn about the support options available to them and to consider how they themselves might make decisions, if they experience a conflict among their student/work/family roles. The development of this resource was part of a larger project called [Positive Digital Practices](), a collaboration involving three UK higher education institutions (The UK Open

University, The University of Warwick, and The University of Bradford) and three UK sector bodies (Jisc, Student Minds, and the University Mental Health Advisory Network). The project aimed to embed and sustain positive practices that support mental well-being in higher education.

Description of the Resource

The *At a crossroads* resource centred on an engaging dramatization, using professional actors, that followed Jaya, a university student, as she struggled to finish her latest assignment on time. Jaya was studying part-time whilst also in paid employment. She lived with her husband and teenage daughter. We deliberately avoided specifying whether Jaya was studying at a conventional campus-based institution or via distance education to ensure the relevance of the interactive resource to a wide audience.

The dramatization followed Jaya's journey over three days as she navigated her work, family, and studies. The film was split into four segments depicting: (a) tensions between Jaya and her wider family after she was late for a family gathering; (b) a lack of support from her employer, who pressured her into working overtime; (c) a perceived lack of support from her partner; and (d) a culminating final scene where Jaya contemplated dropping out of university. Figure 1 illustrates a scene from each of these segments. The interactive resource itself was organized into four segments corresponding to the points or issues raised in the short film. On the main menu, students can choose to follow the interactive sequentially, or skip to any of the four segments.

Figure 1

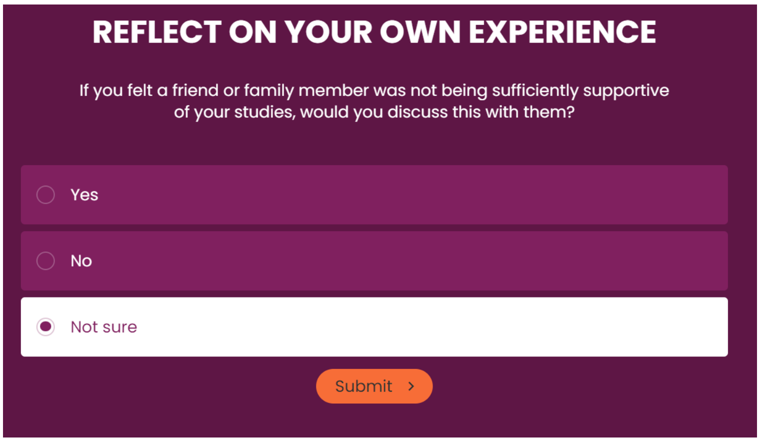
Clips From Each of the Four Segments of the Dramatization

From "At a crossroads: navigating work and/or family alongside study" by OpenLearn, The Open University, 2023 (https://www.open.edu/openlearn/crossroads). Reprinted with permission.

After each segment of the dramatization, reflective questions were presented to encourage users to consider some of the challenges experienced by Jaya in the film (Figure 2). Each segment also contained a section (labelled In their shoes) in which users were able to select a character from the scene to get further thoughts on the situation they just watched (Figure 3 and Figure 4). The aim of this design feature was to help illustrate to learners that in these types of conflicts, different people can have contrasting viewpoints. Lastly there was written text which signposted users to evidence-informed strategies and supports (Figure 5).

Figure 2

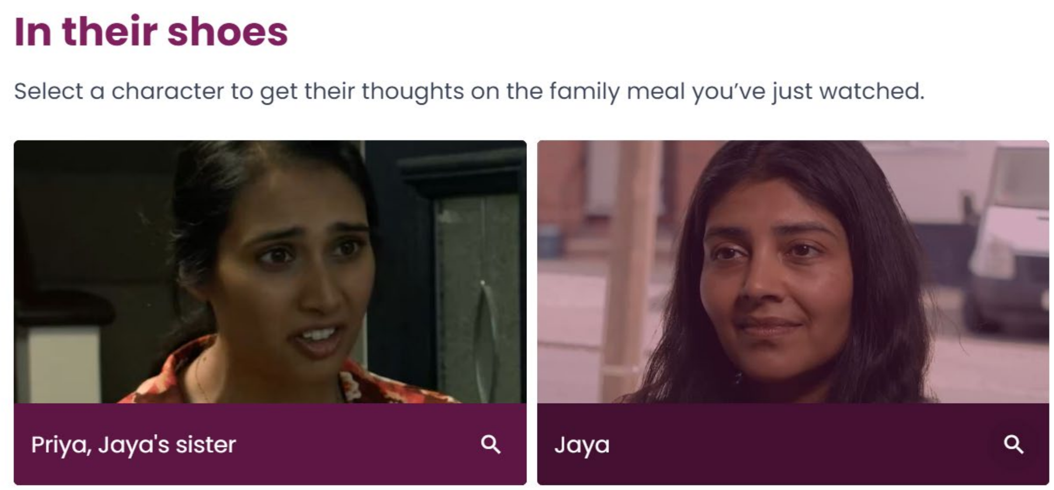
Example of an Interactive Reflective Question in the Resource



From "At a crossroads: navigating work and/or family alongside study" by OpenLearn, The Open University, 2023 (https://www.open.edu/openlearn/crossroads). Reprinted with permission.

Figure 3

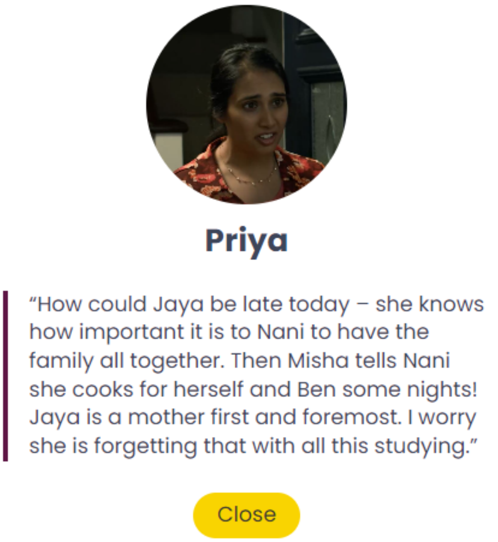
Example of the In Their Shoes Section in the Resource



From "At a crossroads: navigating work and/or family alongside study" by OpenLearn, The Open University, 2023 (https://www.open.edu/openlearn/crossroads). Reprinted with permission.

Figure 4

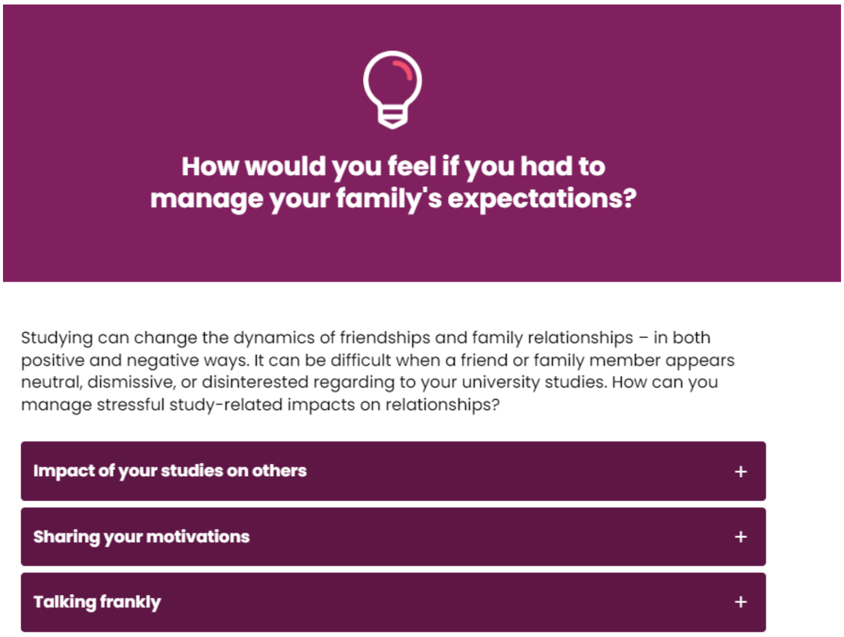
Example of Written Text About one of the In Their Shoes Characters



From "At a crossroads: navigating work and/or family alongside study" by OpenLearn, The Open University, 2023 (https://www.open.edu/openlearn/crossroads). Reprinted with permission.

Figure 5

Example of Written Text as Presented in the Resource

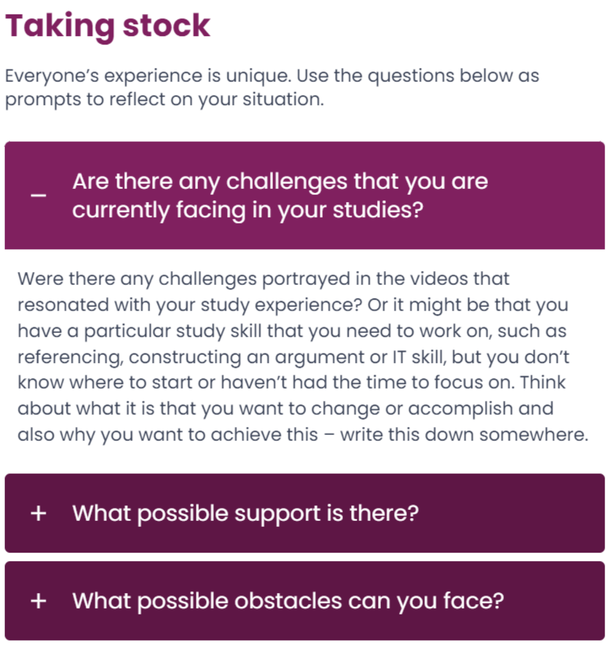


From "At a crossroads: navigating work and/or family alongside study" by OpenLearn, The Open University, 2023 (https://www.open.edu/openlearn/crossroads). Reprinted with permission.

The interactive resource ends with a section labelled Taking stock which asked users to reflect on their own experiences and encouraged them to create an action plan for their own potential role conflicts as supported by a series of prompts (Figure 6).

Figure 6

Taking Stock



From "At a crossroads: navigating work and/or family alongside study" by OpenLearn, The Open University, 2023 (https://www.open.edu/openlearn/crossroads). Adapted with permission.

The Process of Creating the Resource

Research and Consultations Underpinnings

The interactive resource was informed by previous survey-based research funded by the UK Open University PRAXIS Scholarship Innovation Centre. This work explored distance education students' (*N* = 348) experience of combining work and/or family responsibilities alongside their university studies. Quantitative analysis found that higher levels of reported perceived conflict among work, family, and study roles was associated with higher levels of reported mental distress (Waterhouse et al., 2020). One key recommendation from student participants was that universities should provide advice on how students could better navigate difficult study-related conversations (Samra et al., 2021). Respondents explained that there was frequently a need for them to negotiate with their family members regarding study time, and these conversations were sometimes challenging because they were often associated with feelings of guilt. Conversations with employers were also perceived as difficult. In this study students reported different strategies to manage their studies alongside additional commitments, for example pre-planning their annual leave, requesting flexible working arrangements, and organizing quality time with family members.

The development process was also shaped by the aims of the Positive Digital Practices project, which aimed to create research-informed and enduring digital resources that both embedded and sustained positive practices to support student mental health and well-being. As part of this project and to ensure the resource was evidence-informed, we conducted a qualitative story completion study and two consultations with students. The story completion method asked participants to describe what they anticipated or imagined would play out in a provided scenario about a character created for the purpose of the research (Braun et al., 2019). The following story and prompts, provided to participants, was designed to be relevant to the interactive resource.

> Ali has just got the results back from the most recent assignment—and they are *bad*. Ali knows they didn't study enough—too much going in their job, housework, the kids . . . and under pressure to do it all. There isn't a lot of time till the next assignment deadline. What am I going to do?
>
> Please continue the story and write about what happens. There are no limits to the scope of your story but we ask that you consider:
>
> - What you think Ali's thoughts and feelings might be.
> - How Ali decides what to do.
> - What Ali decides to do and what influences this decision.
> - The outcome or consequences of any decisions Ali makes.

Story completion is a method that has gained popularity in recent years, particularly when exploring topics relating to health and well-being (e.g., Diniz et al. 2020; Lupton, 2021; Tischner 2019). Asking participants about a hypothetical situation can be a preferable method when discussing sensitive topics such as mental well-being and study challenges where students may be hesitant to discuss their own experience. In this study, 20 students provided a story that completed this stem.

The interactive resource was also informed by consultations with and feedback provided by a student panel organised by Student Minds (a charity specialising in student mental health in the UK). Due to the under-representation of Black and Asian students in the PRAXIS funded research and in the story completion research and student panel, we conducted a further consultation with Black and Asian students at The Open University (UK). The consultations explored the experiences and perceptions of students regarding the challenges that personal circumstances can place on academic study, barriers to support, and how universities could support students experiencing these role challenges better.

In the story completion research, a main theme found in the thematic analysis of the data (Braun & Clarke, 2006) was complex, strong, and difficult emotions. In stories, the main character was described as dealing with multiple negative emotions, the most common of which were anger, frustration, or disappointment with themselves, arising from a sense that they should be doing better. The next most common feeling described was panic or fear. In some cases, this stopped Ali from being able to decide what to do about their situation. Guilt was also described in a minority of stories as complicating things, making it harder for Ali to make a decision, whilst feelings of loneliness were framed as making the situation worse. In five stories, Ali questioned why they were studying. For example, whether it was worth the investment or whether it was the right time in their lives for studying. The challenges of dealing with strong negative emotions that arise in the context of study/work/family role conflict was also raised in the consultations. Participants highlighted that there was often a lack of acknowledgement by universities of this side of the student journey, and a lack of advice that support students' with dealing with emotions connected with studying. Therefore, in creating the interactive resource we wanted experiencing, managing, and making decisions in the context of difficult negative emotions to be one of the topics of focus.

Underpinning Theory

Lazarus and Folkman's (1984) transactional model of stress, which posits stress as an outcome of the interaction between the individual and their environment, underpinned the interactive resource. Cognitive appraisal is central to this theory. Primary appraisal involves individuals evaluating a situation or environment, and if deemed stressful, secondary appraisal considers what different resources or options are available to deal with the stressor (Lazarus & Folkman, 1984). One aim of the interactive resource was to increase students' knowledge of possible different tools or strategies to deal with demands or challenges of combining their studies with work and/or family responsibilities. The 'taking stock' section at the end of the interactive resource encouraged users to apply this learning to themselves.

The interactive resource was intended to encourage not only reactive coping, but also preventative and proactive coping (Reuter & Schwarzer, 2015). It was designed for use by students who perceived they were experiencing difficulties due to current study situations. It can also act as a preventative measure to help users anticipate possible future demands or challenges that they may face as well as possible actions available to try to mitigate these. Strategies suggested by the interactive resource included direct coping to try and change the situation (e.g., problem solving, time management), affect regulation strategies (e.g., dealing with emotions that arise from the study experience), and devaluation (e.g., understanding a single low assignment mark in the context of how overall degree outcomes are calculated).

Another aim of the interactive resource was to increase users' self-efficacy (i.e., their confidence in using suggested strategies). Social learning theory (Bandura, 1977) has posited that individual self-efficacy can be influenced by vicarious experiences—people learning from observing others that are deemed to be like themselves. We, therefore, decided to use digital storytelling; evaluations have found video-based dramatizations to be a successful educational tool to bring complex topics to life (e.g., Fusco et al., 2020) and we saw this as a way of reducing psychological distance between the user and the content of the interactive. Feedback from the student panel indicated they felt emotionally connected to the characters in the dramatization, and that an outcome was that the video gave them to confidence to enact some of the different strategies highlighted in the resource.

Making the Film and the Interactive Resource

To create the resource, we drew upon institutional expertise. OpenLearn is The UK Open University's (OU) free learning platform. It has been providing free content, including a range of free courses and additional offerings, such as open educational resources with embedded dramatizations, since 2006. Prior to the COVID pandemic, OpenLearn had already received almost 13 million visitors (Law, 2023). However, interest in free learning grew exponentially during the pandemic, which further raised the profile of OpenLearn. For example, during the August 2019 to July 2020 period there were over 24 million visits to the platform. Given the extensive reach of OpenLearn and the opportunities this presented, we developed our resource collaboratively with the OpenLearn team and with the intention of it being hosted on this site. *At a crossroads* was developed in partnership with HZK Productions (for directing, filming, and editing) and Elucidat (for e-learning and technical aspects). Elucidat is a UK-based private company that specializes in commercial e-learning products and the creation of resources, using their bespoke e-learning authoring platform (Elucidat, 2023).

One challenge in making the interactive was making an individual story that could speak to a wide audience. While the stories and personal experiences shared in the consultations evidenced the range of different situations in which study/work/family role conflict is experienced, time pressures were a common theme. This led us to put together a story arc focused on Jaya struggling to complete their assignment due to time pressures. Three main sources of conflict were also identified from the research and OU consultations, namely a lack of support from (a) employers, (b) immediate family members, and (c) extended family members. These areas of conflict formed one segment each of the dramatization. The script was written by a digital media producer at The Open University (UK); filming and editing the video was undertaken by HZK Productions. The digital media producer and director were involved in discussions from inception. Key themes were discussed with them, including (a) potential variations in the level of support offered by colleagues and family members; (b) the expectations of family members and colleagues informed by gender stereotypes (e.g., family roles); (c) misconceptions and lack of understanding of university study by family and employers; (d) the importance of studying for yourself; and (e) dealing with the unexpected and the accumulative effects of demands.

Drafts of the script were reviewed, and suggested changes made by the core research team, who consisted of two academics, an associate lecturer, and student consultant. One challenge was how to end the story. The story initially ended with Jaya's daughter encouraging Jaya to explore specific sources of support, such as the student union. However, it was felt that this ending seemed contrived. We acknowledged that there was no one best ending, as students' situations can vary so dramatically, so it was decided to leave the film on a cliffhanger, with a crossroad moment where several alternative endings were summarized in text.

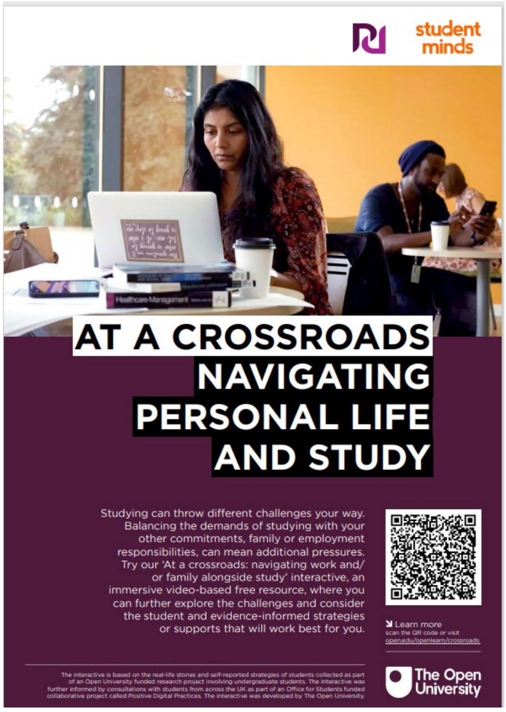
Professional actors, recruited by the director and the digital media producer, were used in the dramatization. Filming took place over two-day period at two locations—a house hired for the purpose of scenes involving the family, and several different locations at The Open University (UK) including a staff room, archive room and cafeteria space. The final film (all four segments) was 7 minutes, 16 seconds in duration.

Dissemination and Evaluation (To Date)

The interactive resource was launched on OpenLearn in February 2023 through this link. The link to *At the crossroads* can be added to student handbooks, well-being Websites, or other student-facing resources (e.g., induction materials). We have also created a student-facing poster (Figure 7) that advertises the resource.

Figure 7

At a Crossroads: Student-Facing Poster



To receive digital or hard copies of this resource, please contact the lead author (philippa.waterhouse@open.ac.uk). We are currently evaluating the resource through an online survey embedded into the end of the OER as well as semi-structured interviews. In the evaluation we are particularly interested in the longer term and personal learning of students—the extent to which students do (or do not) say that engaging with the interactive has left them feeling more confident and informed in managing study/work/family role conflicts.

Conclusion

More broadly, our experience in developing this resource has caused us to reflect on how engaging preventative resources must be part of the solution in a context in which there is significant concern around the mental health of university students. While universities are in many cases expanding their well-being and mental health offering with additional posts to meet demand, it is critical to also consider the role of on-demand interventions that are always available, easily accessed (through an Internet-enabled device), and which consist of more than static text pages. The current resource, in our view, provides one potential model.

Acknowledgements

This work has been financially supported by The Open University Faculty of Wellbeing, Education and Language Studies PRAXIS Scholarship Centre, OpenLearn and The Office for Students [grant number DMH12]. We thank Sas Amoah (Digital Media Producer, OpenLearn), Daniel Browne (Digital Content Producer, OpenLearn), Haider Zafar (Director), Kyle Andrews (student consultant) and Christine Lyle (Associate Lecturer consultant), and Dr Mathijs Lucassen and Dr Erica Borgstorm (Open Media Fellows in the Faculty of Wellbeing, Education and Language Studies, The Open University) for their contributions in making the open education resource. We thank students who took part in the research and consultations for sharing their experiences and stories, and for providing feedback on the resource.

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International **R**eview of **R**esearch in **O**pen and **D**istributed **L**earning
Volume 25, Number 1

February – 2024

Enhancing Online Teaching of Business Statistics: A Pedagogy Before Technology Approach

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Abstract

Learning statistics can be challenging for many students, due to their inability to engage in statistical reasoning and application of techniques. This challenge becomes compounded in online learning contexts where students are spatially and temporally separated from the teacher. This paper describes and explains a case of theory-driven interventions designed to enhance the learning experiences of students enrolled in two similar business statistics units, one for undergraduate and the other for postgraduate programs. The paper based its claims primarily on the analysis of data from a student evaluation of teaching survey. This study affirmed the importance of a pedagogy-first approach. It argued that the interventions, which were effective in enhancing the student learning experience, were underpinned by a robust pedagogical analysis of the teaching and learning issues using both constructive alignment and transactional distance theory lenses.

Keywords: constructive alignment, online learning, pedagogy, statistics teaching, transactional distance

Enhancing Online Teaching of Business Statistics: A Pedagogy Before Technology Approach

Business statistics is one of the fundamental subjects in business-related degrees. The purpose of this subject is to equip students with skills of analysing data in the context of business. Thus, a key goal in teaching statistics is to equip students with the ability to use data to reason appropriately and apply the right techniques in solving real-world business problems. However, learning statistics can be challenging for many students, due to their inability to engage in statistical reasoning and application of techniques (Garfield & Ben-Zvi, 2007; Selvanathan & Selvanathan 1998; Tishkovskaya & Lancaster, 2012). This challenge is compounded in online learning contexts where students are spatially and temporally separated from the teacher (Mills & Raju, 2011). This paper outlines a case which exemplified these challenges obtained and described the interventions that were employed to address them. This study based its claims primarily on the analysis of data from a student evaluation of teaching survey. The aim was to describe and explain theory-driven interventions that were designed to enhance the learning experiences of students enrolled in two similar business statistics units, one for undergraduate and the other for postgraduate programs. A key thesis of this paper was that strategic and meaningful change in teaching and learning happens when a pedagogy-first approach to technology-based learning and teaching interventions is taken. In particular, it argued for a thorough front-end pedagogical analysis of the teaching learning issues if the ensuing changes are to be sustainable and effective.

The outline of this paper is as follows: first, the institutional context is described, followed by analysis of the teaching and learning challenges. Then, the interventions are explained, followed by an evaluation of their impact. The paper concludes with discussion and general recommendations.

Context

The developmental work of this study took place within a regional Australian university with centres or campuses both within and outside the state. As a dual sector institution, it offers vocational education and training (VET) as well as higher education (HE) courses. The majority of the HE enrolments were external, meaning over 50% students studied off-campus, primarily through online delivery mode. Within the HE Faculty of Arts and Society, the business and accounting discipline has run accounting and business courses. Most courses for internally enrolled students were offered from the main campus with some students in accounting and business also enrolled in the interstate campus. There were also external students, meaning most units had these three groups of students—main campus, interstate, and external.

Across the business and accounting discipline, there were two similar foundational business statistics units, one for undergraduates (UG unit) and the other for postgraduate students (PG unit). These units provided core quantitative skills, particularly the use of data to make business decisions, to first-year students as well as non-cognate postgraduate students in business and accounting, respectively. Consequently, the units were usually taken by a high number of students across the two campuses and the off-campus cohort.

Over the years these units have been taught by different lecturers, some of them sessional staff, with a high turnover. Consequently, there had not been any major revisions and there were issues related to teaching and learning. The second author had lectured in these units since 2018, while the first author was an education developer familiar with previous issues related to the teaching and learning of these units and other units with quantitative content across the university. These challenges had manifested themselves through poor student performance and satisfaction as well as staff frustration. In the end of the semester unit evaluation survey, students revealed a substantially lower satisfaction towards the structure of the unit, the appropriateness of the assessment activities in relation to the unit learning outcomes, and the unit's ability to meet students' expectations (see Table 1 for further information). Consequently, the overall unit performance, in terms of the student satisfaction, raised serious concerns (see Figure 5).

The Problem

As outlined above, the nature of the business statistics units and their learning and teaching context had posed a set of pedagogical challenges to the lecturers who taught them, and dissatisfaction to some students. In this section, to gain a more nuanced understanding, these challenges are problematised by way of a theoretical analyses based on constructive alignment model and transactional distance theory.

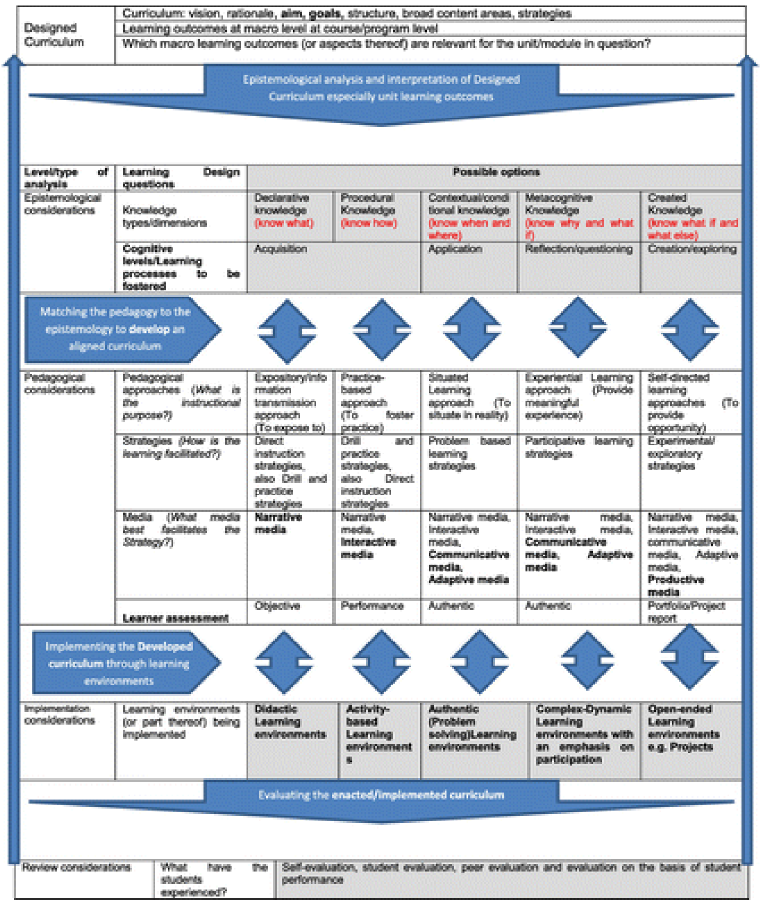
Constructive Alignment Issues

Appropriately designed curriculum is central to effective teaching and learning in any unit of study. The outcomes-based education approach, which the Australian system follows, uses constructive alignment, which refers to the deliberate alignment of intended learning outcomes (ILOs), teaching and learning activities (TLAs), and assessment tasks (ATs) to help learners construct meaning. This approach, key to effectiveness, is intended to ensure that learners engage with TLAs that optimise their chances of achieving the intended learning outcomes, demonstrable through appropriate assessment (Biggs, 2003, 2011).

The starting point to ensuring constructive alignment is to have clear and observable ILOs, as these define the curriculum for a particular unit of study. The TLAs and assessment, on the other hand, reflect the pedagogy employed to facilitate students' achievement of the ILOs. Boitshwarelo and Vemuri (2017) argued for a closer curriculum-pedagogy connection, pointing out that the way the curriculum is designed can limit or aid good pedagogy. Using their curriculum-pedagogy alignment framework, they argued that learning outcomes represented different knowledge types, and that effectiveness was achieved when the attendant pedagogical approaches, strategies, and assessment types were closely aligned. Figure 1 presents this framework (Boitshwarelo & Vemuri 2017).

Figure 1

Curriculum-Pedagogy Alignment Framework



From "Conceptualizing strategic alignment between curriculum and pedagogy through a learning design framework," by B. Boitshwarelo, & R. Vemuri, 2017, *International Journal for Academic Development*, *22*(4), p. 285 Copyright [2017] by Taylor & Francis Group. Reprinted with permission.

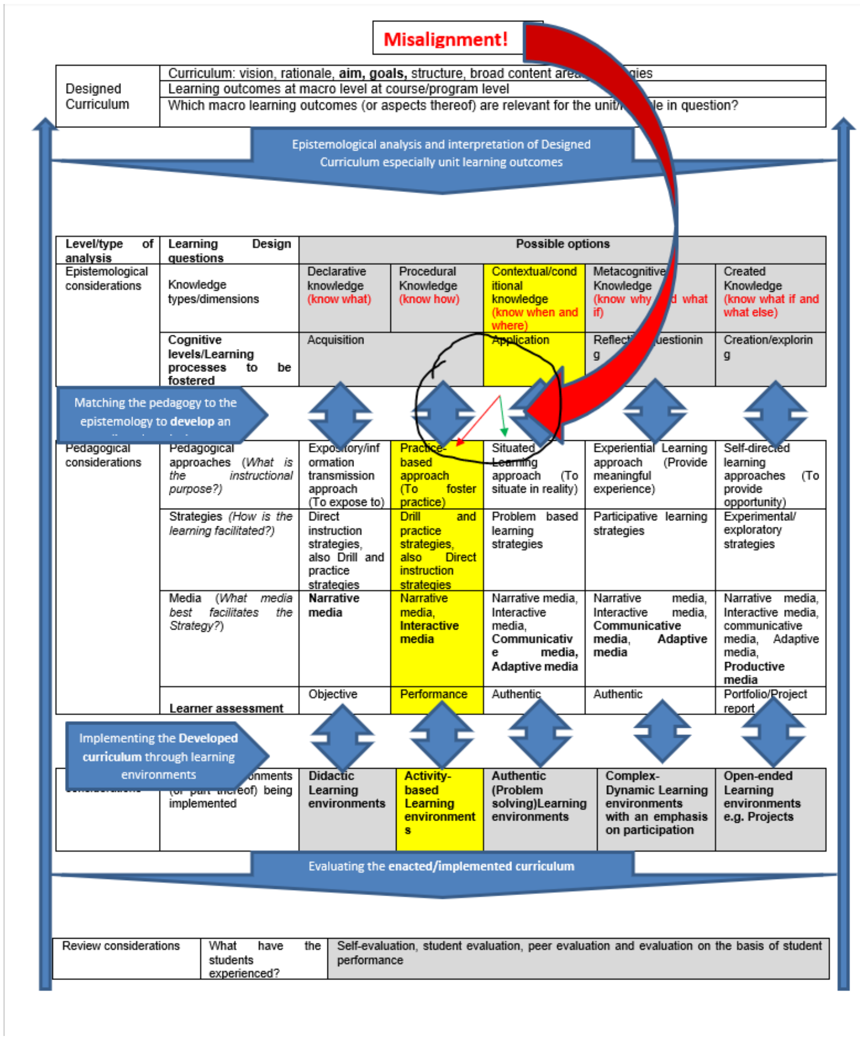
In the case of the units in question, while the ILOs were deemed appropriate for their respective levels and contents, it was the view of the lecturer and previous students' feedback that assessment did not adequately align with the key learning outcomes related to application of statistical concepts. In particular, the ILO, 'to identify, discuss, and apply quantitative and qualitative tools and methods commonly used in decision making in private and public sector organisations,' required that, among other things, students develop procedural and contextualised knowledge. This, in turn, required practice-based and situated learning (problem-based) TLAs respectively and creative use of narrative media or, even more suitably, interactive and/or adaptive forms (refer to Figure 1). However, in contrast, there was a lack of opportunity for students to apply their understanding of statistical concepts. This could partly be because of the fact that the assessment tasks did not require such engagement with the material. Therefore, while the TLAs, perhaps, aligned with the documented assessment specifications, the actual assessment task did not help students to achieve this particular ILO, meaning some of the curriculum expectations were not adequately met.

Feedback from the students' evaluation of teaching survey revealed that they felt that the assignment was poorly structured, and it was more suitable for a closed book exam than for a problem-solving assignment. They further stated that the assignment questions did not prompt students to practically apply statistical theories to solve real-world problems. Consequently, students did not receive the training they should have in order to increase their employability in the current labour market that called for hands-on experience with analysing data.

In general, good practice in teaching statistics is to teach theoretical concepts and procedures as well as let students analyse real-world data using data analysis software and interpret results. However, this aspect was lacking in the unit and, in particular, no data analysis software was incorporated in teaching the two units. The qualitative feedback from students clearly indicated that they would like to learn how to solve business-related problems and how to use statistical software/programs to gain hands-on data analysis experience. After an analysis of the learning outcomes, unit content, previous actual assessment tasks, and student evaluation reports of previous offerings, it was realised that the unit did not adequately facilitate the learning of appropriate statistical reasoning. It also lacked application-based opportunities to solve real-world business problems. The predominant pedagogical approaches used in this unit were either expository or practice-based which did not do full justice to the contextual knowledge intentions. Similarly, the assessment was largely of an objective and/or performance nature and not authentic as expected of contextualised knowledge. As illustrated in Figure 2 through the annotation, the challenge was to bring that into alignment.

Figure 2

Constructive Misalignment and Realignment



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Transactional Distance Issues

As described earlier in the Context section, there were a significant number of students who studied externally, primarily online, and traditionally known as distance education students. The idea of transactional distance has been used in distance education to describe the psychological or communication gap that separates the teacher and the learner (Moore, 1991; Moore & Kearsley, 1996). A student, separated by physical distance from their education provider and/or teacher, experiences a bigger transactional distance, necessitating the use of strategies to bridge or reduce that gap.

The key concepts in transactional distance theory are dialogue, structure, and autonomy (Moore, 1991; Moore 1993; Moore and Kearsley, 1996). Dialogue primarily refers to the interaction between a learner and their teacher during a learning experience, whether synchronous or asynchronous. Other interactions are also important such as with other learners (Quong et al., 2018); Structure describes the rigidity or flexibility of the learning environment design in terms of such elements as the learning outcomes, learning activities, interactions, and assessments. Some learning environments are more democratic and others more prescriptive in nature (e.g., with a defined path or a tightly controlled sequence of learning events). The third element, autonomy, refers to the level of self-directedness or independence a student has in controlling their learning.

Moore and Kearsley (1996) submitted that more dialogue in a distance learning environment reduces transactional distance. However, if an environment is highly structured at the expense of dialogue, then transactional distance may increase, depending on the nature of the content and learning outcomes. High structure and low dialogue necessitate high learner autonomy due to lessened communication and a more prescribed learning experience. As a general principle, it seems, blending highly structured learning environments with increased dialogue reduces transactional distance (Benson & Samarawickrema, 2009). However, this is all dependent on the nature of the learning outcomes, the content, and the characteristics of the learner amongst other things (Moore, 2004) with some subject matter by their very nature requiring greater dialogue than others.

In the case of these units, which required the use of problem-solving procedures, the structure of the learning experiences was of key importance. A key deficiency in the unit resources was the absence of opportunity for students to experience the demonstration of statistical procedures and techniques in an engaging and interactive way; most of the materials were presented in a static text-format, such as PowerPoint slides that described the problem and presented a complete solution already worked out. This appeared to be a critical issue among external students. For example, in the qualitative feedback of the student evaluation survey, students noted their dissatisfaction about not clearly demonstrating the steps involved in solving problems, and as a result, how they relied more on YouTube videos than on their recorded lectures. The lecturers in the discipline were unable to record step-by-step demonstrations mainly because the classroom-based Camtasia technology at the university did not allow for recording any external writing, such as on a whiteboard. Therefore, the external students who listened to lecture recordings could not see the extra explanations the lecturer provided on the whiteboard. This matter had been raised by a number of students in their feedback and they expressed their frustration and dissatisfaction over this matter. External students were concerned that they were not receiving the same level of resources as were face-to-face students. Thus, the perceived lack of structure, particularly by external students, widened the transactional distance.

The Interventions and Related Outcomes

To address the pedagogical issues outlined above, appropriate learning design and technological interventions were done. The interventions had a two-fold purpose.

1. To improve constructive alignment through:

    - introducing an application-based approach teaching and learning approach, using EXCEL for statistical problem solving and decision making

- improving assessment items and aligning them with the contextualised knowledge of the relevant learning outcomes as well as with application-based, problem-solving learning activities, and thus ensuring that there is assessment, for and of, applied skills

2. To bridge the transactional distance through developing and making available step-by-step demonstration of quantitative problem-solving procedures.

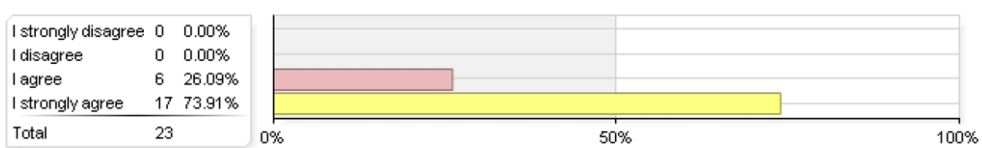
These initiatives are detailed below explaining how they enhanced student engagement and learning of statistics. To evaluate the impact of the interventions, customised student evaluation of teaching survey questions were developed in addition to the regular ones.

Introducing an Application-Based Approach

Past student feedback revealed that the way the units were taught did not provide any applications-based training to enhance students' employability skills. Taking this feedback into consideration, when the units were redeveloped by the second author, she introduced an applications-based approach, and incorporated Excel as a teaching tool. The attraction of Excel is that it did not require licence arrangements for students and, most importantly, was available at every workplace. The problems set for Excel applications were expected to provide students with hands-on experience in analysing real-world datasets and using statistical skills required in the future at their workplace to solve business problems and for decision making. The introduction of Excel was well received by students and their qualitative feedback indicated that they found Excel-based activities useful in enhancing their data analysis skills (Figure 3).

Figure 3

The Excel Activities Were Useful to Gain Data Analysis Skills



Improving Assessment Tasks

The structure of the written assignment was revised so that students were required to analyse a real-world dataset using Excel data analysis tools introduced in the unit. While estimating results for the analysis required the students to use the Excel knowledge they gained from the unit, writing up the findings required them to interpret the results using the statistical techniques they learned. To develop students' interest and sense of necessity in learning Excel data analysis skills, Excel activities were integrated through homework problems and later into assessment tasks. In this way, students gained hands-on experience in both theoretical knowledge and application of statistical concepts. By way of promoting constructive alignment (Biggs & Tang, 2011), a question focusing on the interpretation of Excel generated results was also included in the final examination.

Step-By-Step Demonstration of Problem-Solving Procedures

The need to demonstrate procedures for external students was two-fold: first, to actually demonstrate the problem-solving procedures for students, and second, to use Excel for analysis.

Demonstrating the step-by-step approach to solve statistical problems to face-to-face students was not an issue, as they could easily follow synchronously in class, and even ask questions. However, the key challenge related to reducing the transactional distance and providing equivalent and/or similar learning experience for external students. Recording demonstration lectures was the obvious solution, which has been done elsewhere. However, solutions that are common elsewhere (e.g., 360 Lecture Capture or using SurfacePro notebooks) were not plausible due to a lack of funding. The authors explored other options possible with the existing technology to create demonstration lectures and so allow the external students to enjoy a learning experience similar to that of the face-to-face students.

The solution was to record the lecture using the Blackboard Ultra Collaborate platform in a Collaborate-enabled lecture room. In this environment, a smart pen was used to write on the whiteboard, which was then captured by the projector and displayed as a live annotation to students. This approach had not been used before at the university; some experimenting and setting equipment was necessary to make it work. Students followed the lecture as the procedures were demonstrated either synchronously or through recordings. In addition to lectures, weekly online tutorials were conducted using this same method. Feedback from one external student, who previously attended face-to-face sessions whenever she could, revealed that for the first time, she felt that external students received the same resources as face-to-face students. This improvement was further evident in feedback from a student who withdrew from the UG unit in 2017 and re-enrolled in 2018.

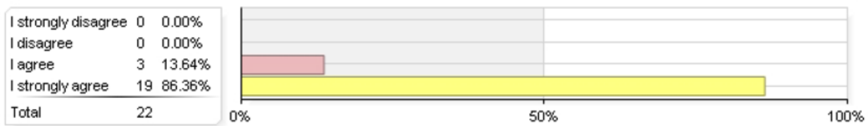
> I would like to say that I am very happy with the UG unit this year. The recordings in the learning area for each week were VERY HELPFUL. The lecturer who recorded these sessions explained the concepts in a way that really helped me understand. When I had attempted to take this unit before I dropped out before census date because I had such difficulties with the learning materials. Very, very happy with the unit this time around.

Additionally, face-to-face students, particularly those with non-English speaking background, revealed that these recordings provided a valuable reference if they could not grasp some content during the lecture. As evident from student feedback in Figure 4, students regarded the new form of lecture recordings as big step forward in their learning experience.

Similarly, the application-based approach using Excel to teach face-to-face students was not challenging as they can always approach the lecturer for help. However, once again the challenge was to enhance the consistency of the Excel training across all campuses and external students. The solution to this problem was to record Excel videos and upload them into learning management system as part of the learning materials.

Figure 4

Weekly Recordings with Annotated Notes Helped Me Understand Statistical Procedures



Concomitant with creating the demonstration videos was improving the overall organisation of the unit, which had been a concern. Doing so improved student satisfaction. As can be seen in Tables 1 and 2, before introducing the changes, (i.e., in 2016 and 2017) the student evaluation of teaching survey question "this unit was well organized" was significantly low, particularly for both units. In fact, until 2017, the unit rating for this question was noticeably lower than that of the average university rating for the same question.

The interventions described above have led to sustainable impact over a number of offerings of the two units, across campuses, with different lecturers, and for both internally and externally enrolled students. Table 1 shows improvements across three evaluation items for both the UG and PG unit, even exceeding the institutional average, particularly for the PG unit. The high performance of the two units was sustained even during COVID-19 period.

Table 1

Change in Unit Performance After Applying the Changes (Out of Four)

Part A: UG unit							
Evaluation question		Before applying changes			After applying changes		
		2016-S1-EXT	2017-S1-EXT	2017-S1-SYD	2018-S1-EXT	2018-SS-EXT	2021-S1 (online due to COVID)
This unit met my expectations as influenced by the unit information	University	3.16 (0.51)	3.19 (0.58)	3.19 (0.52)	3.18 (0.47)	3.20 (0.51)	3.18 (0.54)
	UG unit	3.00 (0.53)	2.50 (0.49)	2.89 (0.67)	3.70 (0.48)	3.40 (0.49)	3.58 (0.47)
This unit was well structured	University	3.15 (0.52)	3.19 (0.552)	3.19 (0.51)	3.17 (0.49)	3.20 (0.50)	3.18 (0.50)
	UG unit	2.60 (0.51)	1.75 (0.62)	3.00 (0.55)	3.60 (0.43)	3.33 (0.48)	3.53 (0.51)
The assessment activities were appropriate for the unit's learning outcomes	University	3.22 (0.51)	3.24 (0.54)	3.24 (0.63)	3.22 (0.52)	3.28 (0.47)	3.17 (0.55)
	UG unit	2.60 (0.53)	1.75 (0.52)	3.22 (0.61)	3.70 (0.50)	3.83 (0.51)	3.63 (0.53)

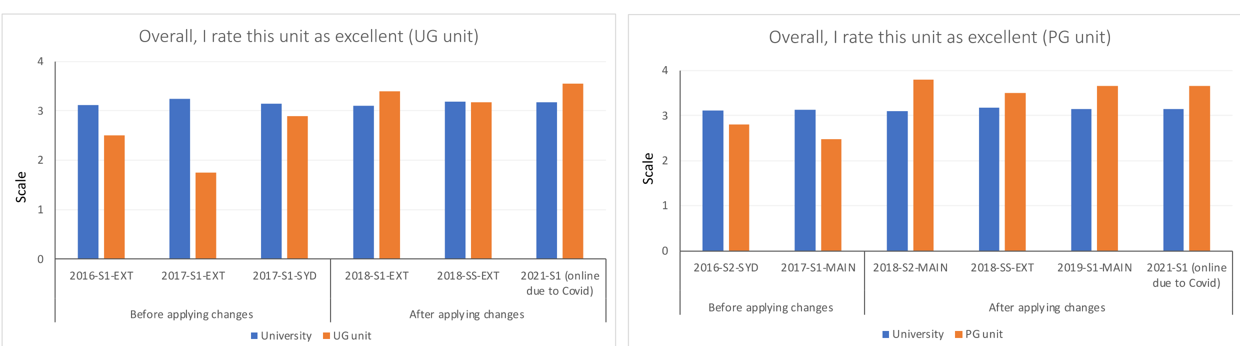
Part B: PG unit							
Evaluation question		Before applying changes		After applying changes			
		2016-S2-SYD	2017-S1-MAIN	2018-S2-MAIN	2018-SS-EXT	2019-S1-MAIN	2021-S1 (online due to Covid)
This unit met my expectations as influenced by the unit information	University	3.16 (0.61)	3.18 (0.59)	3.18 (0.49)	3.20 (0.55)	3.2 (0.48)	3.18 (0.47)
	PG unit	2.90 (0.51)	2.38 (0.53)	3.63 (0.51)	3.50 (0.56)	3.49 (0.52)	3.54 (0.51)
This unit was well structured	University	3.15 (0.48)	3.18 (0.55)	3.17 (0.55)	3.20 (0.48)	3.19 (0.45)	3.18 (0.48)
	PG unit	2.70 (0.51)	2.57 (0.54)	3.63 (0.54)	3.50 (0.40)	3.65 (0.48)	3.66 (0.43)
The assessment activities were appropriate for the unit's learning outcomes	University	3.22 (0.53)	3.24 (0.52)	3.22 (0.63)	3.18 (0.51)	3.15 (0.55)	3.22 (0.52)
	PG unit	2.80 (0.51)	2.90 (0.55)	3.70 (0.50)	4.00 (0.49)	3.65 (0.56)	3.66 (0.51)

Note. For comparison, 2019 and 2021 ratings (which were out of 7) were converted to align with prior ratings out of 4. SS refers to the summer semester. Standard deviations are given in parenthesis.

Similarly, Figure 5 shows that overall student satisfaction improved significantly as a result of the interventions.

Figure 5

Overall Performance of Units After Applying Interventions



Discussion and Conclusions

This paper has given an account of learning design and technological intervention into business statistics units at a regional university in Australia, with a mix of face-to-face and externally enrolled students. This intervention responded to the epistemological nature of the units, and their requirement to facilitate procedural and contextualised knowledge. The intervention, which has been effective in enhancing the student learning experience, was underpinned by a robust pedagogical analysis of teaching and learning issues. The pedagogical diagnosis revealed constructive alignment issues as well as transactional distance challenges. Thus, while the interventions were largely technological, the underpinning intention was, first, to refine the constructive alignment among ILOs, TLAs, and assessment especially as it related to applying business statistics methods and techniques to solve authentic problems. A second intention was to reduce the transactional distance by improving the structure and dialogue of the units through recording a series of demonstrational videos and improving the units' overall organisation.

The technological interventions were not novel, however we believe they were fit for purpose as they were a result of a strategic approach that took a pedagogy-first strategy. We propose therefore that learning and teaching issues are often complex and a technology-first approach to solving such problems is seldom efficient as it tends to find or manufacture problems that fit the vendor-driven technology solutions. From a curriculum perspective, the constructive alignment lens enhanced effectiveness by helping realign curriculum intentions and pedagogical actions (Boitshwarelo & Vemuri, 2017). It was apparent that refining the alignment of assessment with the intended learning outcomes also necessitated changes in the teaching and learning approach, and consequently the technologies used and how.

Good constructive alignment ensures a robust curriculum-pedagogy connection which in turn needs robust learning environments to mediate effective learning. For online distance students, the learning environment must effectively bridge the transactional distance. What is to be learned, and who are the learners (and their level of autonomy) determines the nature and extent of structure of the learning environment and the level of dialogue. In the case of these statistics units, the external students were of particular interest and needed to learn statistical procedures and develop skills in application-based problem solving thus requiring some structured learning in the form of well sequenced demonstrational videos. Rather serendipitously, this intervention became highly efficacious with the onset of COVID-19 shutdowns in March 2020 when internally enrolled students also had to study externally (online).

While these conclusions are based on a specific case and based almost solely on student evaluation of teaching data, the principles of pedagogy-based learning design and interventions are universally applicable and have been illustrated through this case. Constructive alignment and transactional distance theory are just examples of the frameworks to analyse learning problems and were perhaps the most suitable in this context.

Acknowledgements

The authors wish to acknowledge funds received under the COVID-19 Supplementary Funding Pool Scheme (CSFPS) from Charles Darwin University to undertake this research.

This paper was endorsed by the Institutional Chair of the Ethics Committee as low risk and appropriate as an evaluation or practice piece rather than a fully-fledged report on research on humans, hence its publication in the *Field Notes section*.

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