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Research Article:

Sustainable Online Education for Higher Education Institutions: A Systematic Literature Review

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ABSTRACT

This systematic review article analysed and evaluated the current literature on sustainable educational technology in higher-education institutions (HEI). University stakeholders aspire to have any educational technologies employed be sustainable beyond short-term solutions. Identifying these sustainable factors requires reviews of recent studies, particularly with the insightful experience of the recent pandemic. Unfortunately, systematic reviews on sustainability were few and focused more on specific modalities. Hence, this present study reviewed past studies (published between 2015 and 2021) to identify the types of educational technology or modality being studied on the aspects of sustainability, the topic of interests that contribute to the challenges in online learning, and the themes and subthemes that are critical to the sustainable use of online education. Guided by the preferred reporting items for systematic reviews and meta-analyses (PRISMA) to review five journal databases (Scopus, ProQuest, Web of Science (WoS), Emerald and Google Scholar), 44 articles were analysed systematically. Four themes emerged from the analysis: technology related, teaching and learning, ethical aspects, and instructional support, as well as 12 subthemes. A conceptual framework was proposed, and other recommendations were discussed at the end of the paper for future research.

Keywords: Sustainability, online education, online learning, educational technology, higher education

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INTRODUCTION

"Sustainability" has become a common reference in many fields, especially in technology and the education sector, as much has been invested in digitising learning because of the recent COVID-19 pandemic. The "arrival" of COVID-19 has become the global catalyst for educational institutions to search for innovative solutions in a relatively short time (Tam & El-Azar, 2020). Although most of these solutions might have initially been involuntary as a direct response to the shutdown of institutions, the education system is bound to witness a cascading fundamental shift in how teaching and learning are conducted (Luthra & Mackenzie, 2020). Many universities across the globe are compelled to adapt to the available technologies to continue their daily operations. This sudden change and the reliance on technology are perceived to be opportunities for innovations in delivering lessons to learners. Higher-learning institutions had resorted to remote learning and online learning to sustain their teaching and learning activities (Sangster et al., 2020; Toquero, 2020; Zancajo et al., 2022), and this led to pressing needs for a fast improvement in digital learning. In an ad hoc meeting between UNESCO and education ministers of different countries during the onset of the pandemic, it was suggested that more progress had been made with digital learning in the past 10 days than in the past 10 years (UNESCO, 2020). During times of crisis such as the pandemic, education systems around the world need to be well equipped to improve their resilience in providing "quality education" (Portillo et al., 2020) as stipulated in the United Nation's Sustainable Development Goal 4 (SDG4). Overlooking the SDG4 will have an impact on academic performance because of a lack of inclusive and equitable education (Faura-Martínez et al., 2022). Universities are still lacking in terms of equipping their educators with the needed digital competencies, particularly in solving ICT problems and using Web 2.0 tools (Basilotta-Gómez-Pablos et al., 2022), and this lack of information on the adoptions of pedagogical approaches and principles could lead to fewer quality assurance activities in universities (Crawford et al., 2020).

The term "sustainability" was defined in 1987 by the UN Brundtland Commission which explains "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Håland, 1999, p. 48). When relating it to the practice of educational technology, scholars defined it as "policies and practices that allows for online learning to be financially sustainable" (Meyer et al., 2007), "normative practice of e-learning that meets the present needs and adapt to future needs" (Robertson, 2008), and "practices that promote lifelong changes and consistent efficacies in online learning" (Stepanyan et al., 2013). Based on these definitions, it can be implied that sustainability of online learning addresses the "practice and policies that capture the immediate and future needs of online learners and being consistent in its effectiveness while adapting to the rapid development of technologies in education". Thus, identifying and meeting these "needs" would help in sustaining effective online learning in higher education. Equity needs such as accessibility of technology, digital skills and online pedagogical skills were found to be the main concern during the pandemic (Tate & Warschauer, 2022). Not meeting these needs will have an impact on the quality of education as enshrined in SDG4 (Economic and Social Commission for Asia and the Pacific [ESCAP], 2019). The low level of readiness when higher education had to shift to fully online has led to the birth of "Panicgogy" (Spinks et al., 2023), a term first used to describe pedagogical approach used in time of

panic, specifically during COVID-19 (Baker, 2020). Identifying these online learning needs would help higher education to be ready for any possibility, i.e., pandemic that can help sustain teaching practices without relying to such approach.

Thus, a review study on the dimensions of sustainable online learning would be valuable, particularly when COVID-19 brought about a lot of studies on the experiences of online learning during the crisis. A systematic literature review (SLR) can be used to facilitate researchers and practitioners in understanding and influencing the overall practice and status of higher-education research (Bearman et al., 2012). According to Fink (2019, p.3), SLR is a "systematic, explicit, comprehensive, and reproducible method for identifying, evaluating, and synthesising the existing body of completed and recorded work produced by researchers, scholars, and practitioners". An SLR can be a helpful tool in informing policy and supporting practice (Petticrew & Roberts, 2008).

A quick search on the EBSCOHost database using the keyword phrase "sustainable online education" drew 71,591 articles. Of that number, only 17 SLR articles were related to education, covering mobile learning/devices, massive open online courses (MOOCs), social network analysis, blended learning, emerging technologies, factor specifics such as pedagogical beliefs, sociological perspectives, educator competencies, the definition of sustainability, and good teaching practices (see Table 1).

Table 1. SLR articles related to sustainable online education extracted from EBSCOHost

Author	Article
Alharthi et al. (2019)	Sustainability requirements for e-learning systems: A systematic literature review and analysis
Alonso-García et al. (2019)	Systematic review of good teaching practices with ICT in Spanish Higher Education: Trends and challenges for sustainability
Bhanot et al. (2019)	Sustainable scenario: A systematic review of definitions of sustainability and agenda for future research
Bozkurt et al. (2017)	Trends and patterns in massive open online courses: Review and content analysis of research on MOOCs (2008–2015)
Cechetti et al. (2017)	Gamification strategies for mobile device applications: A systematic review
Corres et al. (2020)	Educator competences in sustainability education: A systematic review of frameworks
Dexter and Dornan (2010)	Technology-enhanced learning: Appraising the evidence
Jan et al. (2019)	Social network analysis and learning communities in higher education online learning: A systematic literature review
Lambert (2020)	Do MOOCs contribute to student equity and social inclusion? A systematic review 2014–18
Lee et al. (2020)	A sociological view on designing a sustainable online community for K–12 teachers: A systematic review
Muljana and Luo (2019)	Factors contributing to student retention in online learning and recommended strategies for improvement: A systematic literature review
Khan, Qureshi, et al.	A systematic literature review paper on online medical mobile applications in Malaysia

(Continued on next page)

Table 1. (*Continued*)

Author	Article
Philipsen et al. (2019)	Improving teacher professional development for online and blended learning: A systematic meta-aggregative review
Qureshi et al. (2020)	A systematic review of past decade of mobile learning: What we learned and where to go
Sosa et al. (2017)	Emerging technologies (ETs) in education: A systematic review of the literature published between 2006 and 2016
Tondeur et al. (2017)	Understanding the relationship between teachers' pedagogical beliefs and technology use in education: A systematic review of qualitative evidence
Valverde-Berrocoso et al. (2020)	Trends in educational research about e-learning: A systematic literature review (2009–2018)

While a considerable number of SLR has been conducted on a specific area of online learning as exemplified in Table 1, reviews encompassing the broader lexicons of online learning were limited. A general view of SLR on sustainable online learning was conducted by Valverde-Berrocoso et al. (2020) on the trends during 2009–2018 focusing mainly on identifying the main study themes such as the most frequently researched e-learning modalities, theoretical frameworks, and methodologies over the past 10 years. Another SLR by Alharthi et al. (2019) emphasised sustainability meta-requirements during 2005–2017 specifically on e-learning and software engineering systems.

The present paper seeks to comprehensively examine existing literature by adopting a systematic literature review to bridge the gap by assessing the rising interest and body of evidence on sustaining effective and quality online learning. The present review is necessary because of the limited research on the sustainable use of technologies that could identify emerging and future elements linked to sustainable online learning. Thus, using a systematic literature review in evaluating studies between 2015 and 2021, the objective of the study is to identify (1) the types of educational technology or modality being studied on the aspects of sustainability, (2) the topic of interests that contribute to the challenges in online learning, and (3) the various themes and subthemes that are critical to the sustainable use of online education.

METHODS

PRISMA Review Protocol

This study was guided by the latest PRISMA review protocol (Page et al., 2021) to aid the reporting of the review. Preferred reporting items for systematic reviews and meta-analysis (PRISMA) provides an evidence-based guide consisting of a checklist and flowchart intended to be used as tools for authors seeking to write SLR (Moher et al., 2009). Although created to review randomised trials, PRISMA broadly applies to myriad research types. Its checklist items apply to reports of systematic reviews evaluating other interventions such as social or educational (Page et al., 2021). PRISMA has gained acceptance in the field of research because a recent study on earlier systematic reviews has shown that PRISMA was the most popular source of external guidelines for social sciences (Chapman, 2021).

The systematic review used various well-known databases and conducted advanced and manual searching efforts on established sources, namely Scopus, ProQuest, Web of Science (WoS), Emerald and Google Scholar, because of their robustness, reliability and coverage of various studies. Studies have found that Google Scholar's multidisciplinary database coverage outperformed those of WoS and Scopus (Gusenbauer, 2019) and recommended that Google Scholar to be used in combination with other controlled databases (Giustini & Boulos, 2013) in certain areas, such as arts and humanities and engineering (Halevi et al., 2017), as it makes for a powerful addition to other traditional methods (Haddaway et al., 2015). Google Scholar also provided a way for researchers to find articles free of charge—compared to others, which were behind paywalls (Shariff et al., 2013). In specific databases where advanced searching was available, the author combined keywords in the advanced search process by using the phrase searching function, phrase matching and Boolean operators.

Identification

In the identification stage, keywords related to the study were identified on the basis of related terms, similar terms, and previous research to select relevant articles. The base search string used in this review was "online education" and "sustainable". The first stage of keyword searching using the selected databases resulted in 1,101 articles. Summary of the search strings used, and other methods are described in Appendix A.

Screening

At the screening stage, 1,101 articles were screened at face value (title and abstract), and the total number of articles was reduced to 688. Inaccessible documents (behind paywalls), environmental studies, and studies in the K–12 context were excluded. Only articles with empirical studies were selected, and grey literature such as book chapters, review articles, proceedings and editorial letters were also excluded. Linares-Espinós et al. (2018) emphasised the importance of choosing publications in languages that the author can understand, as reading articles written in other languages may lead to further misunderstandings. Articles published between 2015 and 2021 were selected. Furthermore, any duplications were removed. Some articles were found to be related to Education on Sustainable Development (ESD) rather than sustainable education, thus ESD was also added as one of the exclusion criteria. Subsequently, the articles' contents were further screened, particularly to make sure the articles focused on sustainability in online learning rather than ESD. The intended criteria were based on the inclusion and exclusion criteria outlined in Table 2. This reduced the articles to 58.

Table 2. Inclusion and exclusion criteria

Criteria	Inclusion	Exclusion
Title or topic or research	Sustainability of online education or sustainability of any online mode of teaching	Not related to teaching and learning process, non-edtech related, curriculum or pedagogy on education on sustainable development (ESD), environmental study

(Continued on next page)

Table 2. (*Continued*)

Criteria	Inclusion	Exclusion
Date of published articles	2015–2021	Before 2015
Language	English articles	Non-English articles
Type of publication	Article journals; peer-reviewed	Review, report, commentary, proceedings, conference paper, conceptual paper, book chapter, editorial letter, not peer-reviewed
Type of study	Empirical cross-sectional study (quantitative, qualitative, mixed method)	Nonempirical study
Population of study (context)	Higher-learning institutions or colleges	Nontertiary education, primary school, secondary school, K–12

Eligibility

In the eligibility stage, the remaining 58 articles were independently evaluated by three reviewers, concentrating on the main findings. According to Petticrew and Roberts (2008), reviewers should qualitatively evaluate the articles by classifying them according to low, moderate, or high quality. Only articles of high or moderate quality are included. Using the mixed-method appraisal tool (MMAT 2018) for both quantitative and mixed-method research and the critical appraisal skills programme (CASP) for qualitative investigations, each article was categorised into three types of study (quantitative, qualitative and mixed method) and appraised by the reviewers on seven criteria based on CASP or MMAT 2018. Shaffril et al. (2021) posited that in quality assessment, emphasis should be placed on searching for articles that would suit the purpose or objectives of the review rather than seeking perfect articles. Utilising appraisal tools with specific criteria allows for more consistency in what are being assessed, as Potter and Levine-Donnerstein (1999) assert the needs for multiple coders to share the mental schema in order to achieve consistency and accuracy of coding. Using an open-source statistical tool JASP and cloud-based statistical tool rBiostatistics, the interrater reliability was calculated for both Fleiss' Kappa and Krippendorf's Alpha and returned a value of 0.516 and 0.703, respectively. According to Landis and Koch (1977), Fleiss' kappa value of between 0.41 and 0.60 is considered as moderate agreement. While Krippendorff (2018) suggests that the minimum conceivable value of alpha is 0.67, with a value of between 0.66 and 0.80 falls under tentatively acceptable agreement. Light (1971) suggests computing kappa for all coder pairs, then using the arithmetic mean of these estimates to provide an overall index of agreement. Weighted kappa (Cohen, 1968) allows researchers to differentially penalise disagreements based on the magnitude of the disagreement, and typically used for categorical data with an ordinal structure, i.e., rating system that categorise high, medium or low. Cohen's weighted kappa was calculated using JASP and returned value of average kappa is 0.651, which according to Landis and Koch (1977) falls under "substantial agreement" (a value of between 0.31 and 0.80).

Since the value of interrater reliability does not reach excellent agreement, we believe the initial use of appraisal tool such as CASP and MMAT helped in providing an added

reliability and confidence. It is known that kappa statistics might behave inconsistently (kappa paradox) in case of strong agreement between raters (Benomar et al., 2023; Giardiello et al., 2023; Jimenez & Zepeda, 2020; Minozzi et al., 2022), thus reviewers took the opportunity to discuss and address any disagreement on the final selection of articles before proceeding with the review. Based on the appraisal, 44 papers were satisfied to be included in the review. The summary of selected articles is described in Appendix B. The flow of the PRISMA protocol is depicted in Figure 1.

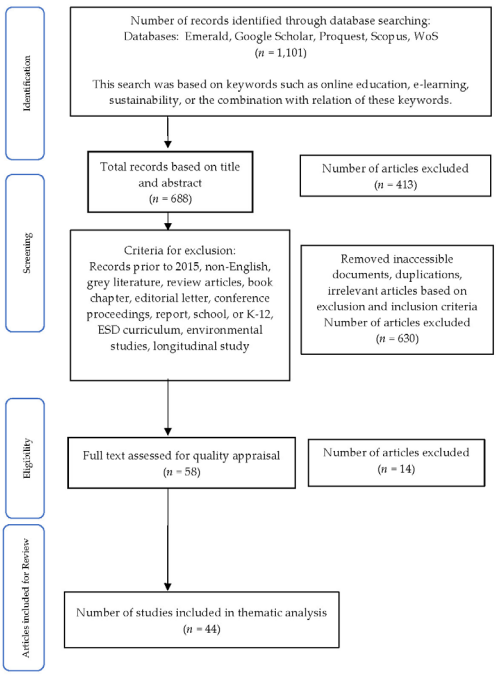

Figure 1. Flow diagram of the study (adapted from Page et al., 2021)

Data Abstraction and Analysis

A thematic analysis was conducted to develop the relevant themes and subthemes, guided by Braun and Clarke's framework of thematic analysis. Without basing the themes on any specific theories prior to the analysis, researcher opted for a data-driven and flexible approach by having an active role in the interpretation of data (Braun & Clarke, 2019). Immersion with the data was done by repeated reading, followed by coding, and developing, reviewing, and defining of the repeated themes. Themes were organically evolved as the analysis progressed, to facilitate the interpretation of patterns and reorganising of codes (Byrne, 2022). Nonetheless, themes related to prominent theories may emerge later organically. This inductive and latent interpretative level fits into Braun and Clark's reflexive thematic analysis (Braun & Clarke, 2021). In this analysis process, the author carefully read the selected articles and analysed their key findings according to the statistical data, statements,

or any other data that the authors deemed crucial to answering the research questions. This resulted in 12 subthemes that the author considered crucial for sustainable online learning. As some of these subthemes intersect, the author later grouped them into four central themes: technology, teaching and learning qualities, ethical aspects and institutional supports (refer Table 3). A review by two experts, one in the area of education and the other in educational technology, resolved any inconsistencies in the themes.

Table 3. Categorisation of the thematic analysis.

Theme	Subthemes	Description
Technology	Ease of use, usefulness, compatibility	User experience and relevancy of the technology and modality
Teaching and learning	Needs and expectations, readiness, pedagogical Skills	Students' individual, social, and academic needs, educators' digital competencies
Institutional supports	Governance, infrastructure, recognition, social support	Various level of supports given by the academic institution
Ethics	Ethics, rules and regulations	Values and ethics for a fair and safe online learning environment

RESULTS

This study reviewed articles that were focused on sustainability of online learning published between the year 2015 and 2021. The objective of this review study is threefold: to identify the types of educational technology or modality being studied on the aspects of sustainability, to identify the trend or topical focus that were being studied on online learning, and to identify the themes and subthemes that are critical to the sustainability of online learning.

According to the locations of where the 44 selected articles were studied, the top four countries were Saudi Arabia (n = 7), India (n = 5), Spain (n = 3) and Tanzania (n = 3). The UK, , Poland, Malaysia, Australia, New Zealand, Uganda and Turkey each had two studies, and the rest (Canada, China, Czech, Egypt, Indonesia, Israel, Japan, Jordan, Korea, Kuwait, Netherlands, Nicaragua, Romania, Sri Lanka, the US, Vietnam and Yemen) had one study each. Three of the reviewed articles were of multi-country studies (see Appendix B, Articles number 4, 10 and 21), where the subjects of the study were from New Zealand and Australia, India and Saudi Arabia, and India and Uganda. All articles were published between 2015 and 2021, with 12 articles published in 2021, 17 in 2020, 6 in 2019, 3 in 2018, 2 in 2017, 2 in 2016, and 2 in 2015. The map visualisation of the selected studies is depicted in Appendix C.

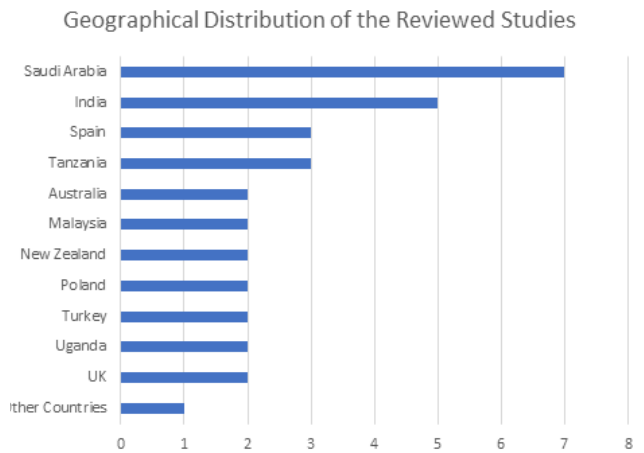

Figure 2. Distribution of the selected studies based on country of origin

Trends on the types of educational technologies

The first objective of the study is to identify the types of educational technology or modality being studied in the reviewed articles. Based on the selected studies, the most frequently discussed technology was e-learning (n = 10), followed by a learning management system (n = 6), mobile learning (n = 6), and Massive Open Online Courses (n = 5). Figure 3 presents the specific educational technology or methodology discussed in the selected studies.

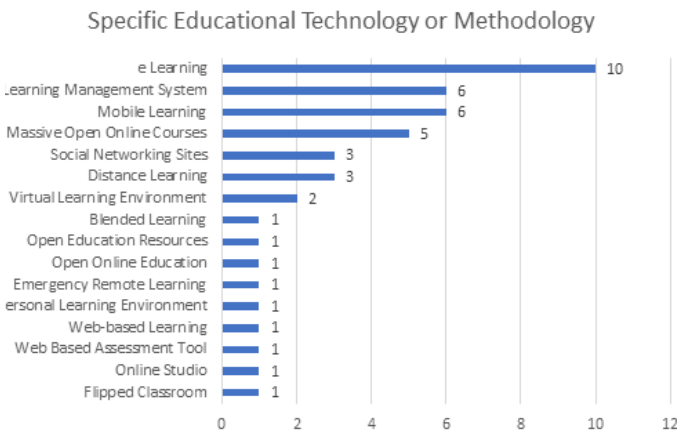

Figure 3. Specific educational technology or methodology discussed in the selected studies.

Trends on the challenges in educational technologies

The second objective of the study is to identify the trend or topical focus that were being studied on online learning. Based on the reviewed articles, the most frequently discussed topics were challenges (n = 8), followed by perceptions (n = 7), sustainability (n = 6), effectiveness (n = 5), continuance intention (n = 5), and critical factors (n = 4). Table 4 presents the specific topical focus discussed in the selected studies.

Table 4. Specific topical focus of online education (some studies focus on multiple topics)

Detailed focus	Total
Challenges	8
Perception	7
Sustainability	6
Effectiveness	5
Continuance intention	5
Critical factors	4
Experience	3
Expectations/Needs	3
Attitudes	3
Opportunities	2
Acceptance	2
Readiness	2
Assessment	1
Strategy	1
Platforms	1
Management	1
Engagement	1
Motivation	1
Quality	1
Participatory process	1
User innovativeness	1
Anxiety and academic dishonesty	1

Themes and Subthemes for Sustainable Online Learning

The third and main objective of this study is to identify the themes and subthemes that are critical to the sustainability of online education. In this section, the following are the key findings of the studies, based on the emerging themes identified through the thematic analysis: (1) technology, (2) teaching and learning, (3) institutional supports and (4) ethical aspects. The matrix table for the SLR is depicted in Appendix D.

Technology

Based on the reviewed articles, 36 articles touched on the domain related to technology. Technology comprises three subthemes: (1) usefulness, (2) ease of use, and (3) compatibility. Because online learning lessons integrate technology, it is imperative to gauge how using the technology can be impactful in its usefulness to instructors and learners. Another important consideration is how relatively easy the online learning system is for users. These two underlying domains are the primary theoretical constructs for Davis et al. (1989) technology acceptance model (TAM), which scholars commonly use to evaluate the level of acceptance for a technology. They found that most of the articles included in the review utilised these two concepts in addressing the issue of sustainable online learning. However, in this study, usefulness and ease of use are not necessarily tied to a specific technology but rather to a specific modality, such as blended learning or hybrid learning. Because online learning can be taught and learned in many ways and forms, integrating the technology into lessons could lead to varying degrees of compatibility or suitability.

The first subtheme under technology was usefulness. Some of the users mentioned promptness; benefits in achieving learning objectives; an increase in learning efficiency as significantly dependent on the student's awareness of its usefulness (Naveed, Alam, et al., 2020); system quality, instructor quality, and institution quality (Alam et al., 2021); enjoyment and self-efficacy (Cicha et al., 2021); comfort and the flexibility of location and time (Khan, Nabi, et al., 2020); information management, sharing information, searching for and publishing information, and clarifying doubts (Rus-Casas et al., 2021); and flexibility in engagement and viewing materials (Moraros et al., 2015; Tuapawa, 2016). Perceived usefulness had significant effects on intention to use and the actual usage of m-learning (Alghazi et al., 2021; Attalla et al., 2020), sustained use of e-assessment (Nangawe, 2015), user satisfaction of learning management system (LMS) (Alomari et al., 2020), attitude (Kim et al., 2021), and e-learning readiness (Linjawi & Agou, 2020). A study on social networking sites found that all respondents appreciated the usefulness of social media in formal teaching and learning and were found to be more beneficial than Google Classroom and Zoom (Sobaih et al., 2020). However, usefulness was negatively affected by previous experience with e-learning (Kim et al., 2021) and tech savviness (Power & Kannara, 2016).

The second subtheme was related to ease of use. A technical factor that positively correlates with the quality of e-learning is having a user-friendly platform for e-learning (Elumalai et al., 2020). Tech friendliness and ease of operation were motivating factors for online education (Sinha & Bagarukayo, 2019). According to the articles reviewed, factors that influence ease of use are accessibility or adaptability to run on a variety of devices (Aldowah et al., 2019; Alnusairat et al., 2021; Naveed, Alam, et al., 2020), previous experience, familiarity with or the availability of more straightforward system (Alomari et al., 2020; Cicha et al., 2021; Edelhauser & Lupu-Dima, 2020; Power & Kannara, 2016; Rizun & Strzelecki, 2020; Sobaih et al., 2020), enjoyment and self-efficacy (Cicha et al., 2021; Rizun & Strzelecki, 2020), freedom to and simplicity of use (Edelhauser & Lupu-Dima, 2020), limitation of technology (Moraros et al., 2015), complexity (Simamora, 2020), media support (Alam et al., 2021), design interface (Alam et al., 2021; Aldowah et al., 2019; Power & Kannara, 2016; Ramachandran & Kuppusamy, 2018; Tuapawa, 2016), and quality

internet connection (Alnusairat et al., 2021). Ease of use is a significant contributing factor in distance learning towards attitude (Rizun & Strzelecki, 2020), adoption of mobile learning systems (Dolawattha et al., 2019), user satisfaction (Alomari et al., 2020), and readiness for online learning (Simamora, 2020).

The third subtheme was compatibility. A study by Simamora (2020) indicated that certain courses may have compatibility issues when converted into online teaching. Similarly, Nangawe (2015) found that the use of e-assessment was positively and significantly related to compatibility, which refers to compatibility with the values and needs of the adopter. Attalla et al. (2020), in their study on m-learning in the medical study found that the need for clinical practice and human interaction in the medical study may put some challenges on medical students. A study by Alam et al. (2021) showed that the use of E-Learning Systems (ELS) was not significantly dependent on the instructor's quality, because more than half of the respondents belonged to applied medical science, where their course design relied on clinical and laboratory training. Azli et al. (2018) found positive perceptions towards the use of m-learning in language studies, which showed general agreement on the potential of mobile-assisted language learning (MALL) for learning English as a second language. However, a study by Pikhart and Klímová (2020) found no difference, which showed no proof of significant improvement when using e-learning for vocabulary retention. When it comes to the suitability of social media, according to Sobaih et al. (2020), using social media to teach practical courses that frequently demand evidence and attendance is quite challenging. A study by Alghazi et al. (2021) found that device compatibility significantly influenced the students' intention to use mobile learning. Alnusairat et al. (2021), in their study on the perceptions of online design studios, found that online teaching was suitable for other theoretical courses but not for design studios, as only 30.3% believed that online studio was suitable.

Teaching and learning

Based on the reviewed articles, 39 articles touched on the domain related to teaching and learning. Teaching and learning consist of three subthemes: (1) needs and expectations, (2) readiness, and (3) pedagogical skills. Online learning can be taught and learned in many ways and forms, which may lead to varying degrees of the needs/expectations of users, the degree of user readiness, and the pedagogical skills of the practitioners. All these elements of teaching and learning, especially in online education, need to be addressed for any learning process to be effective and satisfactory. For example, an instructor may be competent pedagogically; however, teaching can become effective only if the psychological and academic needs of the students are met and if the students are ready to accept the teaching approach.

The first subtheme under teaching and learning was needs and expectations. Students are perceived to be digital residents with different expectations on the delivery and availability of information (Power & Kannara, 2016). A study by Pikhart and Klímová (2020) found that satisfaction with e-learning was lower than traditional learning. According to the reviewed articles, several factors that contributed to the needs and expectations of teaching and learning are instructor's skills in using online tools (Torres Martín et al., 2021; Tuapawa,

2016), flexibility (Sinha & Bagarukayo, 2019; Sosa-Díaz & Fernández-Sánchez, 2020); social support (Tuapawa, 2016); pleasantness or enjoyment (Alomari et al., 2020; Cicha et al., 2021; Elumalai et al., 2020; Gillis & Krull, 2020; Naveed, Alam, et al., 2020; Naveed, Qureshi, et al., 2020; Rizun & Strzelecki, 2020); clarity of instructions on course assessment (del Arco et al., 2021; Tuapawa, 2016); reasonable workload (Alnusairat et al., 2021; del Arco et al., 2021); methods and level of learning engagement (Alnusairat et al., 2021; del Arco et al., 2021; Moraros et al., 2015; Sosa-Díaz & Fernández-Sánchez, 2020; Tuapawa, 2016); acquiring needed lifelong skills or general competencies such as analytical, technical, and creative skills (Alnusairat et al., 2021; Rus-Casas et al., 2021; Sinha & Bagarukayo, 2019; Sosa-Díaz & Fernández-Sánchez, 2020);

The second subtheme was readiness. Tuapawa (2016) found that students were frustrated by not having received a "good orientation" to the system, and many "features" of the system had not been explained. Alnusairat et al. (2021) found that students admitted that they needed to develop more independence, time and task management, and self-evaluation skills because of the workload of the online course. Additionally, students wanted efficient time management assistance before enrolling in such a course. Alnusairat et al. (2021), in their survey, found that most of the students claimed managing workload and time was a barrier to online learning because communicating online took more time than working in a typical design studio. Furthermore, the quick transition to online learning has dramatically altered how tutors assessed their students' work and added to their workload. Simamora (2020) found that some students face difficulties when learning online in that they are not ready to learn independently. Wang (2020) pinpointed that homework or assignments must involve technology to prepare and help students learn other new technologies such as Zoom and Teams.

The third subtheme under teaching and learning was pedagogical skills. Schophuizen et al. (2018) suggested that one of the biggest challenges for open online education was online teaching at various levels, from the role of the teacher to skills in designing, organising, and teaching in the online environment, particularly in educational flexibility and support mechanisms. Based on the articles included in the review, the factors that contributed to the satisfaction of online learning or the theme of pedagogical skills were quality of evaluation (Coskun-Setirek & Tanrikulu, 2021; Elumalai et al., 2020), social presence (Cornelius et al., 2019; Coskun-Setirek & Tanrikulu, 2021; Elumalai et al., 2020; Sosa-Díaz & Fernández-Sánchez, 2020), pedagogical or social support (Alnusairat et al., 2021; Alomari et al., 2020; Coskun-Setirek & Tanrikulu, 2021; Muganda et al., 2016; Torres Martín et al., 2021), a variety of sufficient and fair assessments and instruments (Cornelius et al., 2019; Coskun-Setirek & Tanrikulu, 2021; Elumalai et al., 2020; Moraros et al., 2015; Simamora, 2020), immediate quality feedback (Alnusairat et al., 2021; Alomari et al., 2020; Gillis & Krull, 2020; Moraros et al., 2015; Naveed, Alam, et al., 2020; Pikhart & Klímová, 2020), use of multimedia (Pikhart & Klímová, 2020), use of collaboration tools or activities (Elumalai et al., 2020; Pikhart & Klímová, 2020; Rus-Casas et al., 2021; Sosa-Díaz & Fernández-Sánchez, 2020), encouragement for interaction and engagement/active learning (Alomari et al., 2020; Cornelius et al., 2019; Elumalai et al., 2020; Gillis & Krull, 2020; Naveed, Alam, et al., 2020; Torres Martín et al., 2021), amount of screen time (Pikhart & Klímová, 2020), flexible approach/techniques (Aldowah et al., 2019; Cornelius et al.,

2019; Gillis & Krull, 2020), quality of course materials (Aldowah et al., 2019; Elumalai et al., 2020; Sosa-Díaz & Fernández-Sánchez, 2020), simplicity and clarity of course design (Elumalai et al., 2020; Gillis & Krull, 2020; Moraros et al., 2015; Naveed, Alam, et al., 2020; Sosa-Díaz & Fernández-Sánchez, 2020), instructors' ICT skills (Naveed, Alam, et al., 2020; Torres Martín et al., 2021), understandable language (Naveed, Alam, et al., 2020; Ramachandran & Kuppusamy, 2018), and involvement of appropriate skills and variety of higher-order thinking skills (Aldowah et al., 2019; Cornelius et al., 2019; Elumalai et al., 2020; Torres Martín et al., 2021).

Institutional support

Based on the reviewed articles, 32 articles touched on the domain related to the supports provided by higher institutions. There are four subthemes under institutional support: (1) governance, (2) infrastructure, (3) recognition, and (4) social support. Institutional support refers to the institution's ecosystem that supports the sustainable use of online learning. In higher education, a university must provide ample support for faculty members to reach their optimal potential. These supports can come in various forms, such as informational, social, administerial, or financial support. According to the articles reviewed, these subthemes were much discussed and deemed critical for online education to be sustainable in the long term.

The first subtheme under institutional support is governance. Some of the factors that fall under governance are related to policies (AI-Youbi et al., 2020; Alam et al., 2021; Aldowah et al., 2019; Coskun-Setirek & Tanrikulu, 2021; Edelhauser & Lupu-Dima, 2020; Muganda et al., 2016; Muries & Masele, 2017; Power & Kannara, 2016; Schophuizen et al., 2018; Simamora, 2020; Sinha & Bagarukayo, 2019; Sobaih et al., 2020), strategies (AI-Youbi et al., 2020; Coskun-Setirek & Tanrikulu, 2021; Fox, 2019; Schophuizen et al., 2018), participatory process (Bolmsten & Manuel, 2020), e-learning executive body or organisational structure (Alam et al., 2021; Muries & Masele, 2017), promotion (Alam et al., 2021; Coskun-Setirek & Tanrikulu, 2021; Muganda et al., 2016), and standardisation (Power & Kannara, 2016; Sinha & Bagarukayo, 2019; Sobaih et al., 2020). Simamora (2020) found that the government's lack of policies trickled down to universities, which showed the importance of having an effective plan for better internet access and devices and having guidelines for online teaching. Fox (2019), in his case study, has shown how a 10-year strategic plan entailing the widespread adoption of digital technology tools and unified and coordinated curricular and learning design frameworks has helped reconceptualise the university's teaching and learning approach. Alam et al. (2021) found that institutional quality, which includes having an adequate policy promoting e-learning and having an executive body or committee to handle e-learning, had a direct and significant impact on the perceived usefulness of ELS and its use. Similarly, Muries and Masele (2017) found that one of the contributing factors to the continued usage of intentions of LMS was top management, particularly in influencing decisions on investing in new technology and establishing a unit of instructional design. AI-Youbi et al. (2020) in a study on a framework for leveraging social media for the sustainable management of higher education, found that institutional strategies, institution-wide decision-making, and readiness to change institutional policies were some of the decisive factors in its successful implementation.

The second subtheme under institutional support is infrastructure. A study on students' satisfaction and perception of online studios by Alnusairat et al. (2021) found that many students were dissatisfied with the learning experience because of technical factors and infrastructure, where 70% of them were struggling with poor internet connectivity. Similarly, Simamora (2020) found that internet access is slow and hampering the learning process, where the study showed that one student had to wait a long time to download a video sent by the lecturer. A study by Nangawe (2015) found that the reliability of internet connectivity and the cost involved were the factors of adopting internet-based assessment technology. On MOOCs, a study by Sosa-Díaz and Fernández-Sánchez (2020) found that one of the most significant obstacles to their implementation was university technological infrastructure such as adequate infrastructure and obtaining digital resources to produce quality materials, in particular the preparation and technical resources to create quality videos and materials.

The third subtheme under institutional support is recognition. According to Alam et al. (2021), the perceived usefulness of ELS and the e-learning system are more strongly influenced by financial support, such as financing for hardware and software updates and financial rewards for stakeholders. A similar impact can also be seen in environmental support provided by an academic institution, such as incentives for e-learning adoption, e-learning deanship, and giving recognition to top performers. Muganda et al. (2016) found that while support is given to staff in OER development workshops, the additional workload in writing and developing OER material might not be recognised appropriately by the institution. Fox (2019) has shown that recognition, such as offering alternative career paths and promotion requirements, is one of the many effective strategic plans for maintaining high-quality online education.

The fourth subtheme under institutional support is social support. The factors that contributed to this theme are administrative support (Alam et al., 2021; Aldowah et al., 2019; Linjawi & Agou, 2020; Muries & Masele, 2017; Sobaih et al., 2020), training support (Alam et al., 2021; Aldowah et al., 2019; Alomari et al., 2020; Dolawattha et al., 2019; Edelhauser & Lupu-Dima, 2020; Gillis & Krull, 2020; Muganda et al., 2016), financial support (Aldowah et al., 2019), environmental support (Alam et al., 2021), technical IT support (Bolmsten & Manuel, 2020; Elumalai et al., 2020; Muganda et al., 2016; Schophuizen et al., 2018; Sobaih et al., 2020), encouragement (Elumalai et al., 2020), orientation (Elumalai et al., 2020), instruction manuals (Elumalai et al., 2020), emotional support (Alnusairat et al., 2021; Sobaih et al., 2020), psychological support (Coskun-Setirek & Tanrikulu, 2021), pedagogical support (Coskun-Setirek & Tanrikulu, 2021), best practice model/trainers (Alam et al., 2021; Power & Kannara, 2016), instructional design expertise (Power & Kannara, 2016), social influence (Cicha et al., 2021; Kim et al., 2021; Linjawi & Agou, 2020) and peer-group support (Naveed, Qureshi, et al., 2020). A study by Coskun-Setirek and Tanrikulu (2021) on critical sustainability factors for m-learning found that psychological support and pedagogical support were the two most influential factors for sustainability. Linjawi and Agou (2020) found that social influence affected the e-learning readiness of both students and faculty members, while institutional support strongly influenced e-learning readiness, particularly for undergraduates.

Ethical aspects

Based on the reviewed articles, 17 articles touched on the domain related to ethical practices in teaching and learning. Ethical aspects consist of two subthemes: (1) ethics and (2) regulation. Given that online learning is somewhat different from traditional face-to-face learning in its approach, a particular concern would be the users' conduct shifting from physical to hybrid or from physical to virtual. Issues such as cyber-etiquette, accessibility (disabilities), academic dishonesty, and copyright infringement and threats such as the invasion of privacy and cyberbullying need to be emphasised and monitored, just like in any face-to-face learning approach. The nature of online learning happening behind a monitor (virtual) makes it harder to supervise, and prolonged exposure to this negative culture might further lead to desensitisation.

The first subtheme is ethics. According to the reviewed articles, factors that contributed to this theme are privacy (Alnusairat et al., 2021; Coskun-Setirek & Tanrikulu, 2021; Naveed, Qureshi, et al., 2020; Simamora, 2020; Sobaih et al., 2020; Tuapawa, 2016), academic integrity (Eshet et al., 2021; Muganda et al., 2016), transparency (AI-Youbi et al., 2020), cyber-ethics (AI-Youbi et al., 2020; Alnusairat et al., 2021; Coskun-Setirek & Tanrikulu, 2021; Elumalai et al., 2020; Gillis & Krull, 2020; Simamora, 2020; Sobaih et al., 2020; Sosa-Díaz & Fernández-Sánchez, 2020; Tuapawa, 2016), equality in access and opportunity (Alnusairat et al., 2021; Coskun-Setirek & Tanrikulu, 2021; Elumalai et al., 2020; Gillis & Krull, 2020; Simamora, 2020; Sosa-Díaz & Fernández-Sánchez, 2020), and fairness of assessment/communication (Alomari et al., 2020; Coskun-Setirek & Tanrikulu, 2021; Simamora, 2020). A study by Naveed, Qureshi, et al. (2020) found that ethical issues and legal issues were ranked 21 and 17, respectively, out of a total of 25 factors. However, ethical and legal issues come under institutional management, which ranked first among all other five dimensions namely Students' Dimension, Instructors' Dimension, Design and Contents' Dimension, Institutional Management Dimension, and System Technological Dimension. Similarly, a study on sustainable m-learning by Coskun-Setirek and Tanrikulu (2021) found that legal and ethical issues had the highest mean value, at 3.78. Legal and ethical issues consist of equity and equality, user-rights sensitivity, the accuracy of stored information, and cyber-ethics, and all of them were significant. Sosa-Díaz and Fernández-Sánchez (2020) posit that though MOOCs provide opportunities regardless of the socioeconomic or personal situation, students' technological access can be a limiting factor and a discriminatory element, particularly for those without sufficient financial resources and access to networks and computers.

The second subtheme under ethical aspects is regulation, where security and a code of ethics are factors. There is a need for data safety and security (Alnusairat et al., 2021; Dolawattha et al., 2019; Nangawe, 2015; Simamora, 2020) and a need to have a form of guidelines or regulations, such as a written code of conduct or a code of ethics (AI-Youbi et al., 2020; Aldowah et al., 2019; Gillis & Krull, 2020; Sobaih et al., 2020; Tuapawa, 2016). Data security is an issue according to Simamora (2020). Nangawe (2015) posits that one of the key obstacles to the acceptance, diffusion, and ongoing use of internet-based assessment technologies in higher education is lack of security, where confidentiality issues involving examinations, research, consultation, and publications are susceptible. A

study by Alnusairat et al. (2021) found that Microsoft Teams was the most commonly used application for online learning because it is considered more secure. Similarly, security and privacy are facilitating conditions according to Dolawattha et al. (2019) study, and these were significant factors in teachers' adoption of mobile learning in higher education. A study by Tuapawa (2016) found that students valued platforms that provided anonymity and freedom to express their thoughts and ideas indirectly without repercussion. However, students admitted that "stricter guidelines" on written conduct need to be established to monitor any excessive actions by the students. Sobaih et al. (2020) found that privacy and account security were some of the concerns amongst faculty members and students when using social media, as personal information accounts might be disclosed, and that online activity could be tracked. Moreover, the absence of ethical codes such as using inappropriate street language and practices in social media, would affect the quality of communication between students and faculty (Sobaih et al., 2020).

DISCUSSION

By reviewing past articles on sustainable online learning published between 2015 and 2021, this review study successfully addressed the established three research objectives. The researcher objectives are threefold: to identify the recent trends on the types of educational technologies or modalities being studied, to identify the common topical focus that contributes to the challenges in online education, and to discover the themes and subthemes that are critical to the sustainability of online learning.

Trends on the Types of Educational Technologies or Modalities

This review study revealed that e-learning, learning management system (LMS) and Mobile Learning were the top three educational technology topics being discussed. It can be argued that this is due to the traction these three modalities gained in the past years as most public universities have implemented an LMS in its teaching and learning (Al-Sharhan et al., 2020; Rusli et al., 2023), and also due to the rapid-rise of mobile user and the increasing affordance and acceptance of mobile learning particularly in developing countries (Correa et al., 2020; Iqbal & Bhatti, 2020). This review study also revealed 13 other terminologies related to online learning, with each describes a different modality or ways to impart knowledge using technology. This variation of modalities could have started in 1955, when the term "e-learning systems" first appeared (Zinn, 2003). Since then, a plethora of terminologies defining a teaching with the use of technology had been coined. A study by Aparicio et al. (2016) looking at the concepts that use electronic in learning revealed 23 different types of terminology such as e-learning, m-learning, blended learning and learning management system, and this list is expected to grow in line with new innovations in technology. In terms of frequency, online learning and e-learning were the most frequently used terminologies among 46 different definitions of "e-learning" in scholarly works done between 1988 and 2017 (Singh & Thurman, 2019). This is due to the definition of online learning that represents a wider concept of modality that transverse across other more specific ones that may either use a specific type of technology such as mobile learning and virtual learning, or approach such as blended learning and flipped

classroom. The rapid evolution in technology requires educators to be aware of the educational trends in higher education as the introduction of a new technology will usually lead to a new and novel teaching approach.

Trends on The Challenges in Educational Technology

Challenges and obstacles are expected when teaching and learning has to go through an intermediary, i.e., technology, to facilitate the learning process. These challenges can be in various forms, can implicate one factor to another, and modify a user's behaviour and perception of using the technology, such is the complexity of learning with technology. In the reviewed articles, more than 20 different topics related to online learning were discussed.

Perceptions and continuance of intention in using technology are found to be at the top three of the most discussed challenges. These two factors are commonly used in assessing the rate of acceptance of technology particularly in education. Other prominent topics such as sustainability and effectiveness were also frequently discussed, pertaining the challenge to sustain the use of technology and its effectiveness in teaching. Behavioural studies such as perceptions, attitudes, and acceptance are frequently used by scholars to assess the merit of utilising a technology in education. Technology Acceptance Model (TAM), Unified Theory of Acceptance and Use of Technology (UTAUT), and Diffusion of Innovations (DOI) are some of the most popular theories used to predict the adoption of technology (Lampo, 2023). Evidently, a review study of the determinant factors of technology adoption on 80 papers and conferences published between 1992–2019 found that perceived ease of use and perceived usefulness, which are part of TAM factors, as the most frequently mentioned factors (Oyetade et al., 2020). Thus, any innovative technology integrated into teaching will most likely be assessed by scholars using TAM due to its credible model for facilitating assessment of diverse learning technologies (Granić & Marangunić, 2019). Nevertheless, other factors that deals with the students' experience in using technology such as expectation and needs, opportunities, engagement, motivation, and anxiety were also discussed in the reviewed articles. The integration of technology in teaching requires educators to be pedagogically competent in the technology when imparting knowledge, as it has a significant bearing in students' learning experience. Technology integration model such as Technological Pedagogical Content Knowledge Framework (T-PACK) is a prominent framework that can be used to assess the level of educators' readiness in integrating educational technology in their pedagogical practices and is a significant contributor to quality online education (Akram et al., 2021) and teaching effectiveness (Tao & Ma, 2022), and often used for professional development for pre-service teachers (Aldemir Engin et al., 2023; Kapici & Akcay, 2023; Liando et al., 2023). Hence, technology readiness, acceptance, and pedagogical competency are some of the critical challenges in online learning sustainability.

Domains for Sustainable Online Learning

The thematic analysis on the reviewed articles revealed 12 subthemes, which are classified into four major themes, namely, Technology, Teaching and Learning, Institutional Support, and Ethical Aspects.

Technology

The technology dimension was found to be an important factor, according to the number of studies (36 out of 44) addressing this dimension. Most of these studies focused on usefulness and the ease of using a technology, and this is particularly understandable given the prominence of the model and the need for the rapid switching from conventional to digital platform during the pandemic. Technology adoption framework particularly TAM was frequently used as the gold standard by scholars when it comes to predicting successful educational technology adoption (Granić, 2022), and the inclusion of the subdomains namely usefulness and ease of use in the technology domain validated this. TAM is currently the most used framework in the study of technology acceptance (Granić & Marangunić, 2019) and both its predictors are the most cited in scholarly works (Oyetade et al., 2020). It was also applied in variety of recent technology such as metaverse (Aburbeian et al., 2022), virtual reality (Fussell & Truong, 2022; Zhang et al., 2022), augmented reality (Oyman et al., 2022), and artificial intelligence (AI) (Chocarro et al., 2023). Thus, our framework's inclusion of ease of use and usefulness was ideal and justified as it is used by most scholars and can be adapted to various educational technologies. When it comes to technology adoption, higher learning institutions will rely on technology that requires the least amount of effort to switch to digital platforms and provides benefit that outweigh the risks.

Another sub domain proposed in the framework is in the aspect of compatibility. Certain technology or modes of teaching were found to be incompatible either with the needs of the educators and learners or with certain types of fields. Even though the integration of technology opens more opportunity for learners, it also provides challenges to certain fields such as language courses, arts and design courses, and those that require clinical practice, such as medical courses. One of the prominent theories that best represent this subdomain is perceived compatibility taken from Rogers' Diffusion of Innovation (DOI) theory, defined as "the degree to which an innovation is perceived as consistent with the existing values, past experience, and needs of the potential adopters" (Rogers, 2003, p. 240). In technical aspects, compatibility may overlap with ease of use as it can also be considered as the ability to sustain teaching approach across different platform or devices which is not the definition this study is planning to use. In our study, compatibility is multilayered and is defined as a degree of which the integration of technology does not impede the learning needs of the users, it is agreeable to the faculty's teaching values, and it is cost-effective for the learning institution to implement. Compared to the ease of use and usefulness which focus on technology acceptance, compatibility goes beyond that which impact the decision to adopt the technology. It supports the view that DOI is the most appropriate framework for investigating the adoption of technology in higher education and education environments (Sahin, 2006), with compatibility issues in online learning have been frequently raised in past studies and the need for this gap to be bridged (Leszczyński et al., 2018). Though we believe that ease of use and usefulness provide a degree of acceptance that sustain online learning, it must however be complemented with a degree of compatibility on academic relevancy for the technology to be adopted. Academic relevancy of using technology is an important factor for users to adopt the technology (Al-Rahmi et al., 2022), and especially true when it positively associated with successful learning outcomes and institutional goals. Courses from a certain field may work best with a certain teaching approach to best achieve

its educational goals. Some studies on technology adoption had also utilised both TAM and DOI for a more comprehensive predictor in technology adoption (Al-Rahmi et al., 2019), and compatibility has been found to be significant in influencing adoption of online learning in higher education (Ahmad et al., 2023; Chu et al., 2020; Dubey & Sahu, 2022; Isaac et al., 2019).

Teaching and learning

The teaching and learning dimension was found to be the most crucial factor according to the number of studies (39 out of 44) that touched on this aspect. This is understandable given that the quality of online learning depends on the process and outcomes of the online learning itself. The current study shows that learners' needs and expectations are the most highlighted factor particularly in acquiring lifelong skills and general competencies, such as digital skills, analytical skills and creative skills. Students' 21st-century skill improvement is shown to have a significant influence on students' learning satisfaction (Shwartz-Asher et al., 2022). This corresponds to the study by Rodrigues et al. (2021), where the importance of technological skills needed by students are strongly related to the professional skills required in the future, particularly demanding abilities that are relevant in society and the digital world of the future, such as problem-solving skills, creativity, and time management. This is consistent with the United Nations in its 1987 Brundtland Commission report which defined "sustainability" as meeting "the needs of present without compromising the ability of future generations to meet their own needs" (Håland, 1999, p. 48).

Educational technology could be adopted if it allows for the transfer of lifelong skills that are relevant to the needs of the users. It is crucial to address the educational expectations of the students, as both learning expectation and learning experience greatly influence the level of online learning satisfaction (Casanova & Paguia, 2022). Other than educational needs, it is also important that the learners' social and emotional needs be met as they expect their educators to be supportive during times of crisis. Medical researchers found that the COVID-19 pandemic has had a similar effect as post-traumatic stress disorder (Masiero et al., 2020; Tang et al., 2020), which gives more credence to the importance of students' psychological wellness. Thus, higher-education institutions should provide educational, psychological, and emotional support for students to optimise their learning qualities.

Pedagogical skills emphasising flexibility, immediate feedback, engagement and assessment were often highlighted in the review. Recent studies have highlighted the importance of digital competencies in higher education (Esteve-Mon et al., 2020; Rodriguez-Garcia et al., 2019), and despite having the means to improve this, it was shown that universities, in an institutional context, are lacking in this respect (Basilotta-Gómez-Pablos et al., 2022). A recent article collecting experiences of teaching and learning a language online during the pandemic by Tao and Gao (2022) found that though learners perceived online language classes to be less effective and rather dull, their effectiveness can be improved through the better design and implementation of pedagogical activities that focus more on learner centred interactions, collaboration and on the needs of attending to the emotional needs of both instructors and learners. To address this issue, various countries have similar frameworks on digital competency such as UNESCO's ICT Competency Framework for

Teachers, ISTE's NETS-T, the EU's DigCompEdu, and Leicester's DigiLit or Spain's DTC (Revuelta-Domínguez et al., 2022) to name a few. It is also important for higher-learning institutions to provide self-assessment reports, such as the Technological Pedagogical Content Knowledge (TPACK) as a starting point to develop their digital competencies (Fedeli, 2022). This will allow them to self-evaluate their pedagogical knowledge to effectively teach while using technology, particularly in using an active learning model or a constructivist approach. This promotes a degree of readiness that needs to be ascertained before adopting a certain technology or modality long term. From learners' perspective, they need to undergo orientation on the use of technology or mode of online learning and be ready for self-regulated learning particularly among first-year students. This will reduce their level of anxiety and improve their self-efficacy at using the technology, which will lead to more sustainable and enjoyable learning experiences. Hence, teaching and learning qualities can be enhanced by fulfilling the educational expectations and needs and equipping them with the required study skills and pedagogical skills which are crucial for successful online learning practices.

Institutional support

Institutional support was often addressed, according to the number of reviewed articles (32 out of 44) highlighting this dimension. The inclusion of this domain reflects its important in higher education. Institutional support significantly moderates e-learning, m-learning, d-learning, and students' performance in educational institutions (Nuseir et al., 2022), is a mediator for students' satisfaction and TAM model (Heng et al., 2022), is found to be significant predictors of students engagement in online learning (Abubakari et al., 2022), and has significant positive impact on the effectiveness of online learning (Aaron et al., 2022; Roy & Al-Absy, 2022), willingness in online learning (Akhter et al., 2022), and self-efficacy beliefs in online teaching (Göbel et al., 2023). A systematic review study asserts the need for institutional support that address accessibility, culture, equity, ethics and policy management, with institutional support such as leadership, policy and management as the least studied domain (Martin et al., 2020). Therefore, the significance of institutional support evident across dimensions justifies its inclusion.

Infrastructure is one of the subdomains in Institutional Support and is critical for online learning to be implemented in higher education. Universities lack of enough infrastructure was evident during the pandemic's rapid transition to online education (Jebbour, 2022; Masalimova et al., 2022) and this significantly affect online teaching practices and experience (Teodorescu et al., 2022). Two of the top three biggest factor to online learning were found to be IT infrastructure and university support (Maatuk et al., 2022), and lack of adequate online learning infrastructure was the most frequently reported difficulty among students (Aljaraideh & Al Bataineh, 2019). Thus, infrastructure such as internet connectivity and availability of digital devices are crucial to sustain online learning in higher education. For example, higher learning institutions must make sure that their infrastructure is adequate in terms of access to computers and internet bandwidth to accommodate the increasing number of students every year. Thus, periodic online learning needs analysis must be conducted to identify the infrastructural needs of the faculty members and students.

A study by Kaqinari et al. (2022) showed that a lower level of usage among educators was due to a lack of technological and pedagogical support from the university, due to a lack of collaboration with more-competent educators, and because they rarely perceived institutional support as useful. The level of support provided to educators proved to be crucial, particularly in providing a support system, including training and technical supports, and a model of good practices. This allows educators to be familiar with the technology and with pedagogy that best suits their needs. Thus, good social support such as community of practice, sharing of teaching materials, and even counselling support must be established among faculty members to promote effective online learning approach. Social support was found to have a positive impact in students' resilience (Permatasari et al., 2021), and indirectly reduce the prevalence of academic burnout and stress (Liu & Cao, 2022). This was done during the pandemic when upon the recommendation of the Malaysian Higher Education Ministry, universities had offered tele-counselling services to students and academic staff for psychological support during the Malaysian Movement Control Order (MCO). Therefore, a holistic social support must consider the technological, pedagogical, and psychological aspects of online learning.

Motivational factors play a critical role in the implementation of online learning in higher education. The focus of this subdomain is to leverage intrinsic motivation through incentives and rewards to reinforce positive behaviours. However, not many studies were done to investigate faculty motivation in higher education because the faculty were presumed to be intrinsically highly motivated and the study is methodologically challenging to do so (Daumiller et al., 2020) Notwithstanding that, our study shows that recognition such as reward or incentive to the faculty members is a contributing factor to the implementation of online learning. Incentive such as awards are effective in motivating faculty who values career progression particularly when such awards have clear link to promotional career or for esteem among peers (Seppala & Smith, 2020). Implementing online teaching is a tall order and require a steep learning curve especially for senior teaching members who are already used to conventional approach to teaching. Furthermore, incentives such as awards seems to be effective in motivating early to mid-career faculty members and to faculty members with teaching focus rather than research focus (Seppala & Smith, 2020). Nevertheless, incentivised approach as suggested in this review study can be used as a form of support to maintain the effective use of online learning as extrinsic motivation has a positive effect on perceived usefulness of online learning (Meng & Li, 2023). A scoping review by Pedro and Kumar (2020) on 13 quality assurance metrics of online teaching frameworks from various continents showed only 38% of the frameworks recommended rewards, compensation, and recognition for online course development. Thus, educators who performed admirably in utilising online learning should be rewarded with an award, consideration for career promotion, or be elected as role models for their respective departments.

Lack of educational governance during COVID-19 pandemic has led to ineffective of the governance system, and reinforced pre-existing inequalities in online education (Amaghouss & Zouine, 2022). Thus, a sustainable approach on policymaking should be made a participatory process that include all stakeholders focusing on the educational needs, including redesigning curricula to be more flexible (Korkmaz & Toraman, 2020). This professional development requires a systemic support in order to sustain new forms

of teaching and learning, and such support should be expanded to the state level rather than relegated to the institutional level only (Johnson et al., 2020). Applying digital transformation in the higher education requires the involvement of stakeholders including faculty members, the industry, and the governments and it goes beyond implementation of technological advancement but also a change of culture and its standard operating procedures (Alenezi, 2023). Hence, it is important for higher learning institutions to be in-synced with decisions by higher education ministry and be given the opportunity to participate in any policymaking that affecting the higher education system.

Ethical aspects

Ethical aspects were discussed in 17 of the 44 studies. Ethical considerations, particularly security and privacy, and netiquette were of concern among educators and learners. With social networking sites gaining more traction in the academic world, issues were raised in terms of social conduct and a lack of privacy in online classrooms. The level of trust in using a system is crucial in the adoption of a technology, and any existing ethical issues could lead to resistance in using e-learning services (Saleh et al., 2022). The topic on netiquette had been neglected in cyber ethics literature (Al-Khatib, 2023), and rules for online learning environments should be established to regulate students behaviour such as dress code, engagement, and behaviour (Volpe et al., 2023). Another issue that may require more emphasis is academic integrity, such as fair use and plagiarism. Similarly cited in the institutional support section with the same percentage, a scoping review on 13 quality assurance metrics of online teaching frameworks showed that only 38% of the frameworks mentioned faculty support on fair use, plagiarism, and intellectual property (Pedro & Kumar, 2020). With the emergence of more AI tools that use deep learning available on the internet, plagiarism may soon fall into a grey area and could soon be difficult to distinguish. The issue of academic dishonesty is expected to be more prevalent, as shown in a study by Comas-Forgas et al. (2021), where keywords related to academic cheating in search engines had seen a significant increase during the pandemic. Among 500 top universities, less than a third had implemented a policy on generative AI (Xiao et al., 2023). It is imperative for higher education to have a framework that addresses ethical issues in their institutions, as inappropriate guidelines provided to learners was found to be the biggest contributing factor to academic integrity in higher education (Muhammad et al., 2020).

Thus, online learning practices need to be regulated and online learning policies need to be established that caters to the issues of ethics, equity, and equality. Special groups such as disabled students were found to not receive adequate assistance in higher education (Paramasivam et al., 2022). The issue of sustainability will inevitably lead to the Sustainable Development Goals established by UN as a guideline for a sustainable future. Sustainable Development Goal 4 (SDG4) aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. The recent pandemic evidently affected SDG4 in terms of providing equal opportunity for all, as the digital divide was amplified because of the shift to digital learning. However, this current study shows that the pandemic has impacted not only the quality of education but also the general health and well-being of learners and their economic situations. The studies highlighted the increase level of stress and anxiety experienced during the pandemic due to isolation and increase workloads, lack

access to the internet and digital devices, and financial issue. Taking into consideration on all the themes and subthemes found in this review study, a conceptual framework to address the issue of online learning sustainability was developed.

Conceptual Framework

Based on the themes and subthemes discussed in the earlier sections, a conceptual framework on sustainable online learning was developed. Figure 4 shows the conceptual framework on the summary of the findings.

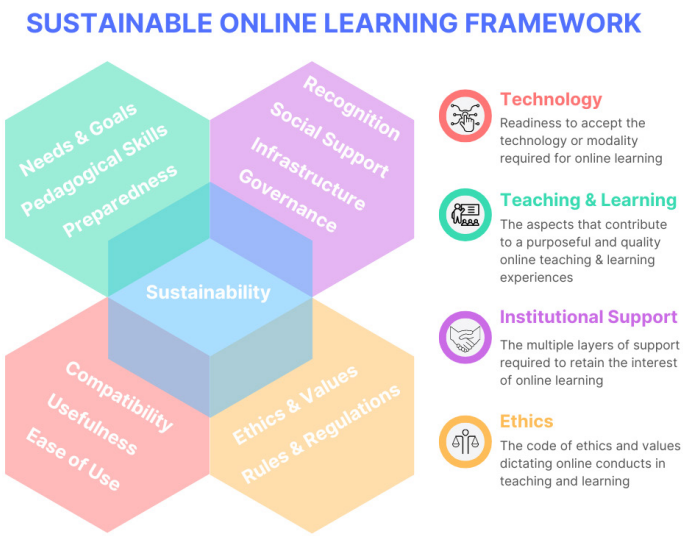

Figure 4. Conceptual framework for Sustainable Online Learning Framework (Source: Author's own work)

Figure 4 is based on the themes and subthemes derived from the systematic review. The conceptual framework provides a simple visualisation of which domain the sub-themes are classified into and how it can contribute to sustainable online learning. The author imagines it as a four-leaf clover, where each leaf contributes to a different domain, namely technology, teaching and learning, institutional supports and ethics.

Technology explains how the attributes of usefulness and ease of use need to be complemented with a compatible modality for online teaching to be effective. Online learning should not be implemented for its own sake. Certain courses may require a specific mode of teaching and may not be compatible, and they could be less effective if taught online, such as courses that require physical interaction or clinical trials. Thus, instructional technologists need to consider these factors when proposing technologies for higher education institutions.

Teaching and learning characterise the needs and expectations for both students and

educators. Higher education institutions must consider a multilayer of needs: individual, social and national needs. Students expect an online learning experience that meets their expectations: flexible, fun, engaging, collaborative and challenging lessons and relevant digital skills for their future employment needs. The students' online learning experience depends on how pedagogically well-equipped the educators are in making the lesson effective. For this to be achieved, students need to be oriented with independent and autonomous learning skills, and educators need to assess themselves with a digital competency framework prepared by their institution.

Institutional supports describe the level of support given to individuals in higher education institutions to sustain the use of online learning, such as governance in a form of clear online learning policy; an adequate infrastructure, such as reliable internet and computers; social supports, such as training and best practices; and recognition by offering rewards and incentives. Providing such systemic support would help in the development of an online learning culture in the institution.

Ethics encompass the codes and values that guide online conduct in teaching and learning. The use of digital communication exposes higher-education institutions and individuals to various digital threats, risks, and limitations that could have significant effects on their reputation. Issues such as academic integrity, security leaks, accessibility, and cyberthreats are some of the risks that need to be mitigated. Cyberbullying and exposure of private information when in an online learning environment could cause long-lasting damage to individuals. Online learning needs to be accessible and inclusive by making sure anyone with disabilities is given equal opportunity. Thus, higher education institutions should provide a written code of ethics on universal values and standards that the institution wants to inculcate. This study suggests that when all four factors are accounted for, online learning is more sustainable in the long term.

This conceptual framework could address the issue of sustainable practice of online learning in higher education by considering relevant use of technology, effective teaching and learning qualities, supportive actions from institutions, and ethical practices. Higher education has always been a field that embraces new technology and practices. Therefore, a framework such as the one proposed in this study could be invaluable in addressing the elementary needs of online learning in higher education allowing for a more sustainable online learning practice.

CONCLUSION AND FUTURE RESEARCH

This review study managed to address the objectives underlined in the earlier section of this paper, which is to identify the trending educational technology, the challenges in delivering online teaching, and more importantly the themes and subthemes that contribute to the sustainable practices of online learning in higher education based on the articles published between 2015–2021. Employing an SLR approach and owing to the heterogeneity of research designs, a thematic analysis was conducted to determine factors that could lead to the sustainability of online education. It resulted in four main themes: (1) technology,

(2) teaching and learning qualities, (3) ethical aspects, and (4) institutional supports, which were further categorised into 12 subthemes. Subsequently, a conceptual framework encapsulates the findings of the study was developed which could be used as a general guideline to enhance the quality of online teaching practices in higher education.

The main contribution of this study is the aggregation of various online learning modalities in identifying sustainable factors of online learning. This differentiates this study to other published SLRs that are towards single-focused modality. It also highlighted the emerging factors that may need more emphasis, such as the issue of cyber-etiquette and academic integrity amid the popularity of social networking sites and the surging revolution of AI. More novel online teaching approaches is expected to emerge in the next few years in line with the integration of disruptive technology in the education sector, paradoxically making online teaching more complex and more challenging.

As presented in this SLR related to the sustainability of online education, multiple factors have been categorised, allowing for the identification of factors involving various stakeholders and opportunities for future studies. However, some limitations are present in this study. Although other scholars suggested having more databases for searching relevant articles, this study only managed to utilise five databases: Emerald, ProQuest, WoS, Scopus and Google Scholar. Meta-analysis was not conducted, because of the varying research questions aimed by the selected papers, which go beyond the scope of this study. In future studies, a meta-analysis study covering wide databases could be beneficial in generating more accurate and generalisable results. A comparative SLR study on specific type of online teaching approach, such as m-learning, flipped classroom, or blended learning, for more in-depth findings would also be helpful. Further research could also include prominent and established journals on sustainability that would include more robust and more relevant articles while providing expansive coverage on the topic at hand. Another inherent limitation is the fact that only English articles were considered in this study, which may have prevented the inclusion of first-rate studies in other languages. Notwithstanding that, this study has shown the various challenges that educators have to face to provide practical teachings, and the themes and subthemes discussed in this study could contribute to a better understanding of the complex nature of online education. The next viable step for this study is to have the conceptual framework validated by experts in the area of educational technology which is currently under way.

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APPENDICES

Appendix A
Search strings used in the extraction of articles

Database	Date of search	Search strings/keywords	No. of records
Scopus	23 February 2021`	TITLE-ABS-KEY (sustainable) and TITLE-ABS-KEY (framework) and TITLE-ABS-KEY (online and education)) and (LIMIT-TO (DOCTYPE, "ar")) and (LIMIT-TO (exactkeyword, "Education") or LIMIT-TO (exactkeyword, "Sustainable Development") or LIMIT-TO (exactkeyword, "E-learning") or LIMIT-TO (exactkeyword, "Sustainability")) and (LIMIT-TO (language, "English")) and (LIMIT-TO (SRCTYPE, "j"))	51
Emerald	23 February 2021	(content-type:article) and (sustainable and (framework) and (online education)); 2015–2021	350
WoS	30 March 2021	(sustainable online learning), timespan: All years. Indexes: SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI	23
Google Scholar	22 March 2021	("Sustainable online education"-development)	472

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Appendix A. (*Continued*)

Database	Date of search	Search strings/keywords	No. of records
ProQuest	25 March 2021	noft (sustainable) and notf (online education or e-learning), Date: After 2015, Source type Scholarly Journals, Document type Article, Language English, Malay, Creative Commons licences CC BY (Attribution), CC BY-NC (Attribution—Non-Commercial), CC BY-NC-ND (Attribution—Non-Commercial—No Derivatives), CC BY-NC-SA (Attribution—Non-Commercial—Share Alike), CC BY-ND (Attribution—No Derivatives), CC BY-SA (Attribution—Share Alike), CC0 (Public Domain), full text + peer-reviewed	205

Appendix B
Summary of selected articles

No.	Author(s)	Year published	Country	Methodology	Technology	Specific topic focus	Method
1	Bob Fox	2019	Australia	QL	Blended learning	Sustainable improvement and strategies	Case study
2	Marian Wang	2020	Japan	QL	ERL dan LMS	Challenges and experience	Survey
3	Ramachandran and Kuppusamy	2018	India	QL	distance education (SNS)	Effective attributes of platforms	Survey
4	Kimberly Tuapawa	2017	Australia and New Zealand	QL	e-learning	Current needs and challenges	Phenomenological interview (Survey)
5	RM Simamora	2020	Indonesia	QL	Distance learning	Challenges and experiences	Document analysis
6	Bolmsten and Manuel	2020	Vietnam	QL	LMS	Participatory process	Case study
7	Muganda et al.	2016	Africa	MM	OER	Challenges	Participatory research
8	Pickhart and Klimova	2020	Czech Republic	MM	E-learning	Perceptions–Attitude and expectations	Experimental research
9	Schophuizen et al.	2018	Dutch	MM	Open online education	Challenges and opportunities	Participatory research
10	Sinha and Bagarukayo	2019	India and Uganda	MM	MOOCs	Motivational factors	Survey
11	Alomari et al.	2020	Kuwait	MM	LMS	Human factors on effectiveness	Survey
12	Sosa-Diaz and Fernandez-Sanchez	2020	Nicaragua	MM	MOOCs	Challenges and opportunities	Case study

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Appendix B. (*Continued*)

No.	Author(s)	Year published	Country	Methodology	Technology	Specific topic focus	Method
13	Al-Youbi et al.	2020	Saudi Arabia	MM	SNS	Factors of sustainable management	Survey
14	Sobaih et al.	2020	Egypt	MM	SNS	Challenges	Survey
15	Coskun-Setirek and Tanrikulu	2021	Turkey	MM	M-learning	Critical factors on sustainability	Survey
16	Duru et al.	2019	Turkey	MM	MOOCs	Course completion predictors (sustainability)	Case study
17	Power and Kannara	2016	United Kingdom	MM	VLE	Factors on effectiveness	Content analysis, focus group, survey
18	Cornelius et al.	2019	United Kingdom	MM	MOOCs	Learner engagement	Survey
19	Li et al.	2021	China	QN	MOOCs	Factors on continuance intention	Survey
20	Moraros et al.	2015	Canada	QN	Flipped classroom	Effectiveness	Survey
21	Elumalai et al.	2020	India and Saudi Arabia	QN	E-learning	Factors affecting quality	Survey
22	Khan et al.	2020	India	QN	E-learning	Perception and readiness	Survey
23	Shukla and Nagar	2020	India	QN	E-learning	Critical factors	Survey
24	Eshet et al.	2021	Israel	QN	Online learning	Anxiety and academic dishonesty	Survey
25	Kim et al.	2021	Korea	QN	Online learning	User innovativeness	Survey
26	Alnusairat et al.	2020	Jordan	QN	Online studios	Attitudes on usage	Survey
27	Attalla et al.	2020	Malaysia	QN	M-learning	Factors and intention	Survey
28	Azli et al.	2018	Malaysia	QN	MALL	Perception	Survey

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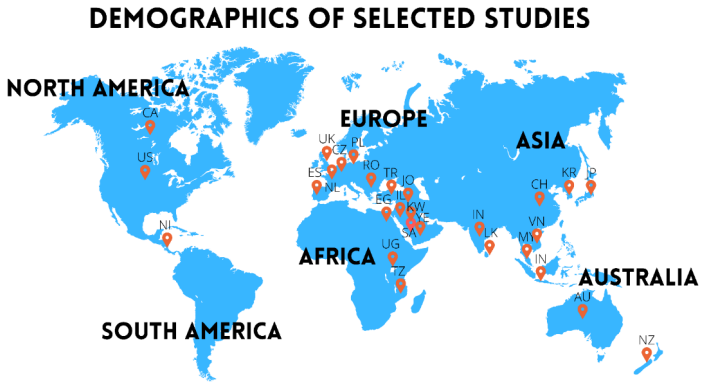
Appendix B. (*Continued*)

No.	Author(s)	Year published	Country	Methodology	Technology	Specific topic focus	Method
29	Cicha et al.	2021	Poland	QN	Distance learning	Expectations	Survey
30	Rizun and Strzelecki	2020	Poland	QN	Distance learning	Students' acceptance	Survey
31	Edelhauser and Lupu-Dima	2020	Romania	QN	LMS	Romanian experience during pandemic	Survey
32	Alghazi et al.	2021	Saudi Arabia	QN	M-learning	Factors and intention	Survey
33	Naveed, Alam, et al.	2020	Saudi Arabia	QN	M-learning	Acceptance	Survey
34	Naveed, Qureshi, et al.	2020	Saudi Arabia	QN	Web based e-learning	Critical success factors	Survey
35	Alam et al.	2021	Saudi Arabia	QN	Blended learning	Determinant factors (critical) sustainability	Survey
36	Linjawi and Agou	2021	Saudi Arabia	QN	E-learning	E-learning readiness	Survey
37	Arco et al.	2021	Spain	QN	Online learning	Students perception	Survey
38	Martin et al.	2021	Spain	QN	VLE	Students perception	Survey
39	Rus-Casas et al.	2020	Spain	QN	PLE	The effectiveness of digital tools in education sustainability	Survey
40	Dolawattha et al.	2019	Sri Lanka	QN	M-learning	Teacher's influencing factors (intention)	Survey
41	Nangawe	2015	Tanzania	QN	Web based assessment tool	Attitudes assessment	Survey
42	Muries and Masele	2017	Tanzania	QN	LMS	Continued usage intentions	Survey
43	Gillis and Krull	2020	USA	QN	LMS	Students perception	Survey
44	Aldowah et al.	2019	Yemen	QN	E-learning	Challenges	Survey

Note: QL = qualitative, MM = mixed method, QN = quantitative

Appendix C
Mapping of selected studies



Appendix D
Matrix analysis on SLR

Authors/theme	Technology related			Teaching and learning			Ethical aspects			Institutional support		
Subthemes	US	EU	CO	NE	RD	PS	ET	RG	GV	IN	RC	SS
Fox (2019)				√	√	√			√	√	√	√
Wang (2020)	√	√		√	√	√				√		
Ramachandran and Kuppusamy (2018)		√				√						
Tuapawa (2016)	√	√		√	√	√	√	√				√

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Appendix D. (*Continued*)

Authors/theme	Technology related			Teaching and learning			Ethical aspects			Institutional support		
Simamora (2020)	√		√	√	√	√	√	√	√	√		
Bolmsten and Manuel (2020)				√		√						√
Muganda et al. (2016)			√			√	√		√	√	√	√
Pikhart and Klímová (2020)			√	√		√						
Schophuizen et al. (2018)						√			√			√
Sinha and Bagarukayo (2019)		√		√	√	√			√	√	√	
Alomari et al. (2020)	√	√		√	√	√	√		√			√
Sosa-Díaz and Fernández-Sánchez (2020)				√		√	√			√		√
AI-Youbi et al. (2020)	√	√		√			√	√	√			√
Sobaih et al. (2020)	√	√	√	√		√	√	√	√	√		√
Coskun-Setirek and Tanrikulu (2021)				√	√	√	√	√	√			√
Duru et al. (2019)					√							
Power and Kannara (2016)		√	√	√		√			√			√
Cornelius et al. (2019)				√	√	√						
Li et al. (2021)	√			√		√						
Moraros et al. (2015)	√	√		√	√	√	√					
Elumalai et al. (2020)	√	√	√	√		√				√		√
Khan et al. (2020)	√	√	√	√	√							
Shukla and Nagar (2020)		√								√		√
Eshet et al. (2021)			√		√	√	√					
Kim et al. (2021)	√	√	√	√	√							√

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Appendix D. (*Continued*)

Authors/theme	Technology related				Teaching and learning			Ethical aspects			Institutional support		
Alnusairat et al. (2021)		√	√	√	√	√	√			√			
Attalla et al. (2020)	√	√	√	√						√			
Azli et al. (2018)	√	√	√										
Cicha et al. (2021)	√	√		√	√								√
Rizun and Strzelecki (2020)	√	√		√	√								
Edelhauser and Lupu-Dima (2020)		√							√	√			√
Alghazi et al. (2021)	√	√	√	√			√			√			
Naveed, Alam, et al. (2020)	√	√		√	√	√	√	√		√			√
Naveed, Qureshi, et al. (2020)	√	√		√						√			√
Alam et al. (2021)	√	√	√	√		√			√			√	√
Linjawi and Agou (2020)	√				√					√			√
del Arco et al. (2021)		√		√	√	√				√			√
Torres Martín et al. (2021)				√	√	√							
Rus-Casas et al. (2021)	√			√									
Dolawattha et al. (2019)	√	√		√	√	√		√					√
Nangawe (2015)	√	√	√					√		√			
Muries and Masele (2017)	√	√							√				√
Gillis and Krull (2020)		√		√	√	√	√	√	√	√			√
Aldowah et al. (2019)		√				√		√	√	√			√
Coverage per subtheme	25	29	15	32	22	28	14	10	15	20	4		25
Total coverage for theme	69	82	24	64									
Number of articles	36	39	17	32									

Notes: US = usefulness; EU = ease of use; CO = compatibility; NE = needs and expectations; RD = readiness; PS = pedagogical skill; ET = ethics; RG = regulation; GV = governance; IN = infrastructure; RC = recognition; SS = social support