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Systematic Review of Educational Technology Courses for Pre-Service Teachers: Trends and Challenges

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Abstract

In the era of the fourth industrial revolution, information technology has become a crucial part of education. Information technology has a significant impact on educational research and development, and it is also a common requirement in pre-service teachers' education and the overall teachers' education system. Moreover, the reform of elementary education poses new challenges to teachers' literacy structure. The educational technology courses have become compulsory courses for pre-service teachers at a university. This systematic review employed the PRISMA guidelines to analyse existing literature on educational technology courses for pre-service teachers. A total of 28 relevant articles published between 2010 and 2025 were retrieved from two major databases: Scopus and Web of Science. The review focused on exploring the trends, challenges, and future directions in designing and implementing these courses. The review identified four key elements commonly emphasized in the design of educational technology courses for pre-service teachers: (i) integration of the TPACK framework, (ii) lesson design and teaching plan practices, (iii) ethical and inclusive practices, and (iv) professional growth or professional development. The TPACK framework appeared as the most dominant trend in 23 of the reviewed articles, while ethical and inclusive practices were the least addressed, mentioned in only 6 articles. The key challenges identified include limited contextual integration of technology within specific subject areas, insufficient practical experience in lesson design, lack of structured content on ethics and inclusivity, and inadequate support for continuous professional growth and lifelong learning. By systematically reviewing existing literature, this study provides a comprehensive overview of development of the educational technology courses for pre-service teachers and proposes effective course design to support the professional development of pre-service teachers' information literacy.

Keywords: Educational Technology Courses, Prisma, Pre-Service Teachers, Teachers' Professional Development, Course Design, Competency

Introduction

The fourth industrial revolution has been reshaping global landscapes by integrating technologies from the physical, digital and biological domains, exerting a profound influence on the global education system (Schwab, 2016). In Malaysia, the accelerating pace of technological innovation has catalyzed significant reforms in education, as seen in the implementation of the 2023 Digital Education Policy (Ministry of Education, Malaysia, 2023). Aligned with national frameworks like the 12th Malaysia Plan (2021–2025) and the Fourth Industrial Revolution Policy, this initiative seeks not only to foster a workforce adept in digital competencies but also to reshape the education landscape (Fadhlina, 2024). Despite Malaysia's national push for digital education reform, technological integration across schools remains uneven. As of 2024, only around 40% of schools across Malaysia have fully integrated digital tools like learning management systems and educational apps into their regular curricula (Ministry of Education, Malaysia, 2024). This lag is also reflected in pre - service teacher training. A study by the Malaysian Institute of Education in 2023 revealed that nearly 60% of pre - service teachers struggle with designing data - driven lesson plans and using adaptive learning platforms, indicating a substantial gap in their digital skills (Malaysian Institute of Education, 2023)

The convergence of emerging technologies such as generative AI, blockchain, and immersive technologies is reshaping the landscape of teaching and learning in Malaysia. In Kuala Lumpur, several pilot schools have partnered with both local and international technology firms to introduce AI-powered learning platforms. These platforms not only personalize learning experiences but also identify early signs of student disengagement, providing tailored tutoring to address individual needs. As a result, student engagement in these schools has soared by approximately 35% compared to traditional teaching methods (Ministry of Education, Malaysia, 2025). This remarkable progress has prompted institutions like the University of Malaya to respond proactively. They have introduced specialized courses in educational technology, covering topics such as AI ethics in education, learning analytics, and metaverse-based teaching strategies (University of Malaya, 2024). These initiatives are paving the way for a more dynamic and inclusive educational future in Malaysia.

Pre-service teacher education faces significant challenges in equipping future educators with the skills necessary to navigate the rapidly evolving tech-driven educational landscape. A study by Universiti Sains Malaysia in 2025 revealed that current teacher training programs often fall short in addressing emerging competencies such as AI-enabled curriculum design, digital equity, and cross-cultural digital collaboration (Universiti Sains Malaysia, 2025). To address this gap, the Malaysian government, which aims to hire 16,886 to 20,081 new teachers over the next five years (Lim, 2023), is prioritizing the enhancement of digital skills among new recruits. Several teacher training institutions have introduced "micro-credentials" in educational technology. These credentials enable trainees to master skills such as developing VR-based lesson plans and conducting digital inclusion audits. These initiatives are part of a broader effort to implement the Digital Education Policy (Ministry of Education, Malaysia, 2025) and ensure that future educators are well-prepared to leverage technology effectively in their classrooms.

The need for systemic reform in teacher education is further emphasized by international frameworks like the OECD's "Digital Competence Framework for Teachers"

(2024). Educational technology and the specific subject teaching need the integration because of the features of educational technology and the specific subject, from the analysis of the existing course of educational technology for preservice, general educational technology has been taught, from the application of text, picture edition, audio or video edition, and some software like PPT, Camtasia. But with the emerge of new technology and the using of smart devices with internet, and new teaching methods has been used widely, like Flipped classroom, Blended learning, Smart classroom, Integrated teaching of face-to-face teaching and online teaching, and AI assisted teaching and learning, the information literacy of preservice teachers need to be updated, and reconstructing educational technology courses around these emerging paradigms is crucial for equipping pre-service teachers with the competencies needed for 21st century classrooms.

Research Objectives

This review aims to comprehensively summarize the existing research on educational technology courses for pre-service teachers. It will analyze the theoretical foundations, the role of educational technology in teachers' professional development, and the current research status of these courses. By doing so, it can identify the research gaps and provide a solid theoretical basis and direction for future research.

This review employs a systematic analysis of existing research to address two primary objectives:

1. To explore recent trends, practices, and developments in educational technology courses for pre-service teachers.
2. To identify the key challenges and issues faced in the design, implementation, and integration of educational technology courses, including but not limited to the TPACK framework.

Methodology

A systematic review of the literature was performed based on the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology which is a recognised approach from (Liberati et al., 2009). A comprehensive search of electronic databases was conducted from the Web of Science (WOS) database and the Scopus database as they include all big journal such as SAGE Journals, IEEE Explore and Sciencedirect and their comprehensive access to full titles and abstracts, facilitating early screening. Database were searched using the keywords ALL=(("pre-service teachers" OR "normal students" OR "normal college students" OR "normal school students" OR "normal university students") AND ("educational technology course" or "information technology course")). The search keywords were set to identify and recognize all the studies published on the trends and challenges of designing the educational technology courses for pre-service teachers and to cover the support that can be suggested as solutions to these challenges. The incorporation and exclusion criteria serve the purpose of ensuring the legitimacy and relevance of the primary studies included in the Systematic Literature Review (SLR). The database searches will be restricted to include articles published from 1 January 2010 onwards (2025-02-01) and only articles available in English will be included.

Table 1
Inclusion and exclusion Criteria

Inclusion Standards	Exclusion Standards
Full-text articles published during the designated timeframe (from 2010 to 2025) and available in the specified database. Study manuscript written in English. Articles focused on educational technology courses for pre-service teachers who not majored in educational technology.	Uncompleted papers Non-English papers Outside the selected period Non-empirical papers Articles focused on pre-service teachers who majored in educational technology. Articles with insufficient or unclear methodologies. Theoretical papers without empirical evidence (unless highly relevant).

In the initial phase, this investigation identified, we identified 88 articles. After removing 25 duplicates articles, we were left with 63 unique articles.

Based on Figure 1, of the 63 articles, 16 were excluded for not meeting our inclusion criteria, as detailed in Table 1. This exclusion process left us with 47 articles. However, 6 of these articles were not accessible and had to be excluded from detailed examination. Ultimately, 41 articles were selected for further study. Notably, 28 articles addressing the educational technology course for pre-service teachers were deemed significant.

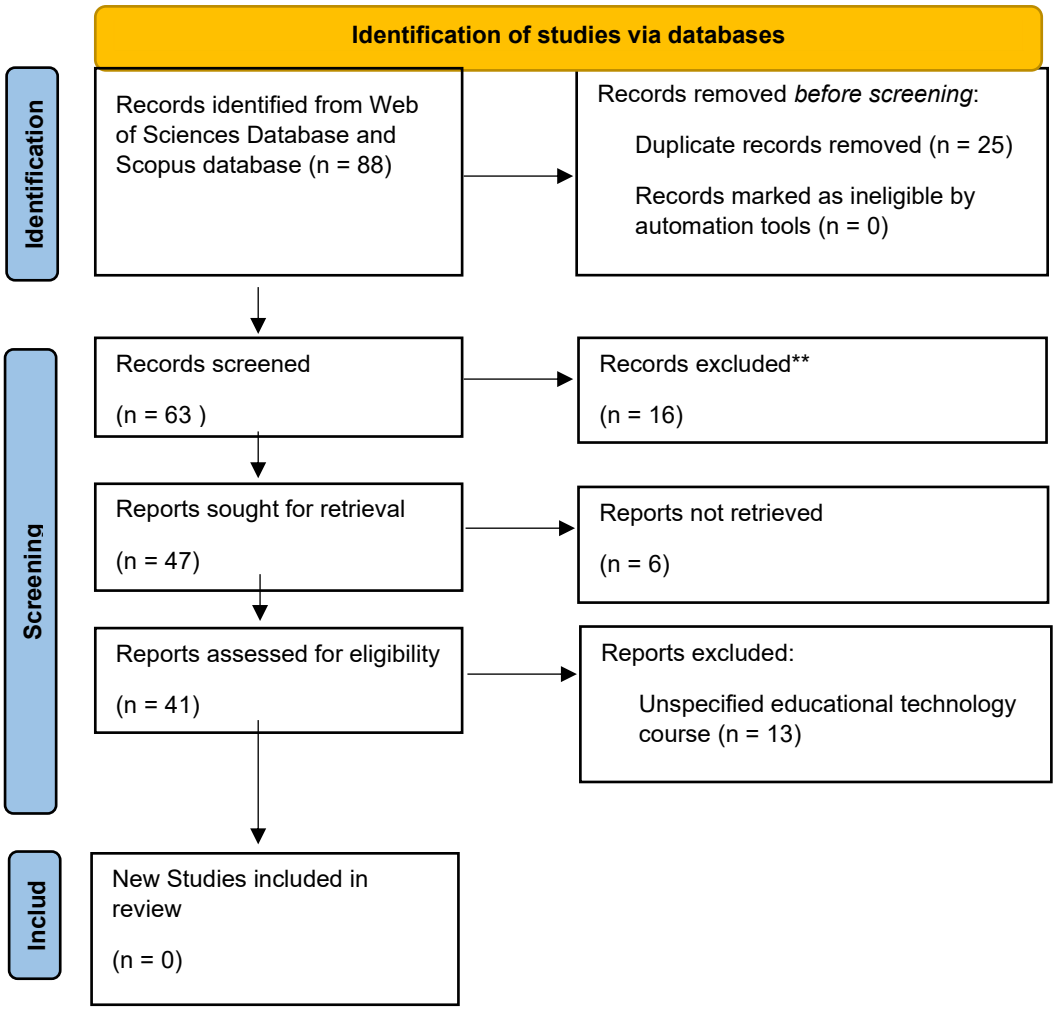

Figure 1: PRISMA Steps

Findings on Recent Trends, Practices, And Developments in The Educational Technology Courses for Pre-Service Teachers

Based on the analysis of 28 selected articles, this review identified four key elements that represent recent trends, practices and developments in the design of the educational technology course for pre-service teachers. This review identifies four key elements integrated into educational technology courses—not standalone courses themselves. These elements address competencies pre-service teachers develop within ET coursework. These elements are: (i) the integration of TPACK Framework (Techology, Pedagogy, and Content Knowledge) (ii) Lesson Design or teaching plan development, (iii) Ethical & Inclusive Practices, and (iv) Professional Development Skills Integration. The frequency of these elements across the reviewed studies is listed in Table 2.

Table 2
Elements Analysis of Educational Technology Course for Pre-service teachers

No.	References	TPACK Framework or Integration of Techology and Content Knowledge	Lesson Design or Teaching Plan	Ethical & Inclusive Practices	Professional Development Skills Integration
.	(Incikabi, L., Tokmak, H.S., 2013)	✓			✓
.	(Cheong, D., 2010)		✓	✓	
.	(Yan, H., Xiao, Y., Wang, Q., 2012)				✓
.	(Istenič Starčič, A., Turk, Z., 2016)	✓			✓
.	(Roberts, K., Kruse, J., 2023)	✓		✓	
.	(Yang, H., Mouza, C., et al., 2018)	✓	✓		
.	(Jiang, L., 2011)	✓	✓		
.	(Campbell, C., Tran, T.L.N., 2021)		✓	✓	
.	(Fadzil, H.M., 2018)	✓		✓	
10.	(Demirer, V., Sahin, I., 2013)	✓		✓	
11.	(Yang, X., Ji, M., Zhang, J., et al., 2019)	✓			
12.	(Huang, K., Lubin, I.A., Ge, X., 2011)	✓			✓
13.	(Funkhouser, B.J., Mouza, C., 2013)	✓			
14.	(Giles, M., Baker, S.F., Willis, J.M., 2020)	✓			✓
15.	(Kulaksiz, T., 2023)	✓	✓		
16.	(Daud, M.Y., Khalid, F., 2014)	✓			✓
17.	(Campbell, C., et al., 2013)	✓			

No.	References	TPACK Framework or Integration of Techology and Content Knowledge	Lesson Design or Teaching Plan	Ethical & Inclusive Practices	Professional Development Skills Integration
18.	(Haşlaman, T., et al., 2024)	✓			✓
19.	(Mouza, C., et al., 2017)	✓	✓		✓
20.	(Thohir, M.A., et al., 2025)	✓	✓		
21.	(Lubin, I.A., Ge, X., 2012)	✓	✓		
22.	(Jian, C., Lei, X., Feng, W., 2011)				✓
23.	(Eltahir, M.E., et al., 2024)			✓	✓
24.	(Lux, N., et al., 2011)	✓	✓		✓
25.	(Zhao, L., Liu, X., et al., 2021)	✓			✓
26.	(Anas Thohir, M., et al., 2021)	✓	✓		
27.	(Bello, LK, et al., 2020)	✓			✓
28.	(Sen-Akbulut, et al., 2021)	✓	✓		
	Total	23	11	6	13

Integration of TPACK Framework or Integration of Techology and Content Knowledge

The integration of the TPACK Framework (Technology, Pedagogy, and Content Knowledge) has emerged as the most dominant approach in the design of educational technology courses for pre-service teachers. Notably, 23 out of the 28 reviewed articles explicitly incorporated the TPACK framework as a core element in structuring and delivering these courses. This highlights the widespread recognition of TPACK as an essential model for fostering technology integration skills among future educators. Opposite to a simple view of technology, TPACK framework presents a way of thinking about effective technology integration (Incikabi & Tokmak, 2013; Yang et al., 2019), the development of digital competences has to take place in a cross-curricular context and according to the TPACK technology integration model.

In China, the educational technology course has become a compulsory course for pre-service teachers who are not majored in educational technology (Zhao et al., 2021). But the instructional contents of this course need to be modified to cope with the discipline which will be taught by pre-service teachers, the Modern Educational Technology Center (METC) of East China Normal University (ECNU) decided to improve the course for pre-service teachers at the end of 2010 (Yan et al., 2012).

In order to sufficiently integrating educational technology and teaching content, a theoretical framework needs be introduced to pre-service teacher, TPACK centres on the nuanced interactions among three bodies of knowledge: content knowledge (CK), technology knowledge (TK), and pedagogical knowledge (PK) (Mouza et al., 2017), which can help the

pre-service teachers have a framework of integrating the educational technology with their teaching content.

Lesson Design or Teaching Plan

Lesson design or teaching plan development is another essential element frequently integrated into educational technology courses for pre-service teachers. In this review, 11 out of the 28 analyzed articles explicitly focused on incorporating lesson design activities as a core component of the course. This finding underscores the growing emphasis on providing practical, hands-on experiences that enable pre-service teachers to apply their knowledge of technology within authentic teaching contexts.

Typically, during the implementation of educational technology courses, the students were required to create and apply their own teaching plan through their experiences, and the instructor acted as the provider of the guidance rather than transmitter of the knowledge (Incikabi & Tokmak, 2013). In pre-service teachers' teaching practice in a team, collaboration can enhance friendship and facilitate lesson design and teaching practice, offer the opportunity for discussion about teaching, build practical knowledge, and provide more educative field experience (Cheong, 2010). Examination of preservice teachers' lesson designs indicated a growing understanding of TPACK-CT over time, despite differential starting points (Yang et al., 2018). Successful interventions for language teachers' TPACK development include collaborative lesson designing, understanding TPACK, and modeling, however, pre-service teachers' TPACK development is not standardized; it is rather an individualized process (Kulaksiz, 2023).

TPACK is renowned for its pre-service teachers' competence in integrating technology into learning proposed that TPACK can be conducted using the learning technology by design method because it has a rich context to create a product (Thohir et al., 2025). Technology integration through demonstration and modeling and opportunities were provided for the pre-service teachers to build lesson plans and implement technology-infused teaching. Faculty continued to model integration of technology by requiring students to videotape one another for peer review, using technology, "to aid in the creation of developmentally appropriate lesson plans for children in grades K-5" (Lux et al., 2011). The comparison of several models described to propose the effectiveness of the model in enhancing the pre-service teachers' competence through constructing the element of generic lesson planning and Web lesson design (Sen-Akbulut et al., 2021). they prepared a technology-enhanced lesson plan covering ISTE's creativity standards for their chosen subject and shared it with other groups. The lesson plan format was not structured, but they were asked to use ICT tools (e.g., Mindmeister and Storybird) to support creativity and explain their evaluation methods (Sen-Akbulut et al., 2021).

Ethical & Inclusive Practices

Ethical and inclusive practices represent an essential but least emphasized element in the design of educational technology courses for pre-service teachers. In this review, only 6 out of the 28 analyzed articles explicitly addressed issues related to ethics, equity, accessibility, and responsible technology use in educational technology courses. This finding indicates that while the importance of ethics in technology integration is acknowledged, its practical incorporation into course design remains limited and underdeveloped.

As educational technologies increasingly rely on internet-based tools, artificial intelligence (AI), and digital platforms, ethical considerations have become a crucial component of pre-service teacher training. However, the Internet and online learning environments are not free from risks or challenges. Ethical concerns such as privacy, security, digital responsibility, and equitable access need to be embedded explicitly in the educational technology curriculum.

Teaching practice sessions with students, though it does provide opportunities for pre-service teachers to improve their teaching abilities, exposes the students to untried teachers, which could raise an ethical concern (Cheong, 2010). Educators and policymakers must proactively embrace AI integration, ensuring ethical and equitable implementation (Eltahir et al., 2024).

Educational equity is an issue that every educator cannot avoid. Roberts (2023) Emphasized two important aspects in the field of technology. On the one hand, we should have the ability to effectively use technology and think critically about it, while also being able to recognize the problems and negative impacts that technology may bring. On the other hand, we should actively build new technological systems with the aim of identifying inequalities. With the development of Artificial Intelligence, AI promotes educational equity, ensuring that learners of different abilities and backgrounds receive the support they need (Eltahir et al., 2024).

Web-based educational technology has been changing the classroom teaching. The online environment may provide accessibility and flexibility in terms of time and place with the opportunities of more interaction through online discussion (Demirer & Sahin, 2013).

Integration of Professional Development Skills

Professional growth or professional development emerged as the second most frequently emphasized trend in the design of educational technology courses for pre-service teachers. In this review, 13 out of the 28 selected articles highlighted the importance of embedding elements of professional growth within these courses. This finding indicates increasing recognition of the need to prepare pre-service teachers not only with technical skills but also with the ability to continuously develop and adapt their competencies in line with rapid technological advancements in education.

The Educational Technology Course for pre-service teachers should include the professional growth content of pre-service teachers to open a door and build a platform for them to renew their teaching skills through emerging technologies continuously, it is an ability of not only self-study but also long-life study for pre-service teachers. Rather than standalone courses, PD is integrated through:

- Micro-credentials: Short certifications in niche skills (e.g., VR lesson design, digital inclusion audits) (Ministry of Education, Malaysia, 2025).
- Reflective practice: E-portfolios documenting skill evolution and self-directed learning goals (Campbell & Tran, 2021).
- Future-focused projects: Tasks requiring exploration of tools beyond the syllabus (e.g., AI-assisted grading systems) (Zhao et al., 2021).

Studies stress that PD components must bridge initial training and lifelong learning. For example, Huang et al. (2011) found that pre-service teachers rarely connected course content to their future professional identity, while Lux et al. (2011) emphasized that PD support is vital for sustaining technology integration post-graduation.

Findings on Key Challenges and Issues

The review of 28 selected articles revealed several critical challenges and issues that hinder the effective design, implementation, and integration of educational technology (ET) courses for pre-service teachers, including but not limited to the TPACK framework. These challenges occur across four major dimensions: (i) Integration of TPACK Framework, (ii) Lesson Design Practice, (iii) Ethical and Inclusive Practices, and (iv) Professional Growth Development.

Limited Integration of TPACK Framework Across Subject Discipline

One of the primary challenges identified in the reviewed studies is the limited and superficial integration of the TPACK framework in ET courses. While TPACK has been widely recognized as essential for developing pre-service teachers' ability to merge content knowledge, pedagogy, and technology, its practical application remains problematic.

Several studies reported that educational technology courses often deliver generic technology skills (e.g., picture editing, audio-video editing, PowerPoint creation) without aligning them with specific teaching disciplines. For example, Jiang (2011), in his research, highlighted that pre-service teachers in physical education (PE) courses received the same ET content as those in other fields, resulting in a disconnect between technology training and subject-specific teaching needs. This phenomenon actually appears in the teaching process of educational technology courses in many universities.

In the education scene, the integration of technology is largely driven by the current educational technology development trend (Fadzil, 2018). Strong technology integration affects pre-service teachers' ability to self-regulate in the design, development, practice and evaluation of teaching processes and knowledge (Thohir et al., 2025).

In contrast to a general view of educational technology, TPACK framework stresses the connections, interactions, affordances, and constraints of technology, pedagogy, and content; TPACK framework gives teachers a way of thinking about effective technology integration; TPACK requires teachers to find out technologies and pedagogical strategies that fit the subject teaching (Incikabi & Tokmak, 2013). The TPACK framework requires teachers to go beyond the general use of technology and to look at and use technology from a more critical perspective (Roberts & Kruse, 2023). Pre-service teachers' competency in technological literacy will be enhanced by integrating dimensions of technology, pedagogy and content knowledge (Istenič Starčič & Turk, 2016).

Teachers need to master the knowledge of integrating technology with the teaching of specific disciplines so that they can effectively use technological tools to teach the content of specific disciplines in the teaching process (Yang et al., 2019). One of the key factors for successful technology integration lies in the teaching philosophy and personal beliefs of teachers (Funkhouser & Mouza, 2013). Educators in teacher preparation programs need to

have a thorough understanding of strategies that can positively influence the use and integration of technology in pre-service teachers (Giles et al., 2020).

Lesson design: Lack of Practical Lesson Design Skills and Contextual Application

The second major challenge is the insufficient emphasis on lesson design practice in ET courses. Many courses focus heavily on theory and basic technology use but provide limited opportunities for pre-service teachers to design, develop, and implement technology-enhanced lesson plans in realistic teaching contexts.

The preparation of the practical activity had two aims, one was to prepare a lesson plan and material, the other was to prepare teaching tools (Cheong, 2010). Jiang (2011) said that practices should be increased for PE students during the course study. Practice contents should be set to enable the students to carry out concrete practice, besides learning theoretical courses, so as to master educational technology and skills.

Campbell (2021), said that the challenges identified included the disconnect between learning design and implementation, pre-service teachers' lack of design skills and knowledge, varied pedagogical methods, context constraints, limited tool functionality, lack of collaboration among practitioners, and the mismatch between teachers' design and student behavior.

According to Yang (2018), the pre-service teachers first examined user-created projects available on a community (an online publicly forum where educators exchange resources pose questions and share experiences to broaden the integration of technology into core curricular contexts) that fit their curricular goals. And then, they examined a variety of lesson plans through the community. At last, they identified a learning goal within their content areas (e.g., science, mathematics, English) and developed a lesson plan that integrates technology with curriculum content. Yang (2018), also pointed out that pre-service teachers encountered difficulties in either selecting appropriate technologies into the context of disciplinary content and pedagogy.

Mouza (2017) mentioned to use Technology Integration Assessment Rubric to evaluate pre-service teachers' lesson plans in the spirit of the TPACK framework; and Thohir (2025) said to use learning management system (LMS) and the Web to design lesson plans. But they didn't mention how to make a lesson plan. Lux (2011) said that instead of providing pre-service teachers with all the tips, tricks, and complete lesson plans, teachers could guide them toward their own understanding of how technology supports teaching and learning.

Anas (2021) has mentioned that TPACK framework can provide guidance for curriculum design, it can also provide theoretical and epistemological support in specific learning environments such as Web learning.

Inadequate Focus on Ethical & Inclusive Practices in Technology Use

Ethical and inclusive practices in educational technology were found to be the least emphasized area in the reviewed studies, appearing in only 6 out of 28 articles. Despite the growing importance of digital ethics, privacy, equity, and accessibility in the use of technology,

ET courses for pre-service teachers rarely offer structured content or activities addressing these issues.

The ethical education for pre-service teaching using educational technology is very important. Cheong (2010) said that unintended mistakes during practicing teaching may negatively impact to the students because in a classroom any undesirable behaviors or mistakes by pre-service teachers cannot simply be undone. Eltahir (2024) pointed out ensuring ethical and equitable implementation. And Campbell (2021) has also mentioned ethics approvals, but they were only for their research needs.

Educational equity is an issue that every educator cannot avoid. Roberts (2023) said that responsible use and equity issues related to technology is one of course objective. The rapid integration of AI in education further complicates the ethical landscape, requiring new policies and practices to ensure responsible and equitable implementation (Eltahir et al., 2024).

Eltahir (2024) has mentioned that AI-driven technologies enhance accessibility and inclusivity, it makes equitable learning opportunities for all students. Fadzil (2018) said accessibility to online information is one of integration of technology. Demirer (2013) pointed out that Online environments may provide accessibility and flexibility in terms of time and place.

From above review, all of them did not mention how to do and what to do on Ethical & Inclusive Practices for pre-service teachers during learning Educational Technology Course. This highlights an urgent need for ET courses to incorporate structured modules on digital ethics, AI literacy, and equitable technology practices.

Professional Growth of Pre-Service Teachers

The final challenge concerns the limited focus on fostering professional growth and lifelong learning skills among pre-service teachers. Although ET courses typically run for one or two semesters, the rapid evolution of educational technologies requires teachers to continually upgrade their digital competencies beyond initial training. Lux (2011) highlights the critical role of adequate professional development opportunities and corresponding support in achieving effective technology integration.

With the rapid technological development, pre-service teacher education and continuing professional development are facing major changes especially in the area of teacher competence (Istenič Starčič & Turk, 2016). Incikabi (2013) has pointed out the importance of professional development, teachers are not very likely to integrate technology-based or technology-rich activities into their courses without professional development on integrate technology use into the lesson content. Part of the difficulty may be related to the teaching support received at the university, there is also the aspect of future teaching practice (Huang et al., 2011).

Researchers, such as these, provided justification for further investigative research in this area, which may lead to recommendations for improved teacher education programs

and professional development opportunities that improve self-efficacy in technology-assisted instruction. (Giles et al., 2020).

Jian (2011) has suggested to use the WebQuest template to design the contents of "Instructional Media Selection and Development", according to the characteristics of professional and future career of students. By harnessing the potency of AI, we can not only enhance the quality of teaching and learning but also groom learners to be well - prepared for an AI - propelled future (Eltahir et al., 2024), eventually, they will be able to use these technologies in their future professional careers (Zhao et al., 2021).

To address these challenges, researchers recommend that ET courses be designed not only to build initial competencies but also to nurture self-directed learning, adaptability, and engagement in professional learning communities (Giles et al., 2020).

Conclusion

This systematic review was conducted to explore the recent trends, key challenges, and future directions in the design, implementation, and integration of educational technology (ET) courses for pre-service teachers. The analysis of 28 selected articles revealed four major elements commonly emphasized in the development of ET courses, namely: (i) the integration of the TPACK framework, (ii) lesson design and teaching plan practices, (iii) ethical and inclusive practices, and (iv) fostering professional growth or professional development.

Among these, the integration of the TPACK framework appeared as the most dominant trend, adopted by 23 out of 28 studies, reflecting its critical role in equipping pre-service teachers with the ability to effectively merge technology, pedagogy, and content knowledge. Lesson design practices were highlighted in 11 articles, focusing on developing practical skills for creating technology-enhanced lesson plans. Meanwhile, professional growth and development were emphasized in 13 studies, showcasing the increasing need to nurture lifelong learning skills among future teachers. However, ethical and inclusive practices emerged as the least addressed area, mentioned in only 6 articles, indicating a significant gap in the current ET course design.

Despite these advancements, this review also identified several critical challenges faced in the design and implementation of ET courses. These challenges include the limited integration of technology within subject-specific contexts, insufficient practical lesson design experiences, lack of structured ethical and inclusive practice modules, and inadequate support for continuous professional growth beyond the completion of the course. Addressing these challenges requires a paradigm shift in how educational technology courses for pre-service teachers are designed and delivered. Course developers and educators should move beyond basic technology training and focus on holistic, practice-oriented learning experiences that integrate technology meaningfully within specific disciplines. There is also an urgent need to embed ethical considerations, digital responsibility, and inclusive practices into the curriculum to prepare future teachers for responsible and equitable technology integration in diverse classroom settings.

Moreover, ET courses should not be treated as standalone or short-term programs but should be part of a broader professional learning ecosystem that fosters continuous growth, adaptability, and innovation among pre-service teachers. Institutions should develop dedicated professional growth lessons integrated in the ET courses, e.g., 'AI-Driven Curriculum Design,' 'Digital Equity Leadership', to address emerging gaps. Examples include Universiti Malaya's specialised courses in AI ethics and metaverse teaching (University of Malaya, 2024) and Malaysia's micro-credential initiatives for VR/adaptive tools (Ministry of Education, 2025). The EDUTECH BOOTCAMP initiative, facilitated through the EDUTECH ALUMNI WhatsApp group, Facebook, YouTube at Universiti Teknologi Malaysia (UTM), organizes numerous webinars and workshops on educational technology. These activities provide substantial benefits for both current students and graduates.

In conclusion, this review provides valuable insights into the current landscape of educational technology courses for pre-service teachers, highlighting both progress and persistent gaps. Future research should focus on developing integrated frameworks, exploring contextual challenges, and designing innovative pedagogical strategies to ensure that educational technology courses are capable of producing future-ready teachers who are skilled, ethical, and adaptable in an increasingly digital educational environment.

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