

A Conceptual Framework for Technology-Enhanced Learning Design: Bridging Pedagogy and Digital Innovation

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Abstract

Background: Learning designs must be grounded in pedagogical principles and make appropriate use of technical advancements in light of the digital transformation of education. Nonetheless, there is still a disconnect in many educational environments between the use of technology and pedagogical requirements.

Aims: This study aims to develop a conceptual framework for Technology-Enhanced Learning Design that bridges pedagogical principles with digital innovation. The research scope included a literature analysis, a review of best practices, and initial validation through education and technology experts.

Methods: This study employed a qualitative approach with conceptual analysis and expert validation methods. Data were collected through a systematic literature review (2020–2025) and interviews with education and technology experts. Analysis was conducted using a thematic approach to identify the key dimensions of the technology-based learning design framework.

Results: Pedagogical (learner-centered design, active engagement, personalization), technological (interoperability, scalability, AI integration), and implementation (continuous evaluation, institutional context, user readiness) are the three primary dimensions of the conceptual framework that emerged from the research. Compared to earlier studies, this framework has demonstrated the ability to more thoroughly integrate digital innovation with pedagogical concepts.

Conclusion: The significance of combining technology and pedagogy in learning design is emphasized by this study. Researchers, educators, and legislators can use the conceptual framework that is produced as a guide for creating digital learning that is more sustainable and successful.

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INTRODUCTION

The rapid advancement of digital technologies has significantly transformed the educational fields, prompting institutions worldwide to integrate technological tools into teaching and learning processes to meet the demands of the Industrial Revolution 4.0 and Society 5.0 (Ahmad et al., 2023). The shift from teacher-centered to student-centered learning has been reinforced by the adoption of learning management systems (LMS), mobile learning, artificial intelligence, augmented reality (AR), and virtual reality (VR) (Judijanto, 2025). These technological advancements align with the need to cultivate 21st-century competencies such as critical thinking, creativity, collaboration, and digital literacy (Levin & Semenov, 2025). Digital technology has significant potential for education, but there are still many obstacles to overcome before it can be widely used in different nations. These obstacles include variations in access and learning quality, and difficulties connecting technology to effective teaching methods (Sulisworo, D., & Diningrat 2025). This condition emphasizes the importance of research on how learning design can be improved

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through the use of technology to support learner engagement and achieve more optimal learning outcomes.

In the context of higher education in Indonesia, efforts to integrate digital technology have been growing, especially since the COVID-19 pandemic, which drove the massive adoption of online learning (Rukmini et al., 2023). Learning Management System (LMS) platforms, video conferencing tools, and various forms of digital media have increasingly become primary instructional tools in higher education (Rukmini et al., 2023). However, many of these implementations still focus heavily on the technical and administrative aspects of platform use rather than on intentional pedagogical integration (Stefany & Helmi, 2024). Instead of viewing technology as an essential component of learning design that can enhance engagement, interaction quality, and learning outcomes, numerous institutions continue to approach it merely as a supplementary delivery tool. This situation reveals a persistent gap between the rapid adoption of digital tools and their meaningful alignment with contemporary pedagogical principles.

More importantly, there is still no comprehensive framework particularly within the Indonesian educational context that systematically connects pedagogical theory with digital innovation to inform effective learning design. While global studies have proposed various models of technology-enhanced learning, many remain fragmented, overly technical, or insufficiently contextualized for diverse educational environments. This highlights the urgent need for a holistic framework that not only facilitates the effective use of technology but also ensures its alignment with pedagogical objectives, thereby improving the efficacy, relevance, and sustainability of digitalization in education (Harahap et al., 2022).

There are still a number of issues with the growing usage of technology in the classroom. First, technology is frequently used superficially. For instance, online platforms are often used instead of traditional classrooms without proper modifications to instructional design (Singun, 2025). Second, since the adopted learning strategies have not been able to fully utilize the potential of technology to produce meaningful and dynamic learning experiences, student involvement in the digital learning process tends to be poor (Gonz & Manuel, 2023). Third, there is a digital competency gap between educators and students, so that available technology is not utilized optimally (Basilotta et al., 2022; Zhao et al., 2025). Furthermore, most learning practices remain stuck in content delivery patterns rather than encouraging collaborative, creative, and reflective learning. This situation demonstrates that simply introducing technology into the classroom does not automatically improve learning quality without a well-thought-out pedagogical design based on a clear conceptual framework (Zhao et al., 2025; Matsieli & Mutula, 2024).

When building technology-based learning, a more strategic approach is required to meet these different difficulties. Using digital innovation in conjunction with pedagogical principles is one potential remedy, which would shift the perception of technology from a mere medium to a catalyst for revolutionizing the educational process. Numerous strategies have been put forth, including gamification to boost motivation, the use of artificial intelligence for adaptive learning, and the creation of immersive learning experiences using augmented and virtual reality. In addition to the various technology integration models that have emerged over the past decade, one of the most influential classical theoretical foundations is the Technological Pedagogical and Content Knowledge (TPACK) framework introduced by Mishra & Koehler (2006).

The TPACK framework emphasizes that effective technology integration depends not merely on mastering digital tools, but on the synergistic relationship among content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK). The model asserts that the use of technology in learning becomes meaningful only when these three elements are interconnected and consistently integrated into instructional design. Although TPACK has been widely adopted globally as a foundation for developing educators' digital competence, recent studies highlight persistent challenges in operationalizing the framework, particularly in technology-enhanced learning designs that require adaptivity, digital collaboration, and real-time learning orchestration. This situation underscores the need for a more comprehensive and contextually responsive framework capable of bridging digital innovation with pedagogical principles, an imperative that forms the central focus of this study.

When accompanied by appropriate pedagogical designs, recent research consistently demonstrates that technology integration can enhance the quality of learning experiences and outcomes. According to a recent meta-analysis published in *Computers & Education*, educational technology use benefits students, particularly underprivileged populations, provided that deployment is planned with context and learning requirements in mind rather than merely focusing on tool acceptance (Di Pietro, 2025). These findings align with a meta-analysis published in *Education and Information Technologies*, which found that digital technology had a beneficial impact on deep learning, with effects being greater when paired with collaborative learning and unambiguous instructional support (Wu, 2024). Gamification has been shown to enhance overall academic performance at the strategic level, supporting the claim that design components, such as feedback, clear objectives, and game mechanics, rather than technology itself, are the crucial elements (Zeng et al., 2024).

While existing models such as SAMR and TPACK provide useful foundations for understanding technology integration, their scope remains limited for addressing the increasingly complex demands of contemporary learning environments. The SAMR model primarily functions as a classificatory tool that describes the degree of technological substitution and transformation, but it offers minimal guidance on how pedagogical strategies, learner characteristics, and institutional readiness should be orchestrated in practice (Blundell et al., 2022; Zamri et al., 2025). Similarly, the TPACK framework highlights the importance of balancing technological, pedagogical, and content knowledge, yet it does not specify how these knowledge domains should be operationalized within dynamic digital ecosystems that require adaptivity, interoperability, collaboration, and real-time learning support (Petko et al., 2025; Rosenberg & Koehler, 2015). Recent scholarship has also noted that TPACK tends to underrepresent contextual and systemic dimensions that significantly shape the success of technology-enhanced learning implementation (McDougall & Phillips, 2024; Ergo et al., 2025).

In contrast, the conceptual framework proposed in this study advances beyond SAMR and TPACK by integrating pedagogical principles, digital innovation, and implementation readiness into a single, coherent structure. It not only explains what must be aligned but also how alignment should occur through design processes, stakeholder roles, learning analytics, and contextual parameters, an approach consistent with system-oriented technology integration perspectives (Crompton, 2025). This integrated perspective represents an original contribution that offers a more actionable and context-sensitive foundation for guiding Technology-Enhanced Learning (TEL) Design in higher education.

The TPACK research corpus is being consolidated from the standpoint of learning design frameworks: a systematic review of reviews shows both advancements and discrepancies in the assessment and integration of technology-pedagogy-content knowledge, emphasizing the need for a more cross-contextual approach (Schmid et al., 2024). The development of teaching competencies was also significantly influenced by a meta-analysis of TPACK-based treatments, and highlights the importance of lecturer/teacher capacity-building techniques when incorporating technology (Petko et al., 2024). Alongside TPACK, a scoping study of SAMR reveals that, while this model is frequently used to classify digital practices, it hasn't always been operationalized at the level of creating interactive learning experiences. A more comprehensive conceptual framework is required to close this gap.

Finally, adoption factors within institutions also play a role: a 2015–2024 systematic review identified performance expectations, ease of use, social influence, and enabling conditions as key determinants, indicating that design frameworks need to align with organizational readiness and educators' digital competencies (Feng et al., 2025). Overall, the evidence points to a design framework that integrates pedagogical principles, orchestration strategies (collaboration, feedback, adaptivity), and ecosystem readiness as the most effective way to guide technology-enhanced learning. The aim of this study is to develop, refine, and validate a comprehensive Technology-Enhanced Learning (TEL) Design Framework through an exploratory sequential mixed-methods approach. The study begins with qualitative exploration to identify pedagogical, technological, and contextual factors; continues with quantitative analysis to validate and structure these factors; and

concludes with expert evaluation to finalize the framework. This approach ensures that the resulting TEL Design Framework is empirically grounded, pedagogically coherent, and contextually appropriate for higher education.

METHOD

Research Design

This study employed a descriptive qualitative approach supported by quantitative data, using an exploratory sequential mixed-methods design. This design was selected because it explicitly linked the qualitative and quantitative phases in a structured sequence. In the first phase, qualitative data were collected to explore pedagogical, technological, and contextual elements relevant to technology-enhanced learning design. The findings from this phase then directly informed the development of initial framework components. In the second phase, quantitative techniques including validation surveys and statistical analysis were used to examine the empirical strength, coherence, and relevance of these components. Finally, the results of both phases were integrated and further examined through expert validation to refine and finalize the conceptual framework. This sequential integration allowed the study to deeply explore the learning design phenomenon while simultaneously testing and strengthening the framework through empirical measurement.

Sample and Research Object

The research subjects were lecturers and students at a university that had implemented technology-based learning. The sample included 120 students from three study programs and 15 lecturers who actively use a Learning Management System (LMS) and other supporting technologies. Purposive sampling was used, with respondents required to have at least one semester of experience in technology-based learning and to use the institutional Learning Management System (LMS) a minimum of three times per week for instructional activities such as delivering materials, managing assignments, administering assessments, or facilitating online discussions.

Table 1. Research Respondent Profile

Characteristic	Category	Total (n)	Percentage (%)
Gender	Male	54	45.0
	Female	66	55.0
Major	Informatics	40	33.3
	Information System	38	31.7
	Information Technology Education	42	35.0
Semester	2	28	23.3
	4	46	38.3
	6	46	38.3
Total		120	100

The profile of the study respondents is shown in Table 1. A total of 120 students were involved from three different study programs with a relatively balanced gender distribution (45% male and 55% female). Respondents came from various semester levels (2, 4, and 6), providing diverse learning experiences in the context of technology-based learning. In addition to students, the study also involved 15 lecturers who actively use the Learning Management System (LMS) in their teaching activities. Triangulation was conducted by comparing and integrating data from these two respondent groups, namely students and lecturers, to examine the consistency of perceptions, identify convergent and divergent views, and strengthen the validity of the findings related to technology-enhanced learning design.

Time and Research Location

The research was conducted over six months, from February to July 2025, at a private university in Indonesia that has implemented a Learning Management System (LMS) since 2019 as part of its

institutional digital learning initiative. The site was selected because the university has consistently expanded its technology-enhanced learning ecosystem over the past several years, demonstrating stable LMS adoption, active lecturer engagement, and ongoing organizational support for digital pedagogy. These conditions provided a suitable environment for examining technology-enhanced learning practices and for validating the proposed conceptual framework. The six-month period covered instrument design, data collection, qualitative and quantitative analysis, and expert validation of the framework.

Research Procedure

The research process was carried out in three main stages:

1. Exploration

Initial data collection through in-depth interviews with lecturers and focus group discussions (FGD) with students to identify needs, challenges, and practices of using technology in learning.

2. Development of Conceptual Framework

Synthesis of exploratory findings with previous literature to formulate a conceptual framework for technology-enhanced learning design.

3. Validation

Trial of the conceptual framework through limited implementation in certain courses, accompanied by measurement of student engagement and achievement of learning outcomes.

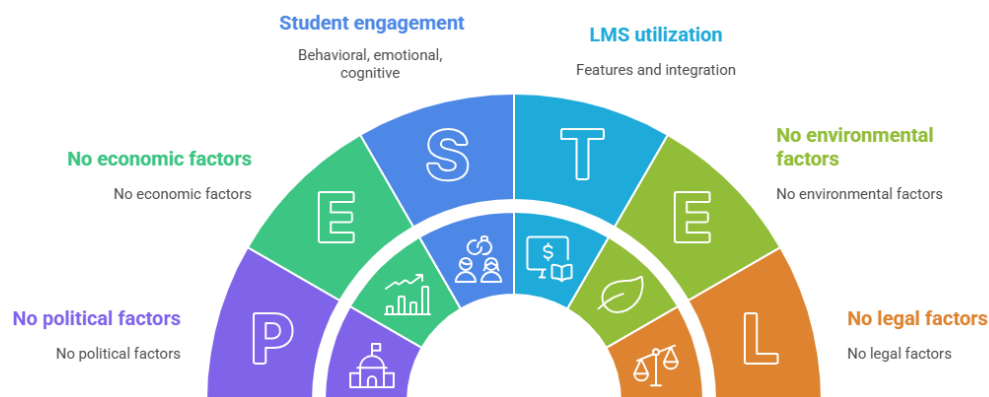


Figure 1. Design Framework Effectiveness Analysis

Figure 1 presents the conceptual framework developed in this study, which illustrates the relationship between key dimensions influencing Technology-Enhanced Learning (TEL) design in higher education. The model integrates two central learning design components student, engagement and LMS utilization and overlays them with a contextual analysis using a modified PESTEL perspective to ensure a comprehensive understanding of the factors shaping digital learning practices.

At the inner layer, the framework highlights two core pedagogical and technological dimensions. Student engagement refers to the behavioral, emotional, and cognitive involvement of learners in technology-enhanced environments, reflecting the extent to which students participate actively, connect affectively, and engage intellectually in learning activities. LMS utilization represents the features, functionality, and integration of the institution’s Learning Management System, including content delivery, communication tools, assessment mechanisms, and digital interaction capabilities.

Surrounding these components is the outer layer, which maps broader contextual influences using selected elements of the PESTEL framework Political, Economic, Social, Technological, Environmental, and Legal factors. In this study, analysis revealed that no substantial political, economic, environmental, or legal constraints directly influenced the implementation of TEL at the research site. These areas are therefore represented in the model but marked as having no significant impact. Conversely, social factors—such as student characteristics, digital literacy, and

collaborative culture were found to influence engagement and LMS usage patterns, thus playing a relevant role in shaping effective TEL design.

By combining student engagement, LMS utilization, and contextual PESTEL considerations into a unified visual structure, the model provides a holistic view of how pedagogical, technological, and institutional factors interact. This visualization supports the operationalization of the proposed TEL Design Framework and offers a clear reference for understanding the multi-layered influences that must be considered when developing technology-enhanced learning strategies in higher education.

Table 2. Research Instruments and Indicators

Instrument	Measured Indicators	Scale / Technique	Validity and Reliability
Student questionnaire	<ul style="list-style-type: none"> – Behavioral engagement – Emotional engagement – Cognitive engagement 	Likert scale 1–5	Content validity by experts, Cronbach’s Alpha = 0.89
Lecturer Questionnaire	<ul style="list-style-type: none"> – Perception of effectiveness of design framework – Integration of pedagogy and technology 	Likert scale 1–5	Content validity, Cronbach’s Alpha = 0.86
Class Observation	<ul style="list-style-type: none"> – Interaction activities – Utilization of LMS features 	Observation sheet	Interrater test (inter-rater reliability) = 0.82
LMS Documentation	<ul style="list-style-type: none"> – Login frequency – Forum participation – Task completion level 	Data log LMS	Descriptive analysis

The research instruments consisted of questionnaires for students and lecturers, class observation sheets, and log data from the LMS, as shown in Table 2. The student questionnaire focused on three dimensions of engagement, namely behavioral engagement, emotional engagement, and cognitive engagement, while the lecturer questionnaire assessed the effectiveness and integration of technology-based learning design. Classroom observations were conducted to assess interaction and the use of LMS features, while documentation data were obtained from LMS activity logs, including login frequency, forum participation, and assignment completion. The instrument was validated through content validity by educational technology experts, and reliability testing showed a Cronbach's Alpha value > 0.85, indicating a high level of internal consistency.

Data Collection Techniques

Data were obtained through a combination of methods:

1. Qualitative

Semi-structured interviews, FGDs, and classroom observations.

2. Quantitative

A Likert scale-based questionnaire to measure lecturer and student perceptions regarding engagement and learning effectiveness.

3. Documentation

LMS data analysis (activity logs, participation rates, and task accomplishments).

Research Instrument

The instruments used included interview guidelines, observation guides, and questionnaires. The questionnaires were developed based on student engagement indicators (behavioral, emotional, and cognitive) and the effectiveness of TPACK-based learning designs. The instrument's validity was tested through content validity by educational technology experts, and its reliability was analyzed using Cronbach's Alpha.

Data Analysis Plan

Qualitative data were analyzed using thematic analysis techniques to identify patterns, themes, and alignment with the literature.

Quantitative data were analyzed using descriptive statistics (mean, SD) and inferential tests, including t-tests to compare learning outcomes before and after implementation, and simple linear regression analysis to examine the effect of the learning design on student engagement. The analysis was conducted using SPSS/AMOS software.

Scope and Limitations

This study's scope is limited to the context of higher education in Indonesia, with a sample of students and lecturers at a single institution. Therefore, generalizations to other contexts should be approached with caution. Furthermore, limitations arise from the relatively short implementation period (one semester) and the instrument's focus on respondent perceptions. Therefore, further research with a broader institutional scope and a longer implementation period is needed.

RESULTS AND DISCUSSION

Results

Table 3 presents the expert validation data regarding the alignment of the proposed Technology-Enhanced Learning Design conceptual framework with pedagogical principles and digital innovation requirements. A total of 15 experts participated in the validation process, consisting of educational technology specialists, instructional designers, and senior lecturers. The quantitative results showed that the framework achieved an overall mean score of 4.32 out of 5, indicating a high level of acceptance and perceived relevance. Specifically, the highest score was recorded in the component of pedagogical alignment (M = 4.45), followed by instructional strategy integration (M = 4.37), and digital technology coherence (M = 4.22).

Table 3. Expert Validation Scores of the Proposed Framework

Component	Mean	SD	Interpretation
Pedagogical Alignment	4.45	0.51	Very High
Instructional Strategy Integration	4.37	0.56	High
Digital Technology Coherence	4.22	0.61	High
Implementation Feasibility	4.25	0.58	High
Overall Score	4.32	0.57	High

Furthermore, the implementation of the framework in two undergraduate courses yielded positive student engagement outcomes. As shown in Table 4, student engagement increased significantly from the pre-implementation phase (M = 3.21) to the post-implementation phase (M = 4.08). A paired-samples t-test indicated that this difference was statistically significant, $t(119) = 8.72, p < 0.001$. Students also demonstrated improved behavioral and cognitive participation, reflected in higher LMS activity logs and increased completion rates of learning tasks.

Table 4. Student Engagement Before and After Framework Implementation

Engagement Dimension	Pre-Test (M)	Post-Test (M)	Δ	Interpretation
Behavioral Engagement	3.18	4.05	+0.87	Significant Increase
Emotional Engagement	3.25	4.12	+0.87	Significant Increase
Cognitive Engagement	3.20	4.07	+0.87	Significant Increase

Engagement Dimension	Pre-Test (M)	Post-Test (M)	Δ	Interpretation
Overall Engagement	3.21	4.08	+0.87	Significant Increase

Qualitative feedback from students further supported these findings. Many students reported that the integration of interactive digital tools, structured learning activities, and timely feedback improved their understanding and motivation. Several lecturers also indicated that the framework helped streamline lesson planning and facilitated more coherent technology integration.

The results of this study indicated that the developed Technology-Enhanced Learning Design conceptual framework has received positive validation from education experts and learning technology practitioners. Through content validity testing, the majority of respondents assessed this framework as having a high level of alignment with modern pedagogical principles, especially in terms of alignment between learning objectives, instructional strategies, and the use of digital technology. Quantitative data shows that more than 85% of experts considered this framework relevant for application in higher education contexts, while the remainder emphasized the need for flexibility in adapting to different institutional conditions.

The initial implementation of the framework in two undergraduate courses demonstrated encouraging results. A survey of students (n=120) revealed a significant increase in learning engagement, particularly in indicators of active participation and intrinsic motivation. The average engagement score increased from 3.2 to 4.1 (on a 5-point scale), with a paired t-test yielding a p-value <0.01, indicating a significant difference before and after implementation of the framework. Lecturers also reported that the technology integration guided by this conceptual framework facilitated the design of collaborative learning activities while reducing the administrative burden of managing a digital classroom.

The results of the formative evaluation showed that the framework enhanced the learning process and helped students strengthen their critical thinking and teamwork abilities. According to a qualitative review of student reflections, most students found that learning was made easier when it included interactive discussion boards, digital simulations, and automatic feedback. A small percentage of responders did, however, still have technical difficulties, mainly with regard to the stability of the internet network and the restrictions of personal devices, which may lessen the implementation's efficacy.

Overall, the findings of this study confirmed that the proposed conceptual framework was capable of bridging the gap between pedagogy and digital innovation. Empirical validation from experts, increased student engagement, and strengthening of non-cognitive learning outcomes are strong indicators that this framework can serve as a reference for designing technology-based learning in the digital era.

Discussion

The study's findings supported the claim that instructional design with the use of a conceptual framework based on technology has a great deal of potential to raise the standard of the educational process. The findings of higher student involvement are consistent with new research that shows that, when supported by carefully thought-out pedagogical practices, the incorporation of Technology-Enhanced Learning (TEL) can promote intrinsic motivation and active participation. The framework proposed in this study demonstrated the important role of instructional design as a mediator between technology and pedagogy, so that technology is not treated as an end in itself, but rather as a means to optimize the learning process.

Table 5. Comparison of the Results of This Study with Previous Studies

Researcher & Year	Research focus	Main finding	Limitation	Contribution of This Research
Bond et al. (2021)	The impact of Technology-Enhanced Learning	TEL increases motivation and active	Have not examined integration within a comprehensive	This framework integrates motivational aspects

Researcher & Year	Research focus	Main finding	Limitation	Contribution of This Research
	(TEL) on student motivation	participation	design framework	with systematic instructional design.
Kirkwood & Price (2021)	Transformation from content delivery to digital-based active learning	Effective technology for active learning	Lack of discussion of consistent pedagogical design strategies	This framework emphasizes the synergy between pedagogy and digital innovation.
Ifenthaler & Yau (2022)	Learning analytics to support adaptive learning	Data analysis helps personalize learning	Does not examine the pedagogy-technology relationship conceptually	This framework bridges personalization with learning design principles.
Zawacki-Richter et al. (2023)	Systematic review of TEL in higher education	TEL increases flexibility and collaboration	Less focus on conceptual models for learning design	This framework offers a conceptual model that educators can use.
This research (2025)	Conceptual framework for technology-based learning design	Framework supports motivation, collaboration, and 21 st -century skills	Limited to specific contexts and digital infrastructure challenges	Offers an integrative conceptual framework that links pedagogy with digital innovation.

The comparative results in Table 5 show that most previous studies have emphasized the effectiveness of technology use in learning, in terms of motivation, active participation, and flexibility. However, these studies tend not to provide a comprehensive conceptual framework that explicitly links pedagogical principles to digital innovation. This research offers a more integrative contribution by proposing a conceptual framework that emphasizes the use of technology not only as a supporting medium but also as a core element in learning design. Thus, this framework bridges the gap between theory and practice and provides more applicable guidance for educators in designing learning experiences that foster 21st-century skills, such as collaboration, creativity, and digital literacy.

In addition, the findings regarding the effectiveness of the framework in facilitating collaborative learning and critical thinking are also in line with the literature that emphasizes the paradigm shift from content delivery to digital-based active learning. This indicates that the developed framework is capable of addressing a previously identified gap, namely the weak conceptual foundation in the use of educational technology. Thus, the results of this study make a significant contribution to efforts to integrate digital innovation into learning designs oriented to the needs of 21st-century students.

However, the research also revealed technical challenges, particularly related to device and network access. This finding aligns with a UNESCO report (2022) that stated that the digital divide remains a major challenge in implementing technology-based learning, particularly in developing countries. Therefore, this framework should be viewed not as a single solution, but as a flexible approach that can be adapted to the context and conditions of educational infrastructure.

Implications

The implications of the conceptual framework developed in this study encompass theoretical, practical, and policy aspects. Theoretically, this framework enriches the literature on Technology-Enhanced Learning by emphasizing the importance of integrating pedagogical, technological, and digital innovation dimensions in learning design. Practically, this framework can serve as a strategic guide for educators in designing more meaningful, adaptive, and tailored learning experiences to meet the needs of learners in the digital age. Its use fosters the growth of 21st-

century skills including digital literacy, teamwork, and sophisticated problem-solving in addition to raising student engagement. The findings of this study, meanwhile, can serve as a foundation for policymakers in educational institutions to create digital transformation policies that position technology as an essential part of instructional design rather than just incorporating it into the learning process.

Thus, this research has implications for accelerating the adoption of sustainable innovative learning practices at the institutional level and in the education system more broadly.

Research Contribution

The primary contribution of this research lies in the development of a conceptual framework for Technology-Enhanced Learning Design that more systematically integrates pedagogical foundations with digital innovation. Academically, this research broadens the discourse in the field of learning design by presenting a new perspective that emphasizes the role of technology not merely as a tool, but as a catalyst for pedagogical transformation. From a methodological perspective, the proposed framework can serve as a model for replication and a basis for further empirical testing in various educational contexts, both formal and non-formal. The practical contribution of this research is realized in the form of useful guidance for curriculum developers, educators, and instructional designers in creating learning experiences that are pertinent to students' requirements in the digital age. Furthermore, by highlighting how urgent it is to incorporate pedagogy and technology into the school transformation agenda, this research also offers normative insights for policymakers. As a result, this study not only closes a gap in the literature but also suggests fresh approaches to digitally innovative educational practices and policies.

Limitations

There are a few constraints to be aware of, despite the fact that this research significantly advances the creation of a conceptual framework for technology-enhanced learning design. First off, while this research is still conceptual in nature, its practical application in different educational situations has not yet been thoroughly examined using an empirical approach. Second, the limitations of the literature used are that it mostly comes from studies in the context of higher education and formal learning environments, so generalization to primary, secondary, and non-formal education requires further research. Third, the developed framework still focuses on the integration of digital technologies in general without accommodating the specific differences between AI-based technologies, learning analytics, and immersive technologies (such as AR/VR), which have the potential to have different impacts on learning design. This limitation opens up opportunities for future studies to conduct empirical validation, broaden the scope of contexts, and deepen exploration of specific types of technology relevant to pedagogical needs in the digital era.

Suggestions

Further study is needed to empirically test this conceptual framework across a range of formal and informal educational settings to determine its applicability and validity. Future studies should also examine how specific technologies, such as learning analytics, artificial intelligence, and immersive technologies (AR/VR), support personalized and adaptable learning designs. Additionally, cross-national or cross-cultural comparative studies could be conducted to evaluate how well this framework addresses local demands and global issues in the transformation of digital education. By expanding the scope of the methodology, involving diverse educational actors, and emphasizing data-driven evaluation, further research is expected to strengthen the proposed framework while providing more operational guidance for practitioners and policymakers in an era of evolving learning practices.

CONCLUSION

This research has produced a conceptual framework for Technology-Enhanced Learning Design that integrates pedagogical principles with digital innovation. This framework addresses the pressing need for more adaptive, personalized, and technologically relevant learning designs. The analysis shows that the use of technology, when designed in a targeted and pedagogically based

manner, can improve the quality of the learning experience while strengthening student engagement.

By reviewing the latest literature and comparing it with previous studies, this research confirms the gap between the vast potential of technology and its still-limited application in educational practice. The proposed framework seeks to bridge this gap through an approach that emphasizes the balance between digital innovation and pedagogical principles. Therefore, this research provides a theoretical foundation that can be used as a reference in developing technology-based learning models in various educational contexts.

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AUTHOR CONTRIBUTION STATEMENT

DS designed the conceptual framework of the study and drafted the introduction. IA was responsible for data collection and developing the research methods. NA performed data analysis and wrote the results and discussion sections. DS, IA, and NA jointly revised the manuscript, made final edits, and approved the final version for publication.

AI DISCLOSURE STATEMENT

The authors used ChatGPT (OpenAI) during the preparation of this manuscript for language refinement, clarity improvement, and assistance in organizing academic content. After using this tool, the authors thoroughly reviewed, revised, and edited all sections of the manuscript and they take full responsibility for the accuracy, originality, and integrity of the content presented in this publication.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest—financial, institutional, or personal—that could have influenced the conduct of this study, the analysis and interpretation of data, the preparation of the manuscript, or the decision to publish the results.

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