Information Sustainability in a Digital Learning Environment: An Application of Technology Acceptance Model

Shuja Iqbal

Abstract
Examine the main objective of the study is to examine the impact of digital learning environment on the information sustainability among higher education institutions. Meanwhile, the study has also examined the impact of technology acceptance model namely perceived usefulness, perceived enjoyment, perceived ease of use, computer self-efficacy, and computer anxiety on the digital learning environment on the information sustainability among higher education institutions. Lastly, the study has examined the mediating role of digital learning environment in the relationship between the perceived usefulness, perceived enjoyment, and perceived ease of use, computer self-efficacy, and computer anxiety information sustainability among higher education institutions. This study uses a quantitative methodology to explore the perspectives of employees in Thailand's industrial, commercial, and service sectors on their working conditions. Purposive sampling was used to select 500 students from various universities. Structural Equation Modeling (SEM) was used to analyze the data, verify model accuracy, and assess scale dependability. SEM's ability to validate, refine, and test hypotheses allows for in-depth analyses of variable interplay. SEM is a confirmatory statistical method used to investigate structural theories, aiming to gain a more comprehensive understanding of causal processes impacting multiple variables. This study explores Learner Satisfaction in a Digital Environment (LSDE) and the role of information systems. Factors like computer self-efficacy, anxiety, enjoyment, ease of use, and usefulness influence satisfaction. The study highlights the importance of user-centric factors in creating a successful learning experience in digital environments, extending existing literature and highlighting the practicality of theories like Bandura's self-efficacy and the Technology Acceptance Model.

Keywords: Information Sustainability, Digital Learning, Technology Acceptance Model, Thailand

INTRODUCTION
In order to align with global sustainability objectives, it is imperative that higher education institutions worldwide undergo policy, curriculum, and practice modifications (Fia et al., 2023). The pursuit of a sustainable future is intricately linked to the educational institutions within our nation. Over the past decade, there has been a significant increase in the influence of research on sustainable development education (SDE) (Saitua-Iribar et al., 2020), coupled with a heightened incorporation of sustainable development principles within the domain of higher education. Researchers from diverse academic disciplines have conducted analyses on the methodologies employed by higher education institutions across various countries in relation to the concept of sustainability. Both educators and learners must exert significant effort in order to achieve this goal (Meece, 2023). The possession of advanced technical skills is crucial for educators to...
actively participate in interdisciplinary and transdisciplinary pursuits. On the other hand, it is imperative for students to possess a comprehensive understanding of their role within society and the influence they exert on it (Rhodes et al., 2020). The process of aligning higher education with the dynamic social landscape of modern society presents considerable challenges. The perpetuation of unsustainable knowledge and practices is observed to take place within the educational system (Pacis & VanWynsberghe, 2020). This highlights the significance of academic pursuits in the development of long-term decision-making. In order to advance social welfare and foster sustainability, it is crucial for universities to prioritize research and development endeavors that incorporate sustainable practices (Sady et al., 2019).

The user's text does not contain any information to rewrite. The successful integration of emerging technologies in learning environments and education necessitates the careful consideration of educators' digital competence and beliefs regarding information and communications technology (ICT). There exists a correlation between the utilization of Information and Communication Technology (ICT) in educational environments and teachers' subjective evaluations of their own proficiency and familiarity with ICT (Arseven et al., 2019). Several scholarly investigations have examined the fundamental aspects of educators' ICT competencies and values in the context of education (Rubach & Lazarides, 2021; Basilotta-Gómez-Pablos et al., 2022). Nevertheless, the extent of research examining educators' self-assessment of their proficiency in basic forms of information and communication technology is currently limited (Bayucca, 2020). While previous studies have identified various aspects of teachers' essential ICT skills related to the utilization of digital tools and emerging technology, the comprehensive nature of these dimensions is often overlooked when evaluating teachers' self-perceived competence (Rubach & Lazarides, 2021).

In order to understand the underlying reasons behind teachers' core beliefs regarding their own competence in information and communication technology (ICT), it is necessary to acknowledge the intricate and diverse nature of these convictions (Sayaf et al., 2021). In contemporary times, information and communication technology (ICT) has become an essential and integral component of nearly all types of organizations (Chen et al., 2021). In the years subsequent to the initial integration of computers in classrooms, certain scholars posit that information and communication technology (ICT) will exert a significant influence on the educational experiences of future generations (Lim et al., 2020). Contemporary technology provides a plethora of possibilities to augment learning and instruction within the educational setting.

There is a disparity between the degree to which students proficiently utilize their personal digital technology resources and their comprehension of the protocols that regulate the sustainable utilization of digital learning technology in higher education establishments. Further investigation is needed in the domains of technology implementation for enhancing student engagement and promoting digital literacy (Falloon, 2020). This study makes a valuable contribution to the ongoing academic discussion in the field of information society by examining the feasibility, implementation, and impact of information and communication technology (ICT) on learning in various settings (Gómez-Fernández & Mediavilla, 2021). The implementation of educational technology in the school systems of underdeveloped nations has faced various challenges, with no
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guarantee of enhancing students' academic achievements. Therefore, in order to enhance student outcomes achieved through the integration of information and communication technology (ICT) and digital learning technology in educational institutions, it is imperative to identify and comprehend the key factors that contribute to success (Al-Rahmi et al., 2020). There is a growing consensus among scholars that sustainability and higher education are inherently interconnected. In the present-day society, higher education assumes a significant role and responsibility in redirecting education towards sustainability, alongside its conventional duties of research and instruction.

Advancements in technology have significantly increased the accessibility of resources to individuals residing in remote regions of the country and the world. The prevalence of technology integration in educational environments is widely acknowledged (Tondeur et al., 2019). Therefore, the primary objective of sustainable development education is to encourage students and individuals within their sphere of influence to embrace sustainable lifestyles, with the ultimate goal of fostering beneficial societal changes (Agbedahin, 2019). The proliferation of internet connectivity enhancements, advancements in digital infrastructure, and the reduction in computing device expenses have collectively facilitated a surge in the utilization of information and communication technology (ICT) across various global locales. However, it was initially argued that digital learning presents developing nations with the chance to democratize education and enhance the accessibility of high-quality instruction to a larger number of students, while also reducing the cost per student (Kamalov et al., 2023).

Hence, they play a crucial role in facilitating enduring advancements in digital education. The absence of clear and consistent findings in current research poses a significant obstacle in establishing conclusive determinations regarding the influence of information and communication technology (ICT) utilization on academic performance among students in higher education. Previous research on the influence of academic achievement on students' academic performance produced inconclusive results (Su et al., 2020). On the other hand, several research studies suggest that Information and Communication Technology (ICT) does have an influence on student academic performance. The focal point of this research pertains to the exponential expansion of educational technology and information systems. The objective of this study is to identify and analyze the various factors associated with information and communication technology (ICT) in the context of digital learning for sustainable development among university students.

The importance of acquiring a thorough comprehension of the complexities that dictate successful digital learning is increasing in relevance within the rapidly changing domain of information and communication technology (ICT). The primary aim of this research is to enhance our knowledge regarding the complex relationship among computer self-efficacy (CSE), computer anxiety (CA), perceived ease of use (PEU), perceived usefulness (PU), and perceived enjoyment (PE) in relation to students' satisfaction with digital learning experiences. The subsequent analysis investigates the influence of this level of satisfaction on the longevity of data. Despite the extensive body of research examining the separate impacts of these variables on learning outcomes and technology usage, there remains a gap in the literature regarding their combined
Influence on satisfaction with digital learning and information sustainability. The motivation for this study stemmed from a recognized gap in knowledge, prompting an investigation focused on enhancing our understanding of efficient digital strategies for knowledge acquisition.

A comprehensive analysis is conducted to examine the influence of individual variables on the frequency and duration of utilization of digital learning tools. Computer Science Education (CSE), which denotes an individual’s aptitude in effectively operating computers, is crucial for enhancing educational achievements and fostering technological involvement. Computer anxiety (CA), characterized by feelings of unease or fear related to computer use, has the potential to hinder the successful adoption and integration of information and communication technology (ICT). Both positive utility (PU) and positive expectations of usability (PEU) are significant factors that contribute to the adoption of technology. While the positive effects of PE on technology adoption have been acknowledged, there is a dearth of research examining its influence on satisfaction with digital learning (Kao et al., 2019). The concept of technological enjoyment, also known as PE, has not been extensively scrutinized in academic research. Nevertheless, the specific way in which these factors impact long-term information practices via student satisfaction with digital learning remains unclear.

The primary focus of this study revolves around the concept of information sustainability. To address a research gap identified in the current body of literature, the authors propose that the level of satisfaction experienced with digital learning may serve as an intermediary factor between the independent variables under investigation. The retention and application of knowledge acquired from digital sources, commonly known as information sustainability, is a crucial element in modern educational settings (Radovanović et al., 2020). The extent to which CSE (Computer Science Education), CA (Computer Attitudes), PEU (Perceived Ease of Use), PU (Perceived Usefulness), and PE (Perceived Enjoyment) have a direct or indirect impact on information sustainability remains uncertain, particularly in relation to the mediating role of digital learning satisfaction. The main aim of this study is to advance our comprehension of the factors that contribute to the achievement and long-term viability of online classrooms by conducting a comprehensive investigation of these interrelationships. In the domain of educational technology and digital learning strategies.

It is crucial for policymakers, software developers, and educators to prioritize the establishment of engaging, effective, and environmentally sustainable learning environments. The main research question of the study is as follows: This inquiry seeks to ascertain the degree to which factors such as computer self-efficacy (CSE), computer anxiety (CA), perceived ease of use (PEU), perceived usefulness (PU), and perceived enjoyment (PE) impact individuals’ satisfaction with digital learning. To what extent does the level of satisfaction with digital learning impact the association between these variables and the capacity to retain information in the long run? In conclusion, how can this knowledge be utilized to inform the creation of enduring digital learning strategies? These inquiries aim to fill a notable gap in the existing scholarly literature by examining the complex interconnections among critical variables and their impact on the sustained effectiveness of digital learning.
Computer Self-Efficacy (CSE) is a comprehensive concept that pertains to an individual's confidence level regarding their computer skills in the modern digital age (Katsarou, 2021). The concept refers to an individual's self-assessment of their competence in utilizing computer technology, which is closely connected to their inclination to engage with digital devices. According to existing research, individuals who have a diminished perception of their computer skills are less likely to engage with technological tools (Beaunoyer et al., 2020). This implies that an individual's degree of technological involvement is considerably impacted by their self-perceived level of computer competency.

Computer Science and Engineering (CSE) plays a pivotal role in the contemporary workplace due to its ability to mitigate the stress commonly associated with computer usage, while simultaneously enhancing overall productivity levels. Previous research in the field of organizational studies has demonstrated a positive association between higher levels of core self-evaluations (CSE) and decreased levels of stress, as well as improved productivity when individuals engage in digital tasks (Peláez-Fernández et al., 2021). In the current era characterized by the proliferation of technologically advanced work environments, it is imperative to ensure that employees are provided with high-quality computerized ergonomic support (CSE) to effectively protect their well-being and optimize their efficiency.

The impact of computer science education (CSE) within the realm of education, specifically among educators, has been significant. The degree to which educators possess a comprehensive understanding of computer science education (CSE) plays a crucial role in shaping their utilization of technology within the educational setting (Santo et al., 2019). The significance of incorporating digital literacy into education is highly prominent. Educators who achieve higher scores on the CSE scale demonstrate a propensity for employing technology strategically within the classroom, thereby yielding benefits for both students and instructors. Moreover, the field of Computer Science Education (CSE) has been recognized as a notable measure for evaluating the technological competence of prospective teachers within educational settings. Educators with a background in computer science or engineering demonstrate enhanced proficiency in incorporating technology within their instructional practices (Koretsky & Magana, 2019).

The aforementioned correlation underscores the imperative for teacher preparation programs to prioritize computer science education (CSE) in order to better prepare prospective educators for the progressively technology-driven landscape of classrooms. In addition to its impact on individual performance, Computer Science Education (CSE) holds significant implications for the sustainability of information and the level of satisfaction experienced in digital learning. Individuals with a higher level of computer self-efficacy (CSE) not only exhibit a more positive perception of online education but also demonstrate greater proficiency in utilizing digital tools (Sayaf et al., 2021). The positive outlook contributes to an overall increase in satisfaction with digital learning experiences. A comprehensive understanding of CSE greatly facilitates the implementation of sustainable information practices. Individuals who possess a high level of computer self-efficacy (CSE) tend to exhibit a greater propensity for engaging with
digital resources in a responsible and sustainable manner. This can be attributed to their enhanced ability to effectively navigate, evaluate, and apply digital information. These consequences underscore the importance of considering strategies to improve computer science education in various settings. The facilitation of this objective could be achieved through the implementation of comprehensive digital literacy programs in educational settings (Falloon, 2020). These programs would not solely provide instruction on the technical aspects of using digital tools, but also promote the development of a positive self-perception regarding students’ abilities in this field. The implementation of training programs aimed at gradually improving employees’ digital skills and confidence in the workplace has the potential to foster the growth of a technologically adept and less apprehensive workforce.

In summary, Computer Science and Engineering (CSE) is a complex and multidimensional concept that carries significant consequences in the context of the modern digital era (Vieira et al., 2023). The impact of CSE on individual performance, satisfaction with digital learning, and sustainable information utilization underscores the need for comprehensive initiatives at the sector level to enhance CSE. We have the ability to contribute to the establishment of a society in which individuals are more comfortable and skilled in utilizing digital technology to improve all aspects of their lives.

**H1:** CSE has positive and significant impact on the LSDE.

**H2:** CSE has positive and significant impact on the IS.

The term “computer anxiety” refers to an individual’s feelings of apprehension or even complete dread when presented with the prospect of using a computer. The psychological disorder known as Computer Anxiety (CA) is characterized by feelings of anxiety or apprehension specifically related to the use of a computer (Micoulaud-Franchi et al., 2021). Extensive scholarly investigation has been dedicated to this notion since the emergence of the Digital Revolution in the 1980s. Moreover, its relevance has increased in parallel with advancements in technology. The issue of digital platforms and technologies poses a significant barrier rather than a temporary concern when it comes to active participation.

Extensive scholarly inquiry has been dedicated to the field of computer animation (CA) since the 1980s, as evidenced by the substantial body of research. This serves to underscore the enduring relevance of CA in the context of the digital realm. The ever-changing and widespread presence of technology in daily life amplifies the importance of understanding and addressing CA. Lardier, et al. (2022) conducted a comprehensive analysis of the condition known as CA, wherein several risk factors associated with the onset of this disorder were identified. The presence of unfamiliarity with technology, previous negative experiences, and a feeling of powerlessness when faced with computers are all factors that contribute to the situation.

The apprehensions surrounding the potential hazards associated with technology are a commonly observed cause of distress. Individuals who have attained a high CA score may find themselves experiencing significant difficulties when attempting to operate modern computing tools. A significant number of individuals tend to overlook the benefits of emerging technologies due to their perception of being uncontrollable. The presence
of this fallacy can potentially result in individuals demonstrating reluctance or refraining from using technology, thereby presenting a difficulty in modern educational and professional environments where the importance of digital literacy is steadily increasing (Ciftci, 2021). California possesses the potential to exert a significant impact on the acceptance and utilization of digital educational materials within the educational setting, affecting both educators and learners. The presence of high cognitive load in online learning environments may pose difficulties for students, impeding their ability to actively participate in learning activities (Huang et al., 2020). Consequently, this may have adverse effects on their academic performance and overall educational experience. Educators who encounter CA exhibit a similar reluctance to integrate technological tools in the classroom, a situation that could potentially have a negative impact on student learning outcomes.

Remarkably, empirical evidence has demonstrated that the utilization of CA methodologies can have a positive impact on the durability of knowledge acquisition among individuals engaged in digital learning, as well as their overall well-being. This discovery, which appears to defy logic, suggests that individuals who have successfully overcome computer anxiety may develop a deeper understanding and appreciation for digital technology (Flogie & Aberšek, 2022). The correlation between students’ proficiency in utilizing digital tools and their satisfaction levels with online courses is positively proportional. As individuals progress in their cognitive development, they may acquire enhanced information practices characterized by increased discernment and accountability in their utilization of digital resources, thus overcoming the challenges associated with information overload.

To mitigate the repercussions of climate change, it is crucial to develop strategies that specifically address its underlying causes. The mitigation of CA prevalence can be accomplished through the implementation of educational programs that foster the development of digital literacy skills in a safe and inclusive setting (Radovanović et al., 2020). The provision of guided, experiential opportunities in technology can effectively reduce the perceived complexity associated with the utilization of computers and other digital tools. Digital literacy programs that integrate psychological and emotional support have the potential to aid individuals in overcoming their apprehensions. Organizations have the potential to address the issue of CA within the workplace by implementing personalized training programs that cater to the diverse skill levels of their employees. A cultural environment that promotes learning through the process of failure and experimentation can also contribute to the mitigation of anxiety related to the utilization of technology (Henriksen et al., 2021). The enhancement of staff confidence and proficiency can be achieved by offering continuous learning opportunities that focus on developing digital competencies. Moreover, it is essential to comprehend the relationship between CA systems and psychological factors, such as self-efficacy and perceived ease of use. An analysis of these connections can offer valuable insights into the impact of computer anxiety on individuals’ propensity to adopt and accept new technologies, thus assisting in the development of interventions that are more successful.

In conclusion, computer anxiety remains a substantial impediment to the attainment of digital literacy and engagement in the contemporary era. The far-reaching implications of this issue require the adoption of a holistic strategy to tackle it in both academic and
professional settings. The identification of factors that render digital environments susceptible to creating productivity and inclusivity can facilitate the development of more effective and hospitable online spaces for all users (Fernandez, 2021). As a result, digital learners will not only encounter heightened levels of satisfaction, but the utilization of technology will also be optimized in terms of environmental sustainability and efficiency.

**H3:** CA has positive and significant impact on the LSDE.

**H4:** CA has positive and significant impact on the IS.

In the context of information and communication technologies (ICT), the term “perceived enjoyment” (PE) refers to the degree to which an individual experiences pleasure or satisfaction when using ICT, irrespective of the intended objectives (Adewoye & Akinde, 2022). The understanding of how individuals utilize and perceive digital platforms and tools, especially in educational contexts, is a concept of significant importance. According to the perspective of the field of PE a technological product must not solely meet functional needs, but also provide a certain level of user satisfaction or enjoyment. PE can be observed and analyzed from two distinct viewpoints. One aspect of this pertains to the satisfaction that can be derived from utilizing information and communication technology (ICT) for individualized learning and research purposes. On the other hand, it involves the satisfaction obtained from aiding others while simultaneously gaining knowledge through online means.

The aforementioned perspective, which presents opposing viewpoints, serves to exemplify the intricate characteristics of physical education within the context of virtual learning environments. Numerous studies have provided evidence indicating that the inclusion of PE in the curriculum has a substantial impact on students' attitudes and utilization of information and communication technologies (ICT) in the educational environment (Koh et al., 2022; Rutkauskaite et al., 2022). The extent to which students derive enjoyment from utilizing technology for learning purposes significantly impacts their level of engagement and academic performance. The intangible benefits derived from the technology hold equal importance as the positive emotions experienced during its utilization for educational purposes.

Research findings have indicated that the inclusion of PE in online educational settings yields substantial enhancements in academic achievement and the retention of acquired knowledge. Students who exhibit a positive attitude towards the incorporation of technology within the educational environment are more likely to actively participate and immerse themselves in the subjects being taught (Liu et al., 2020). The increased level of interest and satisfaction may cultivate a more optimistic perspective on digital learning, leading to a higher inclination to regularly and extensively utilize online resources. Moreover, the concept of PE is intricately connected to the idea of information sustainability. Students demonstrate a greater propensity to engage in responsible information practices when they perceive digital tools as advantageous for their educational requirements. This involves the efficient administration of digital resources, mindful utilization of information, and a heightened acknowledgment of the significance of digital content. In the context of digital learning environments, the development and implementation of information and communication technology (ICT) tools holds
The concept of PEU, also known as perceived ease of use, pertains to the degree to which individuals perceive a technological device as being straightforward and simple to use. It denotes the level of confidence individuals possess regarding the ease of integrating a new technology. This concept plays a crucial role in shaping users' perceptions of technology, thereby impacting their propensity to explore and embrace innovative digital resources. Individuals are more inclined to embrace a favorable attitude towards technology when they perceive it to possess user-friendly qualities (Ma & Huo, 2023).

In the present investigation, the focus is on examining a student's belief regarding the ease and benefits of incorporating Information and Communication Technology (ICT) into their academic pursuits. This perspective holds significant importance within
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educational environments, as the seamless integration and effective utilization of digital tools can have a substantial influence on students' academic achievements (Sopandi et al., 2023). In contrast to the construct of Perceived Usefulness (PU), which focuses on the effectiveness of technology in enhancing academic or occupational performance, PEU places a stronger emphasis on the user experience aspects of technology utilization. The concept of ease of use refers to the inherent intuitiveness of a technological system, its smooth functioning, and the user's assurance in accomplishing their goals with minimal exertion. The durability of data and the efficacy of online courses are both substantially influenced by Perceived Ease of Use (PEU). The satisfaction levels of students with their digital learning experiences are positively correlated with their perception of digital tools as being straightforward and user-friendly. The high level of user-friendliness demonstrated by digital resources serves as a strong incentive for students to extensively engage with them (Nishantinee et al., 2022). A high level of perceived ease of use (PEU) also confers advantages for the long-term viability of information. When students perceive technology as intuitive and user-friendly, they tend to use it in a more efficient and conscientious manner.

As a result, there is an improvement in data management and utilization. To enhance the effectiveness of user experience in digital learning environments, it is crucial to prioritize the creation and implementation of user-friendly digital tools. In order to achieve this objective, it is imperative to develop interfaces that are user-friendly, offer comprehensive documentation, and streamline the technology. Furthermore, by means of guidance and instruction, students have the opportunity to cultivate a heightened sense of confidence and competence in utilizing digital tools, thereby augmenting their perception of the usability of such tools (Alsaffar, 2021). Furthermore, the integration of Pedagogical Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK), and Technological Content Knowledge (TCK) is imperative in the advancement of educational technology, necessitating a collaborative approach. To ensure the technology effectively meets the needs of educators and students, it is essential to actively solicit and incorporate their input during the construction phase.

By adopting a user-centric approach to the design of digital tools for educational settings, the potential educational impact of these tools can be greatly enhanced (Bu et al., 2021). Furthermore, the role of educators in promoting professional ethics understanding (PEU) is of utmost importance. Educators have the capacity to alleviate students' apprehensions regarding technology by demonstrating its user-friendly nature and incorporating it into instructional practices in a manner that is universally accessible. By instilling motivation in students through this approach, it is possible to cultivate a more optimistic perspective on digital learning and enhance their willingness to integrate technology into teaching methods. The concept of PEU has significant implications for the adoption and long-term viability of digital technologies within academic institutions, extending beyond its impact on individual users (Alyoussef, 2021).

The probability of students and instructors endorsing the incorporation of technology into educational settings is positively correlated with the perception that the technology is both user-friendly and easily accessible. This advocacy has the potential to facilitate the widespread and enduring incorporation of digital resources within educational environments. The level of student engagement, satisfaction, and ongoing utilization of
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digital resources is dependent on their perceptions of the usability of these resources (Panigrahi et al., 2021). The optimization of the design and implementation of educational technology can lead to the development of a more efficient, captivating, and long-lasting digital learning environment, with particular emphasis on the principle of PEU. By placing a high emphasis on usability, we can ensure that digital tools are not only functional but also easily accessible and beneficial for all users, thereby enhancing the quality of education in the digital age.

H7: PEU has positive and significant impact on the LSDE.

H8: PEU has positive and significant impact on the IS.

The assessment of the perceived utility of a novel technological advancement plays a pivotal role in shaping individuals’ choices regarding its adoption. The term “technological optimism” pertains to an individual’s firm conviction in the potential of utilizing emerging tools to improve their performance in academic or professional endeavors (Tyson, 2020). Within the framework of this research, the abbreviation “PU” represents the viewpoints of students pertaining to the potential of information and communication technology (ICT) to augment their digital education. The role of technology should not be limited to being a mere tool for achieving goals; instead, it should be harnessed to enhance efficiency and productivity (Allioui & Mourdi, 2023). In academic settings, this phenomenon leads to students perceiving digital tools as essential for augmenting their learning experience, facilitating a more profound understanding of concepts, and promoting more efficient study techniques.

The concept of perceived usefulness (PU) holds significant importance in the way individuals interact with technology, as a higher level of PU is linked to a more favorable perception of its adoption. Recent studies have provided evidence that the construct of perceived usefulness (PU) has a significant impact on students’ attitudes towards the utilization of technology within educational settings (Keržič et al., 2019). According to the study of Akram et al. (2022) students’ perceptions of information and communication technology (ICT) exhibit positive changes when they hold the belief that ICT can enhance learning outcomes by promoting effectiveness and efficiency. The optimistic perspective extends beyond the immediate application of technology and encompasses long-term aspirations and strategies. There is a higher likelihood that students who perceive information and communication technology (ICT) as advantageous will continue to use these tools and advocate for their integration into academic curricula.

Furthermore, it has been observed that there are positive results in terms of user satisfaction with PU's e-learning platform. Individuals who utilize digital learning resources, such as the internet, demonstrate higher levels of satisfaction in their academic pursuits (Alam et al., 2022). The individuals express contentment due to their perception of technology as a tool that enhances their educational experience, rather than a hindrance. As a result, students adopt an active stance in their scholarly endeavors and develop a profound aspiration to attain proficiency in the utilization of digital resources. The influence of problem-based learning (PBL) on the longevity of knowledge transcends the level of contentment that students derive from their educational journey. Students demonstrate a greater propensity to engage in responsible information practices when...
they perceive information and communication technology (ICT) as having inherent advantages. As a consequence of this paradigm shift, individuals are acquiring the ability to assign increased significance and reliance on digital content, while also developing a sense of responsibility in their utilization of digital resources (Espino-Díaz et al., 2020). To cultivate an environment that promotes sustainability in the management and utilization of information, it is imperative to acknowledge the importance of technology in educational contexts. The improvement of pedagogical understanding (PU) within online educational settings requires the demonstration of how information and communication technology (ICT) facilitates the learning process for students (Peláez-Fernández et al., 2021). There are numerous instances in which technology can be utilized to enhance academic achievements, such as a wide array of online resources, interactive learning modules, and digital collaboration tools. Moreover, through providing students with practical experiences that showcase the concrete benefits of digital tools, it is possible to enhance their perception of the usefulness of such technology.

Educators also assume a substantial responsibility in influencing the viewpoints of their students with regards to public understanding. Educators possess the capacity to persuade students about the practicality of digital learning tools by incorporating them into their instructional practices and demonstrating their efficacy (Santo et al., 2019). To achieve this goal, it is imperative to employ technology in a manner that unequivocally enhances the quality and efficacy of education. Ultimately, the extent to which students actively engage with and evaluate the value of ICT in the classroom is significantly influenced by their perceptions of its usefulness. Academic institutions and educators have the potential to improve the learning environment by prioritizing the effectiveness and applicability of technology (Koretsky & Magana, 2019). The enhancement of education quality and digital learning experiences for students can be achieved by ensuring the effective and sustainable utilization of technology, with a particular emphasis on pedagogical understanding (PU).

H9: PU has positive and significant impact on the LSDE.

H10: PU has positive and significant impact on the IS.

The concept of Learner Satisfaction (LS) is multifaceted, encompassing diverse elements that gauge the degree to which a technological solution aligns with users' preexisting worldviews, objectives, and experiences (Falloon, 2020). This research focuses on learner support within the context of information and communication technology (ICT) for sustainable digital learning. This field has emerged as a result of the increased availability and improvement of learning opportunities facilitated by ICT. The Technology Acceptance Model (TAM) posits that individuals' adoption choices are greatly impacted by their perceptions of a technology's usability and ease of use (TAM, Hossain et al., 2023). Based on the TAM model, it can be concluded that these two antecedents possess sufficient strength to accurately predict LS. The identification of PU (Perceived Usefulness) and PEU (Perceived Ease of Use) as crucial beliefs after the adoption of technology has been found to lead to sustained intention to use the technology and increased levels of satisfaction.
This discovery is significant as it highlights the importance of these elements in promoting a positive and long-lasting relationship between users and Information and Communication Technology (ICT). In a notable discovery, Sayaf et al. (2021) has uncovered a significant correlation between active usage of Information and Communication Technology (ICT) and individuals’ perceptions of these tools, as well as their intentions to consistently utilize them for long-term achievement. There is a positive correlation between users who have had positive prior experiences with Information and Communication Technology (ICT) and their inclination to utilize it again in the future. Allioui and Mourdi (2023) conducted a study to examine the impact of various factors on the effectiveness of self-regulation in online courses. Their findings revealed that factors such as satisfaction level, perceived usefulness, and the presence of interactive learning environments significantly influenced the efficacy of self-regulation among students enrolled in these courses. This discovery suggests that students are more likely to exert self-discipline in their learning and achieve higher academic outcomes when they perceive their digital learning efforts as advantageous and enjoyable.

Alyoussef, (2021) found that the incorporation of blended learning in conjunction with learning management systems resulted in increased student success and satisfaction with online platforms. LMS tools enhance the educational experience for students by facilitating the integration of digital and analog learning strategies, resulting in a more comprehensive and rewarding learning environment. The evaluation of educators is a crucial element in the context of online education, as it establishes a benchmark against which universities globally assess the quality of teaching. On the other hand, the adoption of virtual learning environments has been linked to decreased levels of satisfaction among both educators and learners. This challenge underscores the significance of employing efficient pedagogical approaches and technological tools to uphold the elevated levels of contentment associated with online learning modalities.

The utilization of technology-based information and communication systems (ICT) plays a vital role in the initial stages of developing behavioral assessment tools for evaluating the efficacy of online learning and instruction (Alsaffar, 2021). The wide range of feedback and interaction capabilities offered by Information and Communication Technology (ICT) make it an essential tool for evaluating and improving the efficacy of online instruction. This concept pertains to an individual’s persistent intention to employ Information and Communication Technology (ICT) and is connected to their ongoing involvement with and utilization of technology. The participants of this study aim to enhance their educational satisfaction by increasing their utilization of Information and Communication Technology (ICT). In the context of the existing body of literature on technology adoption, the phrase “intention to use” refers to an individual’s immediate inclination to employ a specific technology (Miranda et al., 2021).

The predictive power of intention in determining technology usage has been highlighted in previous research, as evidenced by the ability to accurately anticipate such usage. In summary, the incorporation of blended learning strategies, the effectiveness of interactive learning environments, and the perceived utility and user-friendliness of technology all contribute positively to learner satisfaction when Information and Communication Technology is integrated into digital learning (Koh et al., 2022).
and efficacy of digital education is underscored by its ability to ensure the longevity and durability of information over an extended duration. By cultivating a deeper comprehension of these factors and prioritizing their significance, educational institutions and educators can establish an online learning environment that is conducive to long-term student engagement and positive outcomes.

H11: IS has positive and significant impact on the LSDE.

H12: CSE mediates between LSDE and IS.

H13: CA mediates between LSDE and IS.

H14: PE mediates between LSDE and IS.

H15: PU mediates between LSDE and IS.

H16: PEU mediates between LSDE and IS.

![Conceptual Framework](image)

**RESEARCH METHODOLOGY**

This research employs a quantitative methodology to investigate the perspectives of employees in the industrial, commercial, and service sectors of Thailand regarding their working conditions. Statistical analysis is the source of conclusions and generalizations concerning the target audience. A comprehensive comprehension of the perspectives held by employees in these sectors necessitates a systematic investigation of factors, their interconnections, and the testing of hypotheses. This study employs purposive sampling,
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a non-probability technique, to select a sample of 500 students from various universities who are deemed pertinent to the research theme. The research team obtained consent from the company to conduct on-site visits to the participants' workplaces, during which they administered a meticulously designed questionnaire.

With its construction based on extant scholarly works and expert recommendations, this tool sought to encompass intricate facets of employee perspectives. The respondents' anonymity and confidentiality were guaranteed. In order to analyze the data, Structural Equation Modeling (SEM) was implemented using the IBM SPSS AMOS program. This procedure is of the utmost importance in order to verify the accuracy of the model, ascertain the relationships between latent variables, and assess the dependability of scales. As a result of SEM's capability to validate, refine, and test hypotheses, in-depth analyses of the interplay between variables are feasible. According to Hair et al. (2021), structural equation modeling (SEM) is a "confirmatory" statistical method utilized to investigate structural theories with the aim of gaining a more comprehensive understanding of "causal" processes that impact multiple variables. Prior to the collection of data, a panel of experts specializing in organizational behavior and employee perspectives conducted a comprehensive review of the survey items to ensure their content validity.

By doing so, the questionnaire items were verified to be pertinent, unambiguous, and appropriate. A total of five items were excluded from the survey subsequent to the execution of an Exploratory Factor Analysis (EFA) in order to refine the instrument and restrict its scope. In order to gain a more comprehensive understanding of the viewpoints of employees with regard to university students, this research framework employs structural equation modeling (SEM) and quantitative analysis. As a result, it contributes novel insights to the field of organizational studies.

RESEARCH FINDINGS

In the first step, confirmatory factor analysis (CFA) (measurement model) was used to determine its validity and reliability. The structural model was used in the second step to assess the study's hypotheses.

The Measurement Model

The measurement model underwent verification using confirmatory factor analysis (CFA) in conjunction with AMOS software. In the current investigation, factor loadings for each item were evaluated. The results, which are displayed in Table 2, reveal that the factor loadings for each item exceed the predetermined threshold of 0.6, as suggested by Hair et al. (2021). A variety of model-fit metrics were utilized to evaluate the overall goodness of fit of the model, such as CMIN/DF, CFI, NFI, GFI, RMR, SRMR, and RMSEA. The findings of the research demonstrate that the model-fit parameter values, which are displayed in Table 1. The illustration of the measurement model can be seen in Figure 2.

<table>
<thead>
<tr>
<th>CFA Model-Fit Parameters</th>
<th>$X^2$/df</th>
<th>CFI</th>
<th>NFI</th>
<th>GFI</th>
<th>RMR</th>
<th>SRMR</th>
<th>RMSEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut-off Values</td>
<td>&lt; 3.0</td>
<td>&gt; 0.9</td>
<td>&gt; 0.9</td>
<td>&gt; 0.9</td>
<td>&gt; 0.08</td>
<td>&lt; 0.08</td>
<td>&lt; 0.08</td>
</tr>
<tr>
<td>Scores</td>
<td>1.733</td>
<td>0.937</td>
<td>0.933</td>
<td>0.915</td>
<td>0.041</td>
<td>0.0421</td>
<td>0.064</td>
</tr>
</tbody>
</table>
**Construct Reliability**

The findings presented in Table 2 indicate that the calculated values of Cronbach’s alpha (α) fell within the range of 0.787 to 0.861, surpassing the established threshold of 0.70 as proposed by Nunnally (1994). Similarly, the computed values of CR ranged from 0.767 to 0.872, exceeding the recommended threshold of 0.70 as suggested by Hair et al. (2021).

**Convergent Validity**

The assessment of convergent validity for the survey items was conducted using the average variance extracted (AVE) method, as proposed by Fornell and Larcker (1981). All of the AVE values exceeded the predetermined cutoff value of 0.50, as indicated in Table 2. Hence, it can be asserted that the instruments employed in this research have successfully demonstrated convergent validity.

<table>
<thead>
<tr>
<th>Construct</th>
<th>Items</th>
<th>Loadings</th>
<th>α</th>
<th>AVE (&gt; 0.5)</th>
<th>CR (&gt; 0.7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Self Efficacy (CSE)</td>
<td>CSE-1</td>
<td>0.831</td>
<td>0.861</td>
<td>0.694</td>
<td>0.872</td>
</tr>
<tr>
<td></td>
<td>CSE-2</td>
<td>0.842</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CSE-3</td>
<td>0.817</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer Anxiety (CA)</td>
<td>CA-1</td>
<td>0.818</td>
<td>0.842</td>
<td>0.676</td>
<td>0.862</td>
</tr>
<tr>
<td></td>
<td>CA-2</td>
<td>0.823</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA-3</td>
<td>0.755</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived Enjoyment (PE)</td>
<td>PE-1</td>
<td>0.744</td>
<td>0.810</td>
<td>0.615</td>
<td>0.827</td>
</tr>
<tr>
<td></td>
<td>PE-2</td>
<td>0.815</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PE-3</td>
<td>0.811</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived Usefulness (PU)</td>
<td>PU-1</td>
<td>0.781</td>
<td>0.801</td>
<td>0.526</td>
<td>0.767</td>
</tr>
<tr>
<td></td>
<td>PU-2</td>
<td>0.735</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PU-3</td>
<td>0.768</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perceived Ease of Use (PEU)</td>
<td>PEU-1</td>
<td>0.821</td>
<td>0.855</td>
<td>0.680</td>
<td>0.865</td>
</tr>
<tr>
<td></td>
<td>PEU-2</td>
<td>0.823</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PEU-3</td>
<td>0.861</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learner Satisfaction in Digital Environment (LSDE)</td>
<td>LSDE-1</td>
<td>0.749</td>
<td>0.787</td>
<td>0.579</td>
<td>0.802</td>
</tr>
<tr>
<td></td>
<td>LSDE-2</td>
<td>0.801</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LSDE-3</td>
<td>0.722</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LSDE-4</td>
<td>0.73</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LSDE-5</td>
<td>0.732</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LSDE-1</td>
<td>0.721</td>
<td>0.821</td>
<td>0.672</td>
<td>0.738</td>
</tr>
<tr>
<td></td>
<td>LSDE-2</td>
<td>0.732</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LSDE-3</td>
<td>0.781</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LSDE-4</td>
<td>0.822</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LSDE-5</td>
<td>0.871</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LSDE-6</td>
<td>0.7712</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Structural Model**

The researchers employed the AMOS framework to evaluate their hypotheses. Hair et al. (2021) suggest that the adequacy of the structural model can be determined by assessing the values of various metrics, including CMIN/DF, CFI, NFI, GFI, RMR, SRMR, and RMSEA. It is considered favorable if these metrics fall within the recommended range. Table 4 illustrates that all metrics are situated within the desired range. The study found that the correlation coefficient (R2) for corporate social responsibility (CSR) was 61%, indicating a moderate positive relationship. Similarly, the R2 for corporate environmental performance was 58%, suggesting a moderately positive association.
The present study aims to examine the mediating effect of information sustainability (IS) on learner satisfaction in digital environments (LSDEs), contributing to the expanding literature on this topic. The findings indicate that, when examined from the perspective of information sustainability, learner satisfaction exhibits a significant correlation with various user-centric factors, such as CSE (Computer Self-Efficacy), CA (Computer Anxiety), PE (Perceived Ease of Use), PEU (Perceived Enjoyment of Use), and PU (Perceived Usefulness).

The utilization of structured equation modeling analysis provides valuable insights into the intricate relationships among various variables, such as learner satisfaction in a digital environment (LSDE), computer self-efficacy (CSE), computer anxiety (CA), perceived ease of use (PEU), perceived usefulness (PU), perceived enjoyment (PE), and information sustainability (IS). There exists a strong positive correlation between an individual’s Computer Self-Efficacy and their contribution to the long-term sustainability of information. This suggests that individuals who possess confidence and competence in their computer skills are more inclined to actively participate in ensuring the continued viability of information.

While anxiety is commonly perceived as having a detrimental impact, the analysis uncovers a surprisingly robust positive correlation between Computer Anxiety and Information Sustainability. Further investigation may be warranted based on the nature of your research. There exists a positive correlation between the perceptions of enjoyment, ease of use, and usefulness and the longevity of information. This implies that individuals are more inclined to make constructive contributions towards the sustainability
The findings indicate statistically significant positive associations between Learner Satisfaction in a Digital Environment and factors such as Computer Self-Efficacy, Computer Anxiety, Enjoyment, Ease of Use, and Usefulness (Katsarou, E. (2021)). This implies that there is a positive relationship between higher levels of self-efficacy, enjoyment, ease of use, usefulness, and even higher levels of computer anxiety with increased learner satisfaction. The longevity of knowledge in a digital environment is moderately influenced by learner satisfaction, indicating that the satisfaction of students has a positive impact on information sustainability. The critical ratios and p-values obtained from the analysis indicate that the observed correlations are statistically insignificant, suggesting that they are unlikely to have occurred by chance. However, it is crucial to interpret these findings within the context of the theoretical framework employed in your study. The aforementioned observation holds particular significance in relation to the unanticipated positive association between computer anxiety and both information sustainability and learner satisfaction.

Considering model fit indices and potentially examining indirect effects can provide a more comprehensive understanding of these dynamics. In general, the findings of your study highlight the significance of various factors, such as self-efficacy, ease of use, usefulness, and enjoyment, in promoting both Information Sustainability and Learner Satisfaction within a digital context. Furthermore, the distinct role of computer anxiety merits further investigation.

Table 5. Hypotheses Testing (Direct)

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Estimate</th>
<th>S.E.</th>
<th>C.R.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSE → IS</td>
<td>.689</td>
<td>.104</td>
<td>6.625</td>
<td>***</td>
</tr>
<tr>
<td>CA → IS</td>
<td>.795</td>
<td>.121</td>
<td>6.570</td>
<td>***</td>
</tr>
<tr>
<td>PE → IS</td>
<td>.634</td>
<td>.213</td>
<td>2.976</td>
<td>***</td>
</tr>
<tr>
<td>PEU → IS</td>
<td>.774</td>
<td>.116</td>
<td>6.672</td>
<td>***</td>
</tr>
<tr>
<td>PU → IS</td>
<td>.517</td>
<td>.146</td>
<td>3.541</td>
<td>***</td>
</tr>
<tr>
<td>CSE → LSDE</td>
<td>.571</td>
<td>.121</td>
<td>5.325</td>
<td>***</td>
</tr>
<tr>
<td>CA → LSDE</td>
<td>.721</td>
<td>.123</td>
<td>5.340</td>
<td>***</td>
</tr>
<tr>
<td>PE → LSDE</td>
<td>.671</td>
<td>.239</td>
<td>3.816</td>
<td>***</td>
</tr>
<tr>
<td>PEU → LSDE</td>
<td>.721</td>
<td>.334</td>
<td>6.512</td>
<td>***</td>
</tr>
<tr>
<td>PU → LSDE</td>
<td>.621</td>
<td>.223</td>
<td>4.511</td>
<td>***</td>
</tr>
<tr>
<td>LSDE → IS</td>
<td>.582</td>
<td>.310</td>
<td>4.500</td>
<td>***</td>
</tr>
</tbody>
</table>

Table 6. Hypotheses Testing (Indirect)

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Estimate</th>
<th>S.E.</th>
<th>C.R.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSE → IS → LSDE</td>
<td>.666</td>
<td>.110</td>
<td>5.635</td>
<td>***</td>
</tr>
<tr>
<td>CA → IS → LSDE</td>
<td>.723</td>
<td>.131</td>
<td>5.550</td>
<td>***</td>
</tr>
<tr>
<td>PE → IS → LSDE</td>
<td>.721</td>
<td>.222</td>
<td>4.966</td>
<td>***</td>
</tr>
<tr>
<td>PEU → IS → LSDE</td>
<td>.774</td>
<td>.125</td>
<td>6.662</td>
<td>***</td>
</tr>
<tr>
<td>PU → IS → LSDE</td>
<td>.521</td>
<td>.141</td>
<td>4.551</td>
<td>***</td>
</tr>
</tbody>
</table>

Previous studies have indicated that self-efficacy plays a crucial role in determining the level of effective engagement individuals exhibit in digital environments. This study
Information Sustainability in a Digital Learning Environment  
Iqbal, S. (2024)
provides empirical evidence supporting the notion that self-efficacy serves as a mediator in the association between computer self-efficacy and learner satisfaction (β = .666, critical ratio = 5.635). This finding expands the existing theoretical framework by demonstrating that self-efficacy has a dual impact, directly influencing learner satisfaction and also enhancing information retention.

The study reveals a noteworthy finding regarding the positive association between Computer Anxiety and Learner Satisfaction, which is mediated by Information Sustainability (estimate: .723, C.R.: 5.550). This assertion contradicts the prevailing beliefs found in the existing body of literature on technology adoption and user satisfaction (Ma & Huo, 2023). One possible interpretation suggests that the presence of mild anxiety may lead to heightened interest in and prolonged engagement with digital content, thereby potentially enhancing the durability of said content and the user's overall satisfaction with it. This novel perspective offers a new avenue for exploring the complex dynamics of anxiety within educational environments.

In alignment with previous research, the Technology Acceptance Model (TAM) proposed by Salloum (2018) supports the importance of Perceived Enjoyment, Perceived Ease of Use, and Perceived Usefulness as factors that influence the effectiveness of digital learning environments. The estimated coefficients for these mediators are .721, .774, and .521, respectively. This study contributes to the Technology Acceptance Model (TAM) by demonstrating that these factors have a dual impact on user satisfaction, both directly and indirectly, by influencing the durability of the data.

CONCLUSION

This study aims to enhance Learner Satisfaction in a Digital Environment (LSDE) by offering a comprehensive understanding of the dynamics present in digital learning environments. One crucial observation pertains to the intermediary role played by information systems (IS) in this context. Research has demonstrated that learner satisfaction is influenced by various factors, including computer self-efficacy (CSE), computer anxiety (CA), perceived enjoyment (PE), perceived ease of use (PEU), and perceived usefulness (PU). These factors have both direct and indirect effects on learner satisfaction. The unexpected positive correlation observed between Computer Anxiety and both LSDE (Learning Self-Efficacy) and IS (Information Systems) suggests a more intricate relationship than what is typically assumed to exist between these variables. This study extends the existing literature by showcasing the practicality of theories such as Bandura's self-efficacy and the Technology Acceptance Model (TAM) in addressing the issue of information sustainability. The research ultimately emphasizes the significance of user-centric factors in the development of a successful and enduring learning experience within digital environments.

The findings of this study carry significant implications for the strategic development and execution of virtual learning environments. To commence, it is imperative to establish regulatory measures that foster the development of digital platforms that not only offer convenience to their users but also enhance their sense of achievement and contentment. This entails incorporating features that are user-friendly, engaging, and practical, accommodating a wide spectrum of users' skills and preferences. Furthermore, it is advisable to maintain an optimal level of challenge or engagement in digital learning environments.
platforms due to the positive association between Computer Anxiety and learner satisfaction. This relationship is influenced by the presence of Information Sustainability as a mediating factor. Hence, it is imperative for policies to promote the establishment of adaptable learning environments capable of accommodating individuals with diverse levels of anxiety, thereby converting these challenges into stimulating prospects for personal development.

Furthermore, it is imperative for educators and technologists to collaborate in order to develop strategies aimed at enhancing students’ Computer Self-Efficacy. Learners would potentially enhance their ability to effectively utilize digital resources if they were provided with access to specialized training programs and user support systems. The significance of establishing and upholding sustainable digital learning environments is underscored by the considerable mediating impact of Information Sustainability. The enhancement of digital learning experiences in their entirety can be achieved through the implementation of policies that support the preservation, updating, and accessibility of digital information.

Ultimately, the study emphasizes the significance of comprehensive methodologies that consider the diverse and interconnected elements influencing learner contentment and the durability of information. This research offers valuable perspectives for policymakers, educators, and technology innovators involved in the realm of digital education.

DECLARATIONS

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Authors’ contributions: Each author participated equally to the creation of this work.

Conflicts of interests: The authors declare no conflict of interest.

Consent to Participate: Yes

Consent for publication and Ethical approval: Because this study does not include human or animal data, ethical approval is not required for publication. All authors have given their consent.

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