Exploring the Satisfaction and Continuance Intention to Use E-Learning Systems: An Integration of the Information Systems Success Model and the Technology Acceptance Model

Original Scientific Paper

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Abstract *– In view of the global crisis that has increased the use of online learning, it is imperative to comprehend the factors that affect users' perceptions and behaviors when utilizing e-learning systems. In order to examine the impact of quality factors on user satisfaction and continuance intention using e-learning systems, this study integrates the Information Systems Success Model (ISSM) with the Technology Acceptance Model (TAM). The aim of this research is to shed light on the relationships between the e-learning systems' quality, perceived usefulness, perceived ease of use, user satisfaction, and intention to continue using them. This research employed partial least squares structural equation modeling (PLS-SEM) to assess the research model. The analysis was grounded in survey data collected from a randomly selected sample of 372 students at Arab Open University in Saudi Arabia. The study's results confirm that information quality for platforms and courses positively influences perceived usefulness, system quality, and perceived ease of use. Additionally, perceived usefulness and ease of use are significantly linked to user satisfaction, supporting the notion that enhancing information quality contributes to higher user satisfaction and encourages continued engagement. The developers of e-learning systems and educational institutions may use these findings to enhance the design, content, and usability of their platforms.*

Keywords: *quality factors, usefulness, ease of use, user satisfaction, continuance intention, e-learning systems*

1. INTRODUCTION

The COVID-19 pandemic has led to a significant transformation in education, prompting universities to adopt innovative approaches like e-learning and mobile learning. These technologies aim to enhance accessibility, meet diverse student needs, improve tracking capabilities, and ensure cost-effectiveness [1]. However, this shift has also highlighted gaps in internet access and technology resources, leading to a digital divide among students [2]. E-learning systems are crucial for their versatility, adaptability, and scalability, allowing students to continue their education despite physical obstacles [3].

In 2022, the global e-learning market reached a substantial size of $288.8 billion, and projections indicate a trajectory towards $840.11 billion by 2030, reflecting a notable compound annual growth rate (CAGR) of 17.5% from 2021 to 2030 [4, 5]. As per SPER Market Research report [6], the Saudi Arabia e-learning market is anticipated to witness substantial growth, with predictions indicating a market size of $8.44 billion by 2032. This projection reflects a Compound Annual Growth Rate (CAGR) of 16.32%, underscoring the significant momentum and expansion expected within the e-learning sector in Saudi Arabia [6]. The data suggests a robust upward trajectory, emphasizing the increasing prominence and investment in e-learning initiatives in the country [6].

Despite substantial financial investments, particularly in Saudi Arabia, certain educational institutions face challenges in realizing the full potential of e-learning [7], leading to a focused scholarly exploration through empirical studies. The sudden shift to remote learning during the global pandemic presented challenges in adapting to new technologies, causing dissatisfaction among learners who prefer traditional, in-person classes [8]. Issues such as a non-conducive home environment, concerns about online education quality, and the absence of social interactions found in traditional classrooms have adversely affected students' e-learning experiences [9]. To address this decline in student interest and improve the e-learning landscape, scholarly efforts are crucial, emphasizing the need to adapt technology, redefine learning environments, and enhance the overall online educational experience.

E-learning system success relies on a thorough examination of course quality, information quality, system quality, services quality, and content usefulness [10, 11]. These factors help create engaging and credible learning experiences, build trust, minimize disruptions, and foster a supportive environment [12]. A well-structured curriculum aligned with learning objectives enhances engagement and comprehension, while accurate and well-organized information builds trust among learners. The technical robustness of the system, coupled with responsive customer support and supplementary resources, contributes to a supportive learning environment and overall learner satisfaction. Intuitive navigation and a user-friendly interface reduce barriers, enhancing accessibility for users. By addressing these quality factors, e-learning providers can tailor their platforms to meet learners' needs and ensure their educational initiatives' success.

The fusion of the Information Systems Success Model (ISSM) and the Technology Acceptance Model (TAM) presents a holistic framework for assessing e-learning systems [13]. Through the integration of these models, researchers gain a comprehensive tool to enhance e-learning systems, focusing on critical factors such as system quality, information quality, and user satisfaction. This thorough examination of elements ensures the sustenance of motivation and facilitates the design of systems aligned with learners' needs. The integrated ISSM and TAM approach enables the identification of strengths and weaknesses, providing insights for initiatives aimed at enhancing system efficiency and overall quality. This method proves instrumental in recognizing both the positive aspects and limitations of e-learning systems, thereby formulating strategies to amplify their effectiveness and quality. Such integration is indispensable for the development of e-learning systems that are not only useful but also of high quality.

This research strives to understand user satisfaction and their intention to continue using e-learning systems by integrating ISSM and TAM models. This will allow for the development of effective techniques for handling issues during crises. The study aims to enhance the learning environment within the e-learning system by identifying factors that contribute to a more satisfying and engaging user experience, ultimately leading to increased retention of learning outcomes. Furthermore, the outcomes of this study provide direction to e-learning system supervisors on how to boost the user experience and facilitate the learning process.

2. LITERATURE REVIEW

2.1. E-LEARNING SYSTEM

E-learning systems are essential for today's society. Because of the rising use of technology and the internet, the e-learning platform has become an essential tool for learners and instructors [14]. According to [15], e-learning is the process of teaching and learning via the use of electronic devices and digital media. It may be delivered through multiple channels, such as online courses, webinars, video conferencing, podcasts, and virtual classrooms. E-learning platforms provide students and teachers with a flexible, convenient, and cost-effective way to study [16].

E-learning systems are described as information systems that provide a secure environment for learning where students can register for online courses [17]. Because platforms enable students to search for online courses and pay the enrollment cost directly, these platforms have been referred to as online training course markets [18]. Similar to this, [19] described an e-learning system as a coordinated collection of interactive services that are available online and are not constrained by time or location. These platforms give educators, students, and individuals who are interested in learning the resources and tools they need to support and improve the educational process [20]. Learners may access courses and take part in a variety of educational activities through an e-learning system. In addition, they provide collaborative environments where students may interact online, share knowledge, and collaborate to solve issues [1].

Moodle is one example of an e-learning platform. Worldwide, educators utilize Moodle, a free and open-source learning management system [21]. According to [22], Moodle offers an environment for developing and delivering online courses that allows students to access course materials, communicate with instructors and other students, and complete assessments. Another example is Blackboard, which is used by numerous universities all around the world. According to [23], Blackboard is a recognized learning management system. Course administration, communication tools, and evaluation tools are only some of its many features and functions. Along with learning management systems, another type of e-learning platform that is growing is massive open online courses (MOOCs). MOOCs are free online courses that are offered by educational institutions and organizations. They usually feature interactive quizzes, discussion boards, and video lectures. MOOCs have limitations, such as poor completion rates and a lack of accreditation, despite the fact that they give many students an opportunity to access high-quality education [24].

Overall, as a result of technological developments and educational reforms, the nature of e-learning platforms is constantly changing. As technology advances, e-learning is anticipated to play a more significant role in how education is delivered. Research on e-learning pros and cons is essential for effective, accessible education.

2.2. BENEFITS AND CHALLENGES

E-learning emerges as a transformative powerhouse in education, fundamentally reshaping learning dynamics beyond conventional boundaries [25]. Its multifaceted advantages redefine how individuals acquire and disseminate knowledge, marking a paradigm shift in educational engagement. Central to its impact is unparalleled flexibility, liberating learners from rigid schedules and allowing them to engage with course materials at their own pace, transcending convenience to foster a culture of lifelong learning [26]. Beyond flexibility, the inherent cost-efficiency of e-learning diverges significantly from traditional models, eliminating physical infrastructure and reducing travel expenses, democratizing education, and breaking socio-economic barriers to access [1]. The global reach of e-learning dismantles geographical constraints, fostering cultural exchange as learners from diverse corners of the world converge in virtual classrooms, highlighting its unifying potential [3]. Additionally, e-learning platforms champion a customizable learning experience through the seamless integration of adaptive technologies, allowing educators to tailor courses to individual needs [27]. This high level of customization ensures an adaptive and responsive journey, accommodating diverse learning styles and preferences [28]. The integration of interactive content further enhances the experience, making multimedia elements integral components that foster engagement, active participation, and improved knowledge retention in online courses [29].

The e-learning landscape, despite its numerous advantages, is intricately entwined with challenges, demanding a nuanced and comprehensive approach for the continual enhancement of online education. Technical barriers pose formidable obstacles to achieving equitable e-learning opportunities, manifested through limited access to reliable internet connections, outdated hardware, and insufficient digital literacy skills [30]. Closing these disparities is crucial for fostering inclusivity in the digital education era, underscoring the urgency of addressing both infrastructural and skill-based gaps. The absence of face-to-face interaction introduces complexity to e-learning as virtual classrooms strive to recreate interpersonal dynamics, yet replicating the immediacy of traditional classroom interactions proves to be inherently intricate [31]. Balancing technological connectivity with the essential human element becomes a persistent challenge in ensuring effective and engaging e-learning experiences, necessitating the ongoing exploration of innovative solutions that cultivate meaningful connections in virtual spaces [32]. Additionally, the e-learning landscape grapples with the critical concern of assessment integrity in the online environment, where the remote nature of evaluations amplifies the risks of cheating and plagiarism [33]. Proactive measures are essential to ensuring the credibility of e-learning programs, emphasizing the implementation of secure and adaptable assessment methods tailored to the nuances of the online medium [34]. Navigating these challenges requires a holistic approach, addressing technical, pedagogical, and socio-economic factors to unlock the transformative potential of e-learning, ushering in an era where education transcends boundaries and becomes universally accessible.

3. THEORETICAL DEVELOPMENT AND FORMATION OF HYPOTHESES

3.1. TECHNOLOGY ACCEPTANCE MODEL (TAM)

The Technology Acceptance Model (TAM) is a theoretical framework rooted in Fishbein & Ajzen's theory of reasoned action, emphasizing that pre-existing attitudes and behavioral intentions shape individual behavior [35]. TAM asserts that a user's attitude toward a new technology, influenced by beliefs such as Perceived Usefulness and Perceived Ease of Use, dictates whether the user will adopt or reject the technology [36]. While TAM has garnered support for its applicability, critics note its limited explanatory and predictive power [37-39], prompting researchers to explore extensions such as substituting learning outcome beliefs for user log data to enhance practicality in the e-learning context [14, 40, 41].

Variables within TAM include Perceived Usefulness, Perceived Ease of Use, attitude, behavioral intentions, and actual use. The model's critical constructs, Perceived Usefulness and Perceived Ease of Use, significantly impact learners' acceptance of e-learning technology and their behavioral intention to use it in future scenarios [41]. Successful technology integration in learning depends on how available technologies are embraced and used, with Perceived Usefulness and Perceived Ease of Use determining learners' acceptance and overall e-learning performance [14]. Additionally, attitude plays a pivotal role in influencing behavioral intention and actual system usage [42]. Studies have consistently highlighted attitude as a crucial factor in acceptance behavior, with Perceived Ease of Use and Perceived Usefulness influencing students' attitudes toward technology [35, 36, 39, 40]. Overall, positive attitudes toward e-learning are fostered when instructors and learners find it valuable and easy to use.

3.2. DELONE AND MCLEAN INFORMATION SYSTEMS SUCCESS MODEL (ISSM)

The DeLone and McLean Information Systems Success Model (ISSM) serves as a comprehensive framework for assessing information systems, including e-learning systems [43]. Originating in 1992 and updated in 2003, the model aims to provide a thorough understanding of factors contributing to information systems' success in organizations [44]. The six ISSM factors encompass system quality, information quality, service quality, user satisfaction, use, and net benefits, offering a comprehensive framework for evaluating the effectiveness of information systems. This model delves into the performance and impact of e-learning systems on learning outcomes, evaluating technological features, educational material accuracy, service quality, system use, and positive outcomes like improved learning performance and efficiency [10, 11, 45].

Within the ISSM, system quality is gauged by technological features such as reliability, accessibility, and usability, while information quality assesses the accuracy, relevance, and completeness of educational material [43, 46]. Service quality measures student assistance and support, influencing user satisfaction, and perceptions of the e-learning system [43, 47]. The model emphasizes system use as a success indicator, with frequency and intensity playing pivotal roles [48]. The net benefits dimension explores positive outcomes, including enhanced learning performance and efficiency [46]. By addressing each factor, educational institutions can enhance their e-learning platforms and optimize their impact on students' learning experiences. This includes actions like improving system quality through seamless integration and enhanced user interfaces, curating relevant educational content for information quality, and providing timely and effective learner support services for improved service quality.

3.3. MODEL DEVELOPMENT

The ISSM and TAM serve as pivotal frameworks for evaluating the effectiveness of e-learning systems, with the ISSM assessing information systems' success across various dimensions and the TAM focusing on user acceptance and behavior. Integrating these models allows for a comprehensive evaluation of e-learning systems, considering not only user acceptance but also their overall impact on education quality. This holistic approach facilitates the identification of areas for improvement, enabling the optimization of e-learning environments. Moreover, the ISSM and TAM offer a nuanced understanding of factors influencing user acceptance of e-learning technology [49]. By merging TAM's user-centric approach with ISSM's broader perspective on system success, institutions can create sustainable e-learning systems that continuously enhance user satisfaction and performance. The study aims to examine multiple factors derived from the ISSM and TAM, such as system quality, information quality (course and platform), perceived usefulness, perceived ease of use, user satisfaction, and intention to continue. Through a thorough literature analysis, the study develops a theoretical model by integrating the ISSM with TAM, providing a visual representation of its innovative approach, and laying the groundwork for future research in this domain.

3.3.1. Information Quality

Information quality refers to the level of information generated by a system, including accuracy, validity, reliability, suitability, and intelligibility [50]. In the digital era, information is crucial for the effectiveness of an e-learning system. This quality includes not only the course content but also the platform on which it is delivered [47]. The perceived usefulness of an e-learning system is significantly influenced by information quality, including course and platform quality [51]. Learners are more likely to regard the system as useful and successful when they have access to high-quality, relevant, accurate, and up-to-date information [43]. Additionally, a user-friendly, visually appealing, and easy-to-use platform increases the likelihood of learners interacting with the information and feeling encouraged to continue their studies [52]. Therefore, the quality of information is essential for the success of e-learning. After analyzing the preceding discussions, the following hypotheses are proposed:

H1: There is a positive relationship between the quality of course information and the perceived usefulness of using e-learning systems.

H2: There is a positive relationship between the quality of platform information and the perceived usefulness of using e-learning systems.

3.3.2. System Quality

System quality refers to a user's perception of a system [50], which is crucial for the success of e-learning. It is measured by the range of software applications and hardware offered [53]. A well-designed system serves as a trustworthy guide, guiding learners smoothly towards their objectives [54]. System quality significantly impacts the ease of use factor, as it directly impacts the user's ability to focus on content and absorb knowledge effectively [12]. A high-quality e-learning system should have reliable hardware, user-friendly interfaces, and an intuitive design. It should also be easily accessible, easy to use, and provide appropriate feedback to learners. User satisfaction is a key factor in the success of an e-learning system, and prioritizing system quality in design and implementation is essential [55]. Thus, the following hypothesis is presented based on the preceding discussions:

H3: There is a positive relationship between the quality of the system and the perceived ease of use of the e-learning systems.

3.3.3. Perceived Usefulness and Perceived Ease of Use

User satisfaction can be influenced by perceived usefulness and perceived ease of use [56]. Perceived usefulness relates to learners' perspectives about how utilizing an e-learning system would improve their performance and help them achieve their learning objectives [17], whereas perceived ease of use refers to learners' perceptions of the system's usability and navigation [57]. Learners are more likely to be satisfied with and engaged in the learning process if they view the system as useful and easy to use. To achieve high levels of user satisfaction, it is critical to develop and execute e-learning systems that are considered useful and easy to use. As a result, the following hypothesis is proposed:

H4: There is a positive relationship between the perceived usefulness of an e-learning system and the user's satisfaction with its usage.

H5: There is a positive relationship between the perceived ease of use of e-learning systems and the user's satisfaction with their usage.

3.3.4. User satisfaction and Continuance Intention

User satisfaction is one of the factors that determines an e-learning system's success [56]. Users who feel satisfied with the system are more likely to stay connected to it as well as participate in future learning activities [47]. Continuance intention is an important component of e-learning systems since it impacts whether or not users will use the system in the future [58]. User satisfaction is crucial in molding users' views toward the system and their willingness to utilize it in the future [59]. Users who are satisfied with the e-learning system are more likely to have favorable feelings regarding it, which impacts their willingness to continue using it [60]. Understanding the influence of user satisfaction on continuance intention is therefore critical for the sustained success of e-learning systems. As a result, the hypothesis that follows is proposed:

H6: There is a positive relationship between the user's satisfaction with an e-learning system and their continuance intention to use it.

4. RESEARCH METHODOLOGY

4.1. RESEARCH DESIGN AND SAMPLING

A questionnaire was employed as a data collection method in this study, using a quantitative approach. Data was collected from 384 students, both online and manually, who were chosen at random from Arab Open University, KSA. The research was explained to the participants before they started filling out the questionnaire, and their participation was completely optional. The survey took about 10 minutes to complete. The participants were chosen from different departments and faculties using a random sampling technique. After taking into consideration the missing data and questionnaires that were incomplete, 12 questionnaires were omitted. According to [61], who claimed the minimal sample size for quantitative research is (N = 200), the sample size of this study (N = 372) is adequate in light of this. The sample size was calculated using the formula below.

$$ss = \frac{z^2(p)(q)}{e^2}$$

where SS = Sample Size; z = 1.96 (95% CI); P = Prevalence Level (0.5 used for sample size required); Q = (1-p); E = Error Term (0.05). By inserting values into the formula, the sample size would be:

$$ss = \frac{1.96^2(0.5)(1-0.5)}{0.05^2}$$

$$ss = 384$$

4.2. INSTRUMENT

Our questionnaire items have been adapted to fit the setting of our study from previous studies, as indicated in Table 1. The constructs considered include Course Information Quality (CIQ) [12, 46], Platform Information Quality (PIQ) [62, 63], System Quality (SQ) [63], Perceived Usefulness (PU) [64, 65], Perceived Ease of Use (PE) [66], User Satisfaction (US) [67], and Continuance Intention (CI) [68, 69]. Except for the items in the demographics section of our study (such as age, gender, specialization, and year of study), all of the items used a five-point Likert scale.

Table 1. Questionnaire

Construct	Item	Measure
Course Information Quality	CIQ.1	The educational materials I require are available through the Arab Open University LMS and SIS.
	CIQ.2	The Arab Open University LMS and SIS provide the latest information about educational materials and their diversity.
	CIQ.3	The courses within the Arab Open University LMS and SIS are well prepared.
	CIQ.4	The information about the courses on the Arab Open University LMS and SIS is accurate.
	CIQ.5	The courses featured on the Arab Open University LMS and SIS are closely related to the learning process.
Platform Information Quality	PIQ.1	The Arab Open University provides the latest information about the LMS and SIS platforms.
	PIQ.2	The information provided by the Arab Open University LMS and SIS is completely easy to understand.
	PIQ.3	The instructions and guidelines for using the Arab Open University LMS and SIS are very precise.
	PIQ.4	The Arab Open University provides sufficient information related to the courses available on the LMS and SIS.
System Quality	SQ.1	The Arab Open University LMS and SIS are always available.
	SQ.2	The Arab Open University LMS and SIS are easy to use.
	SQ.3	The Arab Open University LMS and SIS contain attractive features that are admired by students.
	SQ.4	The Arab Open University LMS and SIS provide quick access to information.
Perceived Usefulness	PU.1	Using the Arab Open University LMS and SIS enhances my learning effectiveness.
	PU.2	Using the Arab Open University LMS and SIS can improve my learning performance.
	PU.3	Using the Arab Open University LMS and SIS gives me greater control over my learning.
	PU.4	I find the Arab Open University LMS and SIS to be useful in my learning.
Perceived Ease of Use	PE.1	Learning to use the Arab Open University LMS and SIS would be easy for me.
	PE.2	I would find it easy to use the Arab Open University LMS and SIS to do my tasks.
	PE.3	My interaction with the Arab Open University LMS and SIS would be clear and understandable.
	PE.4	I find the Arab Open University LMS and SIS require less physical effort.
	PE.5	Using the Arab Open University LMS and SIS gives me greater control over my learning.

User Satisfaction	US.1	The Arab Open University LMS and SIS are effective in their use.
	US.2	I am satisfied with the performance of the Arab Open University LMS and SIS.
	US.3	I am pleased with the experience of using the Arab Open University LMS and SIS.
	US.4	I am happy with the functions provided by the Arab Open University LMS and SIS.
	US.5	My decision to use the Arab Open University LMS and SIS was a wise one.
Continuance Intention	CI.1	I will use the Arab Open University LMS and SIS on a regular basis in the future.
	CI.2	I will frequently use the Arab Open University LMS and SIS in the future.
	CI.3	I will strongly recommend that others use it.

5. DATA ANALYSIS AND RESULTS

For analyzing the data related to satisfaction and continuance intention of e-learning systems, we employed the Smart-PLS version 4 software developed by [70]. This software utilizes Partial Least Squares Structural Equation Modeling (PLS-SEM), which was deemed suitable for our exploratory study. PLS-SEM is particularly advantageous when working with small sample sizes, as it provides high statistical power.

Furthermore, the software allows for the evaluation of both the measurement and structural models, which are the two key stages in PLS-SEM analysis [71, 72]. It is important to note, as highlighted by [73], that SEM is the recommended approach when estimating models involving latent variables.

5.1. EVALUATION OF THE MEASUREMENT MODEL

In the ensuing segments, we embark on a comprehensive examination of the measurement model data in terms of evaluating the measures' reliability and validity. Our analysis encompasses an evaluation of internal consistency reliability and item loadings, as well as convergent and discriminant validity [61].

Item loadings and internal consistency reliability. To scrutinize the item loadings, PLS-SEM was employed. As illustrated in Table 2 and Fig. 1, the findings of this analysis reveal that all item loadings exceeded the recommended threshold value of >0.70 [61]. Moreover, the evaluation of internal consistency reliability for the 30 items included in the analysis was carried out using both Cronbach's alpha (α) and composite reliability (CR) measures, both of which exceeded the recommended cutoff limit of 0.70 [61].

Convergent validity. Assessing convergent validity is a pivotal component in gauging the precision of a statistical model, as it affirms that evaluations of comparable constructs have a favorable correlation. To determine convergent validity, the average variance extracted (AVE) serves as a crucial metric [74]. As demonstrated in Table 2, all AVE values surpass the recommended threshold of 0.50, suggesting that the constructs examined in this study exhibit convergent validity.

Discriminant validity. Three tests, the Heterotrait-Monotrait (HTMT) criterion, Fornell and Larcker's criterion, and cross-loadings, were used to assess the discriminant validity of the research constructs [75]. According to the analysis of the cross-loading values, each item loaded on its construct with a value greater than other constructs' cross-loadings, as seen in Table 3's loadings, which are tabulated in boldface font.

Table 2. Construct Reliability and Validity

Construct	Code	Loadings	VIF	CA	CR	AVE
Course Information Quality	CIQ.1	0.800	2.119	0.863	0.901	0.645
	CIQ.2	0.827	3.165			
	CIQ.3	0.855	3.222			
	CIQ.4	0.769	1.788			
	CIQ.5	0.760	1.539			
Platform Information Quality	PIQ.1	0.704	1.537	0.777	0.858	0.612
	PIQ.2	0.858	3.076			
	PIQ.3	0.862	3.135			
	PIQ.4	0.709	1.576			
System Quality	SQ.1	0.775	1.032	0.703	0.719	0.502
	SQ.2	0.715	1.674			
	SQ.3	0.707	1.840			
	SQ.4	0.738	1.411			
Perceived Usefulness	PU.1	0.715	1.871	0.804	0.856	0.606
	PU.2	0.927	2.790			
	PU.3	0.888	2.487			
	PU.4	0.718	1.952			

Perceived Ease of Use	PE.1	0.868	2.940	0.863	0.901	0.646
	PE.2	0.820	2.153			
	PE.3	0.787	2.116			
	PE.4	0.773	1.993			
	PE.5	0.766	2.258			
User Satisfaction	US.1	0.833	2.094	0.898	0.911	0.672
	US.2	0.745	1.540			
	US.3	0.771	2.004			
	US.4	0.830	2.219			
	US.5	0.909	2.781			
Continuance Intention	CI.1	0.759	2.080	0.776	0.851	0.656
	CI.2	0.790	1.643			
	CI.3	0.877	1.518			

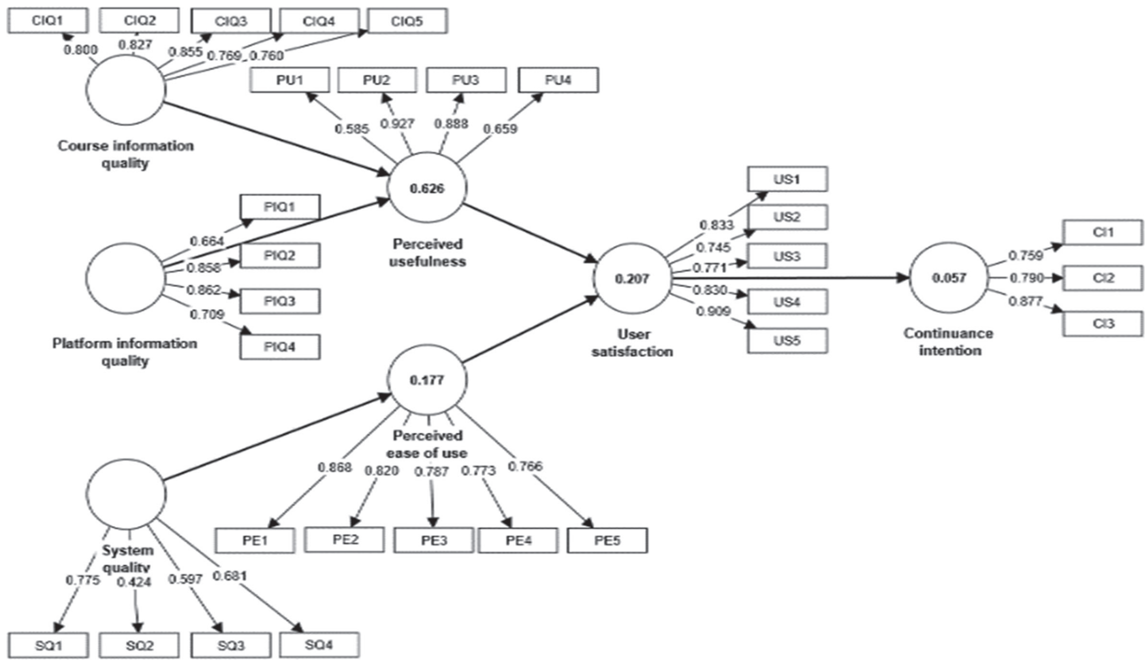

Fig. 1. Item loadings and R^2 values

Table 3. Discriminant validity based on the cross-loadings criterion

Item	CI	CIQ	PE	PU	PIQ	SQ	US
CI1	**0.759**	0.305	0.266	0.126	0.357	0.232	0.036
CI2	**0.790**	0.368	0.406	0.220	0.597	0.352	0.180
CI3	**0.877**	0.131	-0.016	-0.100	0.174	-0.072	0.238
CIQ1	0.383	**0.800**	0.655	0.428	0.645	0.311	0.325
CIQ2	0.160	**0.827**	0.464	0.586	0.503	0.590	0.175
CIQ3	0.250	**0.855**	0.583	0.585	0.499	0.422	0.269
CIQ4	0.311	**0.769**	0.833	0.557	0.695	0.421	0.314
CIQ5	0.118	**0.760**	0.556	0.732	0.617	0.442	0.128
PE1	0.365	0.790	**0.868**	0.530	0.649	0.490	0.250
PE2	-0.097	0.617	**0.820**	0.487	0.529	0.240	0.301
PE3	0.044	0.428	**0.787**	0.566	0.461	0.260	0.243
PE4	0.208	0.572	**0.773**	0.656	0.718	0.322	0.393
PE5	0.219	0.599	**0.766**	0.504	0.636	0.325	0.176
PIQ1	0.385	0.428	0.270	0.461	**0.704**	0.280	0.034
PIQ2	0.317	0.735	0.670	0.651	**0.858**	0.511	0.181
PIQ3	0.386	0.712	0.793	0.555	**0.862**	0.348	0.304
PIQ4	0.264	0.381	0.562	0.587	**0.709**	0.367	0.100
PU1	-0.233	0.266	0.292	**0.715**	0.340	0.375	-0.119
PU2	0.067	0.717	0.632	**0.927**	0.734	0.575	0.050
PU3	0.279	0.769	0.693	**0.888**	0.716	0.546	0.085
PU4	-0.443	0.246	0.331	**0.718**	0.200	0.413	-0.132

SQ1	0.153	0.314	0.366	0.369	0.187	**0.775**	0.288
SQ2	0.066	0.150	-0.043	0.246	0.236	**0.715**	-0.147
SQ3	-0.078	0.404	0.170	0.438	0.359	**0.707**	-0.183
SQ4	0.151	0.487	0.246	0.539	0.590	**0.738**	-0.098
US1	0.368	0.174	0.195	-0.027	0.223	0.081	**0.833**
US2	0.165	0.199	0.324	-0.034	0.107	0.091	**0.745**
US3	0.170	0.240	0.334	0.113	0.192	0.140	**0.771**
US4	0.052	0.262	0.215	-0.010	0.107	0.046	**0.830**
US5	0.176	0.318	0.317	0.051	0.200	0.064	**0.909**

The assessment of discriminant validity was carried out using the [76] criterion. This criterion states that discriminant validity is considered satisfactory when the squared values of the average variance extracted (AVE) surpass the shared variance between the AVE squared values of each construct and those of other constructs. To satisfy the recommendation by [77], a matrix was established, incorporating the correlation coefficient values between the value of each construct and the squared AVE values. As evident from the correlation and squared AVE values in Table 4, the statistical model achieved discriminant validity at the construct level, with higher squared AVE values on the diagonal than off-diagonal values.

Table 4. Discriminant validity assessment using the Fornell-Larcker criterion

Const.	1	2	3	4	5	6	7
CI	0.810						
CIQ	0.287	0.803					
PE	0.209	0.763	0.804				
PU	0.054	0.742	0.686	0.778			
PIQ	0.428	0.736	0.756	0.733	0.778		
SQ	0.145	0.555	0.421	0.621	0.495	0.633	
US	0.239	0.289	0.345	0.021	0.205	0.106	0.820

Table 5. Discriminant validity assessment using the HTMT criterion

Const.	1	2	3	4	5	6	7
CI	-						
CIQ	0.413	--					
PE	0.395	0.843	-				
PU	0.412	0.750	0.740	-			
PIQ	0.590	0.830	0.839	0.785	-		
SQ	0.425	0.637	0.400	0.733	0.672	-	
US	0.256	0.348	0.380	0.152	0.263	0.345	-

The Heterotrait-Monotrait (HTMT) ratio, suggested by [77], is a more recent approach to assessing discriminant validity. A value greater than 0.85 in this method's correlation between two latent variables denotes inadequate discriminant validity [77]. As demonstrated in Table 5, all of our study's HTMT values were below the recommended threshold, indicating sufficient discriminant validity.

5.2. EVALUATION OF THE STRUCTURAL MODEL

The inner Partial Least Squares model was employed throughout the structural model evaluation to assess multiple aspects. These included determining the amount of variance explained by the model, analyzing the magnitude of the relationships between the hypothesized variables, and assessing the significance and contribution of each variable. The coefficient of determination (R^2), effect size (f^2), and predictive relevance (Q^2), three basic metrics proposed by [61], were used to evaluate the structural model. In order to evaluate the model's explanatory power, the strength of the relationships between variables, and the presence of multicollinearity, these metrics were critical.

The findings shown in Table 6 indicate that the proposed model's predictors successfully account for a significant portion of the variance in the relationship between perceived usefulness, platform information quality, and course information quality. The R^2 and adj.R^2 values specifically indicate that the model predictors provide explanations for 62.6% and 62.2%, respectively, of the variation in this relationship. With R^2 and adj.R^2 values of 17.7% and 17.2%, respectively, the proposed model's predictors also account for a significant amount of variation in the relationship between system quality and perceived ease of use.

Additionally, it was found that the relationships between perceived usefulness, perceived ease of use, and user satisfaction were 20.7% and 19.7%, respectively, for R^2 and adj. R^2. On the other hand, user satisfaction and continuance intention had R^2 and adj. R^2 values of 5.7% and 5.1%, respectively. These values indicate that the proposed model predictors explain only a weak proportion of the variance in this relationship.

Nevertheless, it is worth noting that [77] accepts a moderate R2 when the model involves only one or two exogenous latent variables. Determining preferred R^2 values is challenging since they often depend on the level of model complexity and the specific research discipline [61]. Overall, the results indicate that the proposed model effectively explains the relationships between the study factors. However, it is crucial to consider the limitations of the model and the potential impact of other variables not included in the analysis.

A specific exogenous variable's substantive effect on an endogenous variable is measured by f^2, as opposed to R^2, which focuses on each endogenous latent variable. For determining the impact of predictors, this effect size test is employed. The small, medium, and large effects, respectively, are represented by f^2 values of 0.02, 0.15, and 0.35, according to [61], a guideline. Effect size values (f^2) ranging from 0.061 to 0.261 were used in this study to assess how the proposed predictors impacted the variance of the dependent variable. This indicates a medium-level contribution from each predictor in the model. A higher f^2 value suggests a more significant role for the predictor variable.

Furthermore, used to evaluate the PLS model's predictive power was predictive relevance (Q^2). The model is considered valid if the Q^2 value is higher than 0. A blindfolding procedure was used to further assess the accuracy of the model, and the results showed large predictive relevance with Q^2 values of 0.019 and 0.321. Every predictor in the model had a variance inflation factor (VIF) value that was below 3.3.

Table 6. Structural model evaluation

Construct	R2	Adj. R2	f2	Q2
CIQ	-	-	0.240	-
PIQ	-	-	0.203	-
SQ	-	-	0.216	-
PU	0.626	0.622	0.111	0.321
PE	0.177	0.172	0.261	0.103
US	0.207	0.197	0.061	0.128
CI	0.057	0.051	-	0.019

A bootstrapping approach with 5,000 iterations was employed to assess the structural linkages between the study factors. The results revealed several significant positive relationships, confirming the proposed hypotheses, as shown in Table 7.

Table 7. Hypotheses Testing

Structural Path	Coef (β) & T-statistics	P-Values	Bias-corrected 95% CI Lower Upper	Remarks
H1: CIQ→ PU	0.442 (6.108)	0.000	(0.298, 0.576)	Supported
H2: PIQ→ PU	0.407 (5.607)	0.000	(0.270, 0.551)	Supported
H3: SQ→ PE	0.421 (6.468)	0.000	(0.303, 0.559)	Supported
H4: PU→ US	0.408 (4.453)	0.000	(0.577, 0.214)	Supported
H5: PE→ US	0.625 (6.639)	0.000	(0.431, 0.792)	Supported
H6: US→ CI	0.239 (2.852)	0.004	(0.131, 0.384)	Supported

Firstly, results showed that there was a significant positive relationship between course information quality and perceived usefulness (β = 0.442; $p < 0.05$), supporting Hypothesis 1. Similar to the previous finding, Hypothesis 2 was supported by the finding that platform information quality and perceived usefulness had a significant positive relationship (β = 0.407; $p < 0.05$). Additionally, a significant positive relationship between perceived ease of use and system quality was found (β = 0.421; $p < 0.05$), supporting Hypothesis 3.

There was a significant positive relationship between perceived usefulness and user satisfaction (β = 0.408; $p < 0.05$), supporting Hypothesis 4. Additionally, a significant positive relationship between perceived ease of use and user satisfaction was found (β = 0.625; $p < 0.05$), supporting Hypothesis 5. Finally, the findings supported Hypothesis 6 by indicating a significant positive relationship between user satisfaction and continuance intention (β = 0.239; $p < 0.05$). Fig. 2 presents a visual representation of these findings.

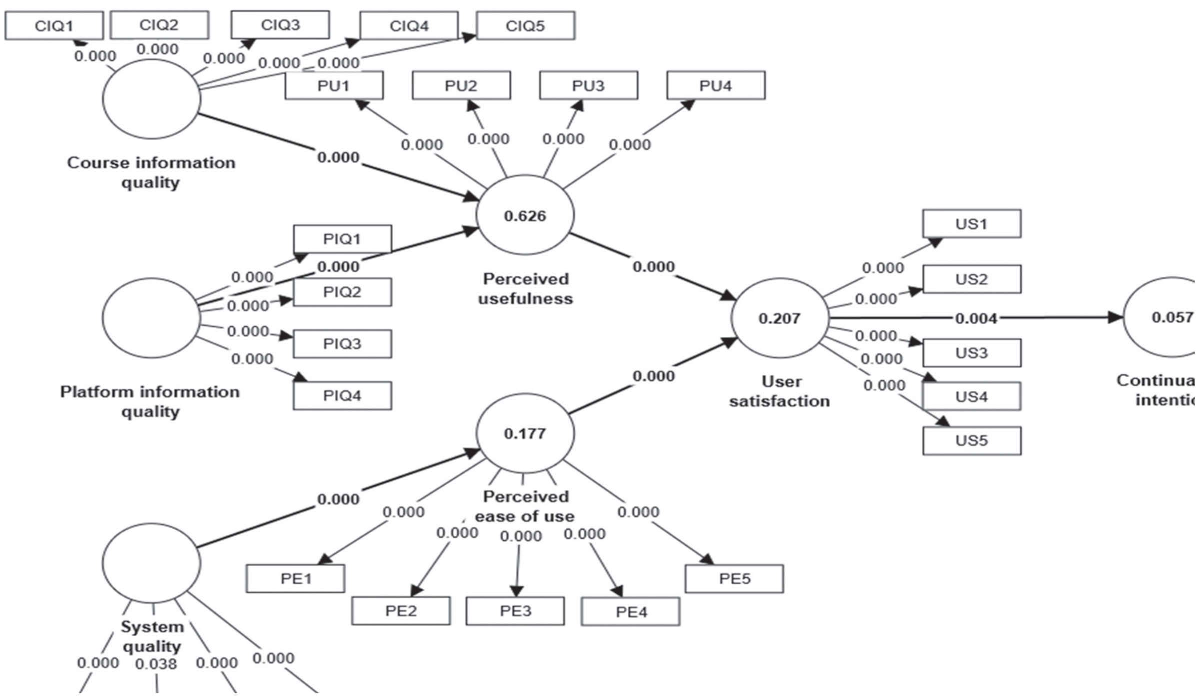

Fig. 2. Coefficient significance test

6. DISCUSSIONS

The study found a positive correlation between the quality of course information and students' perceived usefulness of the course. This suggests that more accurate, comprehensive, and relevant information enhances students' perceptions of the course's usefulness. To improve course information quality, institutions should prioritize it, provide detailed learning outcomes, seek student feedback, offer supplementary resources, and foster communication and transparency. Establishing channels for students to ask questions promotes open dialogue, trust, and a supportive learning environment.

Furthermore, the study found a positive correlation between the quality of platform information and its perceived usefulness, supporting the hypothesis that high-quality information enhances users' perceptions of a platform's usefulness. Institutions and educators should ensure reliable, accurate, and tailored information, communicate features clearly, avoid excessive technical jargon, and regularly solicit user feedback through surveys, interviews, and focus groups. Additionally, providing user support channels like live chat or email can help address user questions and concerns promptly.

To confirm Hypothesis 3, a positive correlation exists between system quality and perceived ease of use. To achieve this, system providers can optimize performance, streamline processes, design an intuitive interface, offer comprehensive user support, conduct regular usability testing, and stay updated with technological advancements and user preferences. This will ensure the system's quality and adaptability to evolving user needs, thereby enhancing the user experience.

To validate Hypothesis 4, system or product providers should align features with user needs through research and feedback, ensure clear functionality, user-friendly interfaces, and comprehensive support channels. Actively gathering user feedback through surveys and testing sessions allows for ongoing improvements and updates. Implementing metrics and analytics to measure perceived usefulness and monitor user engagement provides insights for further enhancements.

The study confirms that perceived ease of use positively influences user satisfaction. To improve satisfaction, system or product providers can simplify the interface, provide clear instructions, streamline workflows, offer responsive support, conduct usability testing, and offer comprehensive training and onboarding resources. Regular usability testing and feedback gathering contribute to continuous improvements. Providing comprehensive training and onboarding resources reduces the learning curve and boosts confidence, further enhancing perceived ease of use and satisfaction.

The study confirms a positive correlation between user satisfaction and e-learning intention to continue, indicating that providers should focus on streamlined interfaces, optimized content delivery, and seamless navigation. Personalizing learning experiences, fostering collaboration, providing timely feedback, updating content and effectively communicating benefits also contribute to satisfaction.

7. CONCLUSION

This study aimed to explore the impact of quality factors on e-learning system user satisfaction and continuance intention by integrating the ISSM with the TAM. The study was motivated by the growing relevance of e-learning systems, particularly in light of the global crisis that has harmed traditional education methods. The study highlights the importance of course information quality, platform information quality, and system quality in enhancing users' perceived usefulness and satisfaction with e-learning systems. Educational institutions and e-learning system providers can use these findings to improve the design, content, and usability of their platforms, leading to higher user satisfaction and increased continuance intention.

However, the study has limitations. Its focus on a specific context or sample may limit its generalizability, and its use of self-reported data is vulnerable to response bias. Additionally, the study did not consider the impact of external factors such as individual characteristics or social factors on user satisfaction and intention to continue. Future research could address these limitations by conducting research in various contexts and using mixed-method techniques.

The study also suggests future research in e-learning systems to understand the impact of individual characteristics, social factors, and new technologies on user satisfaction and continuance intention. Understanding how these factors interact with quality factors can provide insights for personalized e-learning platforms. Longitudinal studies could analyze the long-term impacts of user satisfaction on continuance intention, while new technologies like virtual reality or artificial intelligence could be explored to enhance the effectiveness of e-learning systems in online education.

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