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Research Article

The Impact of User Satisfaction in the Use of E-Learning Systems in Higher Education: A CB-SEM Approach

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Abstract: The primary objective of this research is to thoroughly investigate the intricate dynamics and collective influence of essential elements within the e-learning domain. Examining the interdependencies and combined effects of technology system quality, information quality, and support services on user satisfaction. This study investigates the key factors affecting user satisfaction in e-learning at Universitas Negeri Makassar, focusing on the roles of Information Quality, System Quality, and Service Quality. Survey data from 231 diverse students were analyzed using a Likert scale questionnaire, with Structural Equation Modeling via IBM AMOS. The findings aim to reveal how these quality dimensions impact user satisfaction, potentially guiding enhancements in e-learning system design. A comprehensive study examining e-learning systems conclusively found that System Quality, Information Quality, and Service Quality are pivotal factors influencing user satisfaction. Improving system functionality, ensuring the accuracy and relevance of information, and delivering high-quality service were all significantly correlated with higher satisfaction levels among users. This underscores the critical need for educational institutions to prioritize these aspects to enhance the e-learning experience. The research presents strong evidence that educational institutions can significantly boost user satisfaction by focusing on the quality of the system, information, and services provided in e-learning platforms. These findings provide actionable insights for decision-makers in the education sector, suggesting that investments in these areas will likely yield positive outcomes in user engagement and satisfaction with e-learning systems.

Keywords: Information Quality; System Quality; Service Quality; Structural Equation Modeling; Student Satisfaction.

1. Introduction

Technology-based education has rapidly evolved in recent years, with e-learning becoming one of the increasingly popular approaches to providing broader access to education [1]–[3]. E-learning allows students to learn flexibly, access materials online, and interact with instructors and fellow students without being constrained by geographical limitations [4], [5]. This presents significant potential for improving educational accessibility, particularly for those facing geographical constraints or other limitations in participating in traditional education.

One of the significant challenges in e-learning is ensuring student satisfaction with their learning experience. Factors such as the quality of the technology systems, the quality of the provided information, and the quality of support services can significantly impact student satisfaction [6], [7]. Technology systems' quality encompasses access speed, platform stability, and user-friendly interfaces. Information quality involves the accuracy and relevance of the provided learning materials. Meanwhile, service quality includes the responsiveness of technical support and the availability of assistance to students.

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Although there has been research exploring these aspects individually, there is still a need for a deeper understanding of how these factors collectively influence student satisfaction in e-learning. Therefore, this research aims to fill this knowledge gap by analyzing the combined impact of system quality, information quality, and support services on student satisfaction in e-learning [8], [9]. Thus, this study is expected to provide deeper insights and practical recommendations for educational institutions and e-learning platform developers to enhance the e-learning experience for students [10], [11].

Several prior studies have examined various aspects related to student satisfaction in e-learning. These findings underscore the significance of user-friendly technology systems, relevant and accurate information quality, and responsive, high-quality support services in enhancing the e-learning experience [12]–[16]. Previous research identified that the technology systems deployed in e-learning platforms considerably impact student satisfaction. Systems that are easy to use, intuitive interfaces and stable performance can elevate student satisfaction levels [17], [18]. Furthermore, the quality of information presented in e-learning also plays a pivotal role. Relevant, accurate, and up-to-date learning materials can enhance students' understanding, subsequently increasing satisfaction [12]. Equally vital are responsive and top-tier support services. Swift and efficient technical support and assistance for students facing challenges can amplify student satisfaction levels regarding the e-learning platform [19], [20].

In addition to these factors, fundamental theories and frameworks have been employed in previous research to elucidate student satisfaction with e-learning. The Technology Acceptance Model (TAM), proposed by Davis in 1989, concentrates on users' acceptance and adoption of technology. According to TAM, perceptions about a technology's usefulness and ease of use will influence users' intention to utilize it. In e-learning, technology deemed easy and beneficial by students can enhance their satisfaction [17]. Research related to student satisfaction in the realm of e-learning has evolved alongside advancements in information technology. Initially, this research primarily centers on the technical and functional aspects of e-learning platforms. At this stage, the primary focus was on developing e-learning platforms that could operate seamlessly, efficiently deliver learning materials, and provide essential tools for online instruction and learning [6]. The overarching goal was to ensure that the deployed technology could effectively support learning content delivery.

With the evolution of the concept of customer satisfaction, research is increasingly focusing on the factors that influence students' perceptions of the quality of the e-learning experience. This includes understanding how students interact with technology, how they perceive the quality of the information provided, and to what extent support services meet their needs. Management theories, such as the Technology Acceptance Model (TAM) introduced by Davis in 1989, are becoming more widespread in e-learning research. TAM helps explain why students accept or reject e-learning technology by focusing on perceptions of its usefulness and ease of use [17]. Consequently, e-learning research has shifted from technical approaches towards a more user-oriented and overall service quality-oriented approach.

In the context of this research, e-learning is increasingly understood as an ecosystem that involves technical factors, information quality, system quality, and service quality. This helps research understand that these factors synergize and mutually influence each other to shape the student experience, ultimately affecting their satisfaction. Thus, recent research in e-learning is more oriented toward understanding how these factors work together to create a better e-learning experience and how educational institutions and e-learning platform developers can leverage this understanding to enhance the quality of technology-based education.

While much research has been conducted on the factors influencing student satisfaction in e-learning, a significant research gap remains. One such gap is the lack of understanding of how technology systems, information, and services interact and affect student satisfaction [21]. This research aims to fill this gap by conducting a comprehensive analysis of the combined impact of these factors on student satisfaction in the e-learning context. A significant research gap in student satisfaction in e-learning lies in a deep understanding of the interplay of critical factors, namely technology systems, information, and services, and how this interaction affects student satisfaction. Previous research has identified the crucial roles of these factors, but there is still a need to bridge this gap in greater detail.

E-learning is a highly diverse environment, encompassing various types of educational institutions, e-learning platforms, and subjects [11]. Therefore, a research gap exists in understanding how these factors may operate differently in various e-learning contexts. Some previous studies may not have used comprehensive measurement tools to assess these factors and their impacts on student satisfaction. There is potential to develop better methods and instruments for measuring the quality of technology systems, information quality, and support services in more detailed and accurate ways. By understanding these gaps, this research aims to fill knowledge voids by conducting a comprehensive analysis of the interactions and combined impacts of critical factors in the context of e-learning.

Through a deeper understanding of the relationship between technology system quality, information quality, and support services, this research will provide valuable insights and practical solutions for developing better e-learning.

2. Material and Methods

2.1. Research Approach

Quantitative approaches in scientific research rely heavily on strategies such as experiments and surveys, which allow researchers to collect statistical data to answer research questions empirically [22]. This approach emphasizes the importance of causation, where researchers try to identify causal relationships between the variables they observe [23]. To simplify data complexity, variable reduction is essential in quantitative analysis [24]. Quantitative research involves formulating hypotheses that can be tested empirically [25]. This hypothesis serves as a framework for directing research and provides a basis for data collection and analysis. Finally, this research requires the formulation of specific research questions to be answered [26]. These questions guide the research design and collect relevant data.

2.2. Sample and Data Collection

This study utilized a sample of 231 respondents as research subjects, chosen with meticulous attention to reflecting the diversity of the population pertinent to the study. This deliberate selection ensured robust representation and more broadly applicable results. Data collection was carried out via a survey employing a carefully constructed questionnaire. The questionnaire was randomly distributed to every student at the Universitas Negeri Makassar, and we ensured that respondents had ample time to provide comprehensive responses. The data collected through this questionnaire is the foundation for our research analysis and findings. We meticulously designed the questionnaire to optimize the efficiency and effectiveness of data collection. It comprises questions tailored to elicit pertinent information aligned with our research objectives. The phrasing of these questions was rigorously crafted to prevent bias and ensure data accuracy.

2.3. Research Instrument

A variable is a contract whose properties have been assigned a value as a number or concept with two or more values on a continuum. The value of a variable can be expressed with numbers or words. Variables can also be interpreted as symptoms of something that will be the object of research. Based on the relationship, variables are divided into two: (1) Independent variables influence or cause other variables. The independent variables in this research are Information Quality, System Quality, and Service Quality; and (2) The dependent variable is a variable that is influenced or caused by other variables. The dependent variable in this research is User Satisfaction.

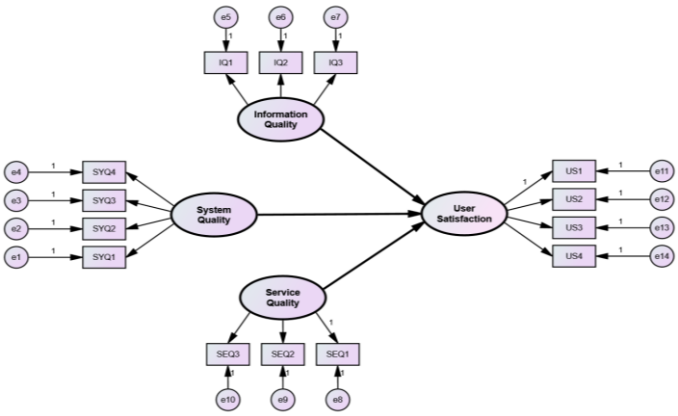

Figure 1. Research Model.

Table 1. Research Instrument

Variables	Kode	Construct	Sources
System Quality	SYQ1	How responsive is this e-learning system to your commands?	[12]
	SYQ2	What is the level of ease of access to this e-learning system?	[27]
	SYQ3	How easily can you overcome technical problems when using e-learning systems?	[28]
	SYQ4	What is the user interface's suitability level in the e-learning system?	[29]
Information Quality	IQ1	How accurate and reliable are the learning materials in this e-learning system?	[30]
	IQ2	How does this e-learning system present information clearly and easily understand?	[31]
	IQ3	What is your perception of the novelty and completeness of the information in this e-learning?	[32]
Services Quality	SEQ1	Is the guidance provided when experiencing difficulties in e-learning adequate?	[33]
	SEQ2	What is the quality of user communication services and e-learning support teams?	[12]
	SEQ3	How responsive and professional is the technical support service?	[34]
	SEQ4	How easy is it to interact in the e-learning system with instructors and fellow users?	[35]

Variables	Kode	Construct	Sources
User Satisfaction	US1	Are you satisfied with the features of this e-learning system overall?	[30]
	US2	What is your level of satisfaction with your academic performance after using this system?	[36]
	US3	Does using this e-learning system positively contribute to increasing your knowledge and skills?	[37]
	US4	Do you feel this e-learning system provides an opportunity to learn more interactively?	[37]

The questionnaire utilized in this study aims to categorize students based on Information Quality, System Quality, Service Quality, and User Satisfaction. To measure these variables, we employed the Likert scale guidelines, widely used to assess individuals' attitudes, opinions, and perceptions regarding specific social phenomena, as determined by the researcher. In this context, the research variables include Information Quality, System Quality, Service Quality, and User Satisfaction. With the Likert scale, these variables are translated into measurable indicators. Each item in the instrument offers a range of responses, from very positive to very negative, expressed in words. The answer options used in this instrument are Strongly Agree (5), Agree (4), Neutral or Neither Agree (3), Disagree (2), and Strongly Disagree (1).

2.4. Data Analysis

In this study, we utilized Confirmatory Factor Analysis (CFA) and the Covariance-Based Structural Equation Modelling (CB-SEM) method to comprehensively examine the relationships between the variables outlined in our previously established conceptual model. CB-SEM represents a robust statistical tool employed to explore connections between latent variables and observed data in research. As elucidated by [38], CB-SEM empowers researchers to scrutinize hypotheses generated from a conceptual model. This methodology seamlessly integrates Confirmatory Factor Analysis, which evaluates the validity and reliability of latent variables, with path analysis to delve into the causal relationships among these variables [39]. In this analysis, the initial step involves estimating the measurement model to assess the construct's reliability and validity. Subsequently, we estimate the structural model to test the hypothesized relationships between variables. Structural Equation Model (SEM) analysis was conducted using the IBM AMOS program as the data processing application to analyze the primary data obtained.

2.5. Hypothesis Development

2.5.1. System Quality

System quality pertains to the accessibility and responsiveness of a system, ensuring it effectively addresses user inquiries and promptly caters to their needs, aligning with user expectations [40]. It gauges the extent to which system users perceive specific systems as user-friendly, comprehensible, learnable, and enjoyable [41]. Evaluating system quality commonly involves assessing the reliability of inherent system attributes, encompassing system performance and system and user interfaces. This investigation focuses on how the quality of a system intricately links to a student's e-learning experience, encompassing user-friendliness, learnability, accessibility, and rapid response times. Moreover, the system's quality significantly influences user contentment and system utilization [42]. User-friendly performance, denoted as a system's operational trait [43], correlates with easily navigable, comprehensible, and graspable systems. It extends to adaptability, reflecting a system's effective response to changing circumstances [44]. Essential aspects of system usage encompass time savings, redundancy reduction, and heightened productivity [45]. Consequently, the timeliness factor also emerges as a determinant impacting system quality.

H1: *There is a significant influence between system quality and user satisfaction.*

2.5.2. Information Quality

Information quality pertains to the caliber of the results generated by the information system [30], [46], [47]. Essentially, it encapsulates the worth of the information output emanating from the system [48]. This discernment underscores that the evaluation of information quality revolves around the outcomes engendered by the system, alongside their value to the user. Information quality assessment encompasses a triad of criteria: precision, punctual delivery, and relevance of information. Evaluating information quality interlinks with the information the system can generate, spanning transactional data and comprehensive reporting [49], [50].

H2: *There is a significant influence between Information quality and user satisfaction.*

2.5.3. Services Quality

Service quality within higher education encompasses the discernible variance between students' expectations and actual encounters within the higher education context [51]. It pertains to the comprehensive assistance furnished by service providers within the information system domain, encompassing contributions from internal and external

entities affiliated with the organization. In pursuing educational objectives, service quality is pivotal in enhancing the educational experience via online platforms [52]. It fortifies competitive advantage by introducing distinctive elements that augment user contentment. Several pivotal facets that serve as service quality indicators within the e-learning landscape encompass administrative and support mechanisms, instructor competence, precision, specialized resources, and security provisions [53]. Cultivating commendable service quality positively influences user satisfaction and system utilization [54]. To advance the quality of information system services in education, a pivotal approach involves enhancing e-learning services, achieved through evaluative processes rooted in students' experiences and perceptions.

H3: *There is a significant influence between Service quality and user satisfaction.*

3. Result and Discussion

3.1. Characteristic of Respondents

This study collected data from 231 respondents to explore various aspects of them. It evaluated the gender distribution among the respondents. The research results indicated that most were males, comprising more than half of the respondents. Although the difference was not statistically significant, it was quite noticeable. There were five different age groups; the 20-year-old age group was the largest. This may suggest that this age group was the most heavily involved in the study. We also examined the faculties or majors chosen by the respondents. The "Engineering" faculty had the highest respondents, followed by the "Mathematical Psychology and Natural Sciences" faculty. This could indicate the interests and distribution of respondents across various fields of study.

Table 2. Characteristic of Respondents

Category		Frequency (n=231)	Percentage
Gender	Men	125.00	54.11%
	Women	106.00	45.89%
Age	18 years	50.00	21.65%
	19 years	52.00	22.51%
	20 years	57.00	24.68%
	21 years	37.00	16.02%
	22 years	35.00	15.15%
Faculty	Technique	63.00	27.27%
	Education Science	52.00	22.51%
	Language and Literature	25.00	10.82%
	Economic, Social, and Legal	35.00	15.15%
	Mathematical Psychology and Natural Sciences	56.00	24.24%

3.2. Goodness of Fit (GOF) Test

The goodness-of-fit analysis evaluates how much the proposed model fits the empirical data. Hu and Bentler explain that goodness-of-fit analysis provides information about the model's suitability to observational data [55]. The results of this analysis provide clues as to whether the model needs to be adjusted. Garson suggests that it is essential to incorporate at least one measure of baseline fit, such as IFI, CFI, TLI, RFI, or NFI, along with one measure of parsimony fit, such as PCFI or PNFI, when presenting the results [56]. The test results from GOF research are as follows (Table 3):

Table 3. Goodness of Fit (GOF) Result

Criteria	Value	Cut-Off	Sources
Chi-Square (X^2)	0.967	≥ 0.050	[57]–[59]
CMIN/DF	0.724	≤ 2.000	[60]–[62]
GFI (Goodness of Fit Index)	0.931	≥ 0.900	[57], [62], [63]
RMSEA (Root Mean Square Error of Approximation)	0.001	≤ 0.080	[55], [62], [64]–[67]
TLI (Tucker-Lewis Index)	1.108	≥ 0.900	[62], [68], [69]
CFI (Comparative Fit Index)	1.001	≥ 0.900	[55], [70], [71]

Criteria	Value	Cut-Off	Sources
IFI (Incremental Fit Index)	1.086	≥ 0.900	[72]
PNFI (Parsimony Normed Fit Index)	0.613	≥ 0.500	[73], [74]
PCFI (Parsimony Comparative Fit Index)	0.785	≥ 0.500	[73], [74]

Table 4. Loading Factor, CR and AVE Test Result.

Construct		Variable Laten	Loading Factor	Construct Reliability (CR)	Average Variance Extract (AVE)
IQ1	<---	Information Quality	0.781	0.744	0.867
IQ2	<---	Information Quality	0.734		
IQ3	<---	Information Quality	0.718		
SEQ1	<---	Services Quality	0.742	0.729	0.854
SEQ2	<---	Services Quality	0.682		
SEQ3	<---	Services Quality	0.762		
SYQ4	<---	System Quality	0.679		
SYQ1	<---	System Quality	0.665	0.728	0.886
SYQ2	<---	System Quality	0.821		
SYQ3	<---	System Quality	0.747		
US1	<---	User Satisfaction	0.733	0.737	0.892
US2	<---	User Satisfaction	0.714		
US3	<---	User Satisfaction	0.686		
US4	<---	User Satisfaction	0.814		

The Goodness of Fit (GOF) criteria are pivotal in deciding whether a model can be accepted or rejected. This determination involves conducting a feasibility test using various indices and predefined threshold values [75]. As presented in Table 3, the GOF criteria have been satisfied, signifying the model's stability and readiness for further analysis.

A concise set of indicators effectively reveals the relationship between latent variables, provided values stay below a specified threshold. Correlation strength is measured by a loading factor exceeding 0.50, indicating that the reflective construct in the structural model surpasses the threshold, making missing latent variables unnecessary. When evaluating the measurement model's quality, consider validity and reliability. In Table 4, the Construct Reliability (CR) value from the SEM study of the measurement approach exceeds 0.70, signifying reliability across all models and instilling confidence in their applicability. The Average Variance Extracted (AVE) reflects the construct variance represented by the latent variable. To ensure robust convergent validity, aim for a threshold of 0.50 or higher [76].

From Table 4, findings confirm positive outcomes, with the AVE indicating excellent validity within the structural model. This suggests latent explanatory variables account for over half the variance in average indicators, further validating the model's reliability.

3.3. Hypothesis Test Result

Table 5 indicates the analysis results indicating a significant relationship between the tested factors and User Satisfaction. System Quality is confirmed to have a positive and significant relationship with User Satisfaction (β = 0.385, $p<0.01$). This implies that enhancing system quality positively influences the level of user satisfaction. These findings support the first hypothesis (H1), which posits that System Quality affects User Satisfaction. Secondly, Information Quality also significantly impacts User Satisfaction (β = 0.524, $p<0.01$). This suggests that improving information quality increases user satisfaction, aligning with the second hypothesis (H2). Thirdly, Service Quality notably substantially impacts User Satisfaction (β = 0.652, $p<0.001$). This underscores that elevating service quality considerably positively affects user satisfaction levels, reinforcing the third hypothesis (H3). These results strongly emphasize the significance of these factors in enhancing user satisfaction.

These results demonstrate a highly significant relationship between System Quality, Information Quality, and Service Quality and their impact on User Satisfaction. Each factor exhibits a robust positive influence on User Satisfaction, as evidenced by the substantial estimated values (β) and low probability values. These findings support this study's three primary hypotheses (H1, H2, and H3).

Table 5. Results of Hypothesis Testing

			Estimate	Hypothesis	C.R.	Probability	Results
System Quality	<---	User Satisfaction	0.385**	H1	2.084	0.001	Significant
Information Quality	<---	User Satisfaction	0.524**	H2	2.052	0.001	Significant
Services Quality	<---	User Satisfaction	0.652***	H3	2.685	0.000	Significant
System Quality	<---	User Satisfaction	0.385**	H1	2.084	0.001	Significant
Information Quality	<---	User Satisfaction	0.524**	H2	2.052	0.001	Significant

Note: *p<0.05, **p<0.01, ***p<0.001

Based on these results, it can be confidently concluded that investing in and actively improving System Quality, Information Quality, and Service Quality can be regarded as an effective strategy for enhancing User Satisfaction within an organizational or corporate context. These findings offer valuable guidance for decision-makers striving to enhance user experience and satisfaction.

The influence of information quality on user satisfaction is crucial in the e-learning context. E-learning employs information and communication technology to deliver information and remote education to users. In an e-learning environment, good information quality can contribute to user satisfaction and the effectiveness of the learning process. Therefore, this research investigates the significant effect of information quality on e-learning user satisfaction.

Previous research has identified several aspects of information quality that potentially influence user satisfaction in e-learning. Common aspects related to e-learning information quality include accuracy, clarity, relevance, timeliness, and availability of information. Studies also indicate that these factors contribute to users' perceptions of information quality and, consequently, to their satisfaction.

A related study by Hong et al. investigated the effect of information quality on user satisfaction in the e-learning context at higher education institutions. The results revealed that aspects of information quality, such as accuracy, clarity, and relevance, significantly and positively influence e-learning user satisfaction [77].

Other research by R. Wang et al. and X. Wang et al. also explored the influence of information quality on user satisfaction on e-learning platforms. They found that factors like the timeliness and availability of information significantly contribute to e-learning user satisfaction. E-learning users tend to be more satisfied when they access current and well-available information [78], [79].

A study by Huang et al. explored the relationship between information quality, user satisfaction, and learning effectiveness in e-learning systems in Taiwan. Information quality, including clarity, relevance, and availability, positively impacts user satisfaction and learning effectiveness [80]. Although the study by Wu & Wang did not focus specifically on e-learning, it centered on measuring the success of a knowledge management system (KMS). This research provides valuable insights into factors affecting user satisfaction, associating it with information quality [81]. The findings revealed that information quality significantly affects user satisfaction in the KMS context. Research by Liu et al. examined the influence of information quality in the context of e-learning technology acceptance. High-quality information, including clarity and relevance, can positively impact user experience and enhance e-learning technology acceptance [82].

Through this research, a better understanding of the relationship between information quality and user satisfaction in the e-learning context is expected. The findings can offer recommendations for educational institutions and e-learning platform providers to enhance the quality of information they provide, thereby increasing user satisfaction and remote learning effectiveness.

E-learning system quality is paramount in enhancing user satisfaction, as underscored by multiple studies and user experience factors. The accessibility and intuitiveness of an e-learning system stand as pivotal elements in this regard. Students appreciate a straightforward platform, enabling them to swiftly access materials, connect with peers and instructors, and easily harness available features. Such systems minimize technical challenges, providing a smooth and efficient learning experience.

Content availability and reliability are foundational for any e-learning system. Students' satisfaction levels soar When they can seamlessly access current, comprehensive, and relevant learning materials. Reliability in delivering these materials and ensuring consistent system functionality is equally critical. This gives students the confidence to depend on the platform for their educational needs.

Interactive and collaborative elements also serve to elevate the e-learning experience. Features that promote discussions, virtual classes, or collaboration platforms foster richer interactions, permitting students to exchange

ideas, offer feedback, and form valuable social bonds. These engagements enhance user satisfaction by making learning more dynamic and interconnected.

The e-learning system's ability to provide prompt and constructive feedback is also a significant determinant of user satisfaction. Students value timely feedback on assignments, exams, and queries, as it clarifies their progress and areas for improvement. Quick responses cater to academic needs and symbolize institutional support, further heightening satisfaction.

Multiple studies corroborate these observations. Wu et al. emphasized the importance of e-learning system quality aspects like response speed, interface design, and feature relevance in influencing user satisfaction [83]. They have pinpointed factors such as ease of use, system responsiveness, and technical support instrumental to e-learning user contentment [42], [84] and echoed these sentiments, emphasizing system reliability, content availability, and interactive features as crucial drivers of user satisfaction [85].

In essence, an e-learning system's quality significantly determines user satisfaction. To offer an optimal learning experience, universities and platform providers must prioritize factors like ease of use, content availability, system reliability, and interactive capabilities. By honing these qualities, institutions can significantly uplift user satisfaction in e-learning environments.

The influence of service quality on user satisfaction is a crucial factor in e-learning. E-learning is a learning method that employs information and communication technology to provide distance education to users. In an e-learning environment, good service quality can contribute to user satisfaction and the success of the e-learning platform implementation. Therefore, this research aims to investigate the significant influence of service quality on e-learning user satisfaction.

The impact of service quality on user satisfaction in e-learning at higher education institutions. E-learning users, namely students, were approached with a survey using a questionnaire as a data collection instrument. The results indicate that service quality dimensions such as responsiveness, technological reliability, and instructor interaction positively and significantly impact e-learning user satisfaction. Service responsiveness, such as quick responses to user queries and problems, enhances user satisfaction [86], [87]. Technological reliability and interaction between instructors and users also contribute to user satisfaction [20], [88].

Another study revealed the influence of service quality on user satisfaction in e-learning platforms [20], [89]. They found that factors like platform accessibility, instructor interaction, and availability of learning resources significantly contribute to e-learning user satisfaction. Easy-to-use and intuitive platform accessibility, good interaction between instructors and users through discussion forums or support services, and ample availability of learning resources are crucial factors affecting user satisfaction.

From this research, it can be concluded that good service quality in the context of e-learning significantly affects user satisfaction. Service quality dimensions such as service responsiveness, technological reliability, instructor interaction, platform accessibility, and the availability of learning resources need to be considered and enhanced to improve e-learning user satisfaction. The recommendations from this research can assist educational institutions and e-learning platform providers in improving the quality of services they offer, thus enhancing user satisfaction and the effectiveness of distance learning.

4. Conclusion

The research highlights the pivotal role of System Quality, Information Quality, and Service Quality in enhancing user satisfaction with e-learning platforms. Institutions must prioritize the development of intuitive and reliable systems, deliver clear and relevant content, and ensure responsive and supportive service to users. The study suggests a comprehensive strategy for educational providers: invest in user-friendly technology, maintain up-to-date and accessible educational content, and provide effective support and interaction. These findings not only guide institutions in refining their e-learning offerings but also have broader implications for educational policy, suggesting a need for standards that uphold these quality dimensions. By focusing on these key areas, educational institutions can foster a more engaging and successful e-learning experience for users.

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References

[1] V. Florjancic and D. Lesjak, "E-learning and study effectiveness," *J. Comput. Inf. Syst*, vol. 49, pp. 40–47, 2009.

[2] A. K. Singh, M. A. Yusoff, and N. Oo, "A comparative study between traditional learning and e-learning," in *Proceedings of Teaching and Learning Open Forum 2009*,

2009, pp. 1–7.
[3] D. Keržič *et al.*, "Academic student satisfaction and perceived performance in the e-learning environment during the COVID-19 pandemic: Evidence across ten countries," *PLoS One*, vol. 16, no. 10, p. e0258807, 2021.
[4] C. Goi and P. Y. Ng, "E-learning in Malaysia: Success factors in implementing e-learning program," *Int. J. Teach. Learn. High. Educ.*, vol. 20, no. 2, 2008.
[5] T. C. Reeves, "The impact of media and technology in schools," *J. J. Art Des. Educ.*, vol. 2, pp. 58–63, 1998.
[6] E. Dahlstrom, J. D. Walker, and C. Dziuban, "ECAR study of undergraduate students and information technology," 2013.
[7] R. Varma, "Women in information technology: A case study of undergraduate students in a minority-serving institution," *Bull. Sci. Technol. Soc.*, vol. 22, no. 4, pp. 274–282, 2002.
[8] T. Chen, L. Peng, B. Jing, C. Wu, J. Yang, and G. Cong, "The impact of the COVID-19 pandemic on user experience with online education platforms in China," *Sustainability*, vol. 12, no. 18, p. 7329, 2020.
[9] R. Oppermann, "User-interface design," *Handb. Inf. Technol. Educ. Train.*, pp. 233–248, 2002.
[10] G. Maheshwari, "Factors affecting students' intentions to undertake online learning: an empirical study in Vietnam," *Educ. Inf. Technol.*, vol. 26, no. 6, pp. 6629–6649, 2021.
[11] Y.-C. Kuo, A. E. Walker, K. E. E. Schroder, and B. R. Belland, "Interaction, Internet self-efficacy, and self-regulated learning as predictors of student satisfaction in online education courses," *internet High. Educ.*, vol. 20, pp. 35–50, 2014.
[12] A. Parasuraman, V. A. Zeithaml, and L. Berry, "SERVQUAL: A multiple-item scale for measuring consumer perceptions of service quality," *1988*, vol. 64, no. 1, pp. 12–40, 1988.
[13] B. Schneider and S. S. White, *Service quality: Research perspectives*, vol. 107. Sage, 2004.
[14] Y.-S. Wang, H.-Y. Wang, and D. Y. Shee, "Measuring e-learning systems success in an organizational context: Scale development and validation," *Comput. Human Behav.*, vol. 23, no. 4, pp. 1792–1808, 2007.
[15] T.-H. Wang, "Developing an assessment-centered e-Learning system for improving student learning effectiveness," *Comput. Educ.*, vol. 73, pp. 189–203, 2014.
[16] T.-H. Wang, "What strategies are effective for formative assessment in an e-learning environment?," *J. Comput. Assist. Learn.*, vol. 23, no. 3, pp. 171–186, 2007.
[17] F. D. Davis, "Perceived usefulness, perceived ease of use, and user acceptance of information technology," *MIS Q.*, pp. 319–340, 1989.
[18] F. D. Davis, R. P. Bagozzi, and P. R. Warshaw, "User acceptance of computer technology: a comparison of two theoretical models," *Manage. Sci.*, vol. 35, no. 8, pp. 982–1003, 1989.
[19] T. Mulla, S. Munir, and V. Mohan, "An exploratory study to understand faculty members' perceptions and challenges in online teaching," *Int. Rev. Educ.*, pp. 1–27, 2023.
[20] F. Li, H. Lu, M. Hou, K. Cui, and M. Darbandi, "Customer satisfaction with bank services: The role of cloud services, security, e-learning and service quality," *Technol. Soc.*, vol. 64, p. 101487, 2021.
[21] E. Alqurashi, "Predicting student satisfaction and perceived learning within online learning environments," *Distance Educ.*, vol. 40, no. 1, pp. 133–148, 2019.
[22] B. Johnson and L. Christensen, *Educational research: Quantitative and qualitative approaches*. Allyn & Bacon, 2000.
[23] J. R. Fraenkel and N. E. Wallen, *How to Design and Evaluate Research in Education*, 7th ed. New York: McGraw-Hill Higher Education, 2009.
[24] J. W. Creswell, *A concise introduction to mixed methods research*. SAGE publications, 2021.
[25] J. W. Creswell, *Educational research: Planning, conducting, and evaluating quantitative*. Upper Saddle River, New Jersey: Prentice Hall, 2002.
[26] J. R. Fraenkel, N. E. Wallen, and H. H. Hyun, *How to Design and Evaluate Research in Education*, 7th ed., vol. 7. New York: McGraw-Hill, 1993.
[27] V. Venkatesh and F. D. Davis, "A theoretical extension of the technology acceptance model: Four longitudinal field studies," *Manage. Sci.*, vol. 46, no. 2, pp. 186–204, 2000.
[28] A. Bhattacherjee, "Understanding information systems continuance: An expectation-confirmation model," *MIS Q.*, pp. 351–370, 2001.
[29] D. Gefen and D. W. Straub, "The relative importance of perceived ease of use in IS adoption: A study of e-commerce adoption," *J. Assoc. Inf. Syst.*, vol. 1, no. 1, p. 8, 2000.
[30] W. H. Delone and E. R. McLean, "The DeLone and McLean model of information systems success: a ten-year update," *J. Manag. Inf. Syst.*, vol. 19, no. 4, pp. 9–30, 2003.
[31] D. Gefen and M. Keil, "The impact of developer responsiveness on perceptions of usefulness and ease of use: An extension of the technology acceptance model," *Acm sigmis database database Adv. Inf. Syst.*, vol. 29, no. 2, pp. 35–49, 1998.
[32] M. Igbaria and M. Tan, "The consequences of information technology acceptance on subsequent individual performance," *Inf. Manag.*, vol. 32, no. 3, pp. 113–121, 1997.
[33] W. J. Doll and G. Torkzadeh, "The measurement of end-user computing satisfaction," *MIS Q.*, pp. 259–274, 1988.
[34] B. H. Wixom and P. A. Todd, "A theoretical integration of user satisfaction and technology acceptance," *Inf. Syst. Res.*, vol. 16, no. 1, pp. 85–102, 2005.
[35] V. Venkatesh and H. Bala, "Technology acceptance model 3 and a research agenda on interventions," *Decis. Sci.*, vol. 39, no. 2, pp. 273–315, 2008.
[36] P. B. Seddon, "A respecification and extension of the DeLone and McLean model of IS success," *Inf. Syst. Res.*, vol. 8, no. 3, pp. 240–253, 1997.
[37] A. Hanif, F. Q. Jamal, and M. Imran, "Extending the technology acceptance model for use of e-learning systems by digital learners," *Ieee Access*, vol. 6, pp. 73395–73404, 2018.
[38] P. M. Bentler and C.-P. Chou, "Practical issues in structural modeling," *Sociol. Methods Res.*, vol. 16, no. 1, pp. 78–117, 1987.

[39] B. M. Byrne, *Structural equation modeling with LISREL, PRELIS, and SIMPLIS: Basic concepts, applications, and programming*. Psychology Press, 2013.

[40] B. Kutlu and A. Alkaya, "Measuring the DeLone and McLean model Of information systems success applied to banking sector of Turkey," *Int. J. Adv. Comput. Eng. Netw.*, vol. 3, no. 8, pp. 2106–2320, 2015.

[41] S. Petter and E. R. McLean, "A meta-analytic assessment of the DeLone and McLean IS success model: An examination of IS success at the individual level," *Inf. Manag.*, vol. 46, no. 3, pp. 159–166, 2009.

[42] D. Al-Fraihat, M. Joy, and J. Sinclair, "Evaluating E-learning systems success: An empirical study," *Comput. Human Behav.*, vol. 102, pp. 67–86, 2020.

[43] P. Ifinedo and N. Nahar, "ERP systems success: an empirical analysis of how two organizational stakeholder groups prioritize and evaluate relevant measures," *Enterp. Inf. Syst.*, vol. 1, no. 1, pp. 25–48, 2007.

[44] Y. Gong and M. Janssen, "Measuring process flexibility and agility," in *Proceedings of the 4th international conference on theory and practice of electronic governance*, 2010, pp. 173–182.

[45] M. H. Riandi, H. Respati, and S. Hidayatullah, "Conceptual model of user satisfaction as mediator of e-learning services and system quality on students' individual performance," *Int. J. Res. Eng. Sci. Manag.*, vol. 4, no. 1, pp. 60–65, 2021.

[46] J. A O'Brien and G. M Marakas, "Introduction to Information Systems." 2010.

[47] C.-S. Ong, M.-Y. Day, and W.-L. Hsu, "The measurement of user satisfaction with question answering systems," *Inf. Manag.*, vol. 46, no. 7, pp. 397–403, 2009.

[48] S. Negash, T. Ryan, and M. Igbaria, "Quality and effectiveness in web-based customer support systems," *Inf. Manag.*, vol. 40, no. 8, pp. 757–768, 2003.

[49] G. Kaisara and S. Pather, "The e-Government evaluation challenge: A South African Batho Pele-aligned service quality approach," *Gov. Inf. Q.*, vol. 28, no. 2, pp. 211–221, 2011.

[50] N. Gorla, T. M. Somers, and B. Wong, "Organizational impact of system quality, information quality, and service quality," *J. Strateg. Inf. Syst.*, vol. 19, no. 3, pp. 207–228, 2010.

[51] M. Stodnick and P. Rogers, "Using SERVQUAL to measure the quality of the classroom experience," *Decis. Sci. J. Innov. Educ.*, vol. 6, no. 1, pp. 115–133, 2008.

[52] R. E. Mayer, "Using multimedia for e-learning," *J. Comput. Assist. Learn.*, vol. 33, no. 5, pp. 403–423, 2017.

[53] L. Pham, S. Williamson, and R. Berry, "Student perceptions of e-learning service quality, e-satisfaction, and e-loyalty," *Int. J. Enterp. Inf. Syst.*, vol. 14, no. 3, pp. 19–40, 2018.

[54] Y.-F. Kuo, C.-M. Wu, and W.-J. Deng, "The relationships among service quality, perceived value, customer satisfaction, and post-purchase intention in mobile value-added services," *Comput. Human Behav.*, vol. 25, no. 4, pp. 887–896, 2009.

[55] L. Hu and P. M. Bentler, "Cut-off criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives," *Struct. Equ. Model. a Multidiscip. J.*, vol. 6, no. 1, pp. 1–55, 1999.

[56] G. D. Garson, *Structural Equation Modeling*, Blue Book. Asheboro, North Corolina: Statistical Associates Publishing, 2012.

[57] K. G. Jöreskog and D. Sörbom, *LISREL 8: Structural equation modeling with the SIMPLIS command language*. Scientific Software International, 1993.

[58] G. D. Garson, *Partial Least Squares: Regression & structural equation modeling*. Asheboro, USA: Statistical Publishing Associates, 2016.

[59] J. J. Hox and T. M. Bechger, "An introduction to structural equation modeling," 2007.

[60] B. Wheaton, B. Muthen, D. F. Alwin, and G. F. Summers, "Assessing reliability and stability in panel models," *Sociol. Methodol.*, vol. 8, pp. 84–136, 1977.

[61] E. G. Carmines, "Analyzing models with unobserved variables," *Soc. Meas. Curr. issues*, vol. 80, 1981.

[62] R. E. Schumacher and R. G. Lomax, *A Beginner's Guide to Structural Equation Modeling: Third Edition*, 3rd ed. Mahwah, NJ: Lawrence Erlbaum Associates, 2010.

[63] J. S. Tanaka and G. J. Huba, "A general coefficient of determination for covariance structure models under arbitrary GLS estimation," *Br. J. Math. Stat. Psychol.*, vol. 42, no. 2, pp. 233–239, 1989.

[64] J. H. Steiger and J. C. Lind, "Statistically based tests for the number of common factors," 1980.

[65] M. W. Browne and R. Cudeck, "Alternative ways of assessing model fit," *Sage Focus Ed.*, vol. 154, p. 136, 1993.

[66] L. J. Williams and E. O'Boyle Jr, "The myth of global fit indices and alternatives for assessing latent variable relations," *Organ. Res. Methods*, vol. 14, no. 2, pp. 350–369, 2011.

[67] F. Chen, P. J. Curran, K. A. Bollen, J. Kirby, and P. Paxton, "An empirical evaluation of the use of fixed cut-off points in RMSEA test statistic in structural equation models," *Sociol. Methods Res.*, vol. 36, no. 4, pp. 462–494, 2008.

[68] L. R. Tucker and C. Lewis, "A reliability coefficient for maximum likelihood factor analysis," *Psychometrika*, vol. 38, no. 1, pp. 1–10, 1973.

[69] P. M. Bentler and L. T. Hu, "Evaluating model fit," in *Structural equation modeling: Concepts, issues, and applications*, Thousand Oaks, CA: SAGE Publications, 1995, pp. 76–99.

[70] P. M. Bentler, "SEM with simplicity and accuracy," *J. Consum. Psychol.*, vol. 20, no. 2, pp. 215–220, 2010, doi: 10.1016/j.jcps.2010.03.002.

[71] T. A. Brown, *Confirmatory Factor Analysis for Applied Research*, 2nd ed. New York: The Guilford Press, 2015.

[72] K. A. Bollen, "A new incremental fit index for general structural equation models," *Sociol. Methods Res.*, vol. 17, no. 3, pp. 303–316, 1989.

[73] S. A. Mulaik, L. R. James, J. Van Alstine, N. Bennett, S. Lind, and C. D. Stilwell, "Evaluation of goodness-of-fit indices for structural equation models.," *Psychol. Bull.*, vol. 105, no. 4, pp. 430–445, 1989.

[74] L. James, S. Mulaik, and J. M. Brett, *Causal analysis: Assumptions, models, and data*. Beverly Hills: Sage publications, 1982.

[75] K. A. Bollen, J. S. Long, and K. G. Jöreskog, *Testing*

structural equation models, vol. 154. Sage, 1993.

[76] R. P. Bagozzi and Y. Yi, "On the evaluation of structural equation models," *J. Acad. Mark. Sci.*, vol. 16, no. 1, pp. 74–94, 1988.

[77] J.-C. Hong, K.-H. Tai, M.-Y. Hwang, Y.-C. Kuo, and J.-S. Chen, "Internet cognitive failure relevant to users' satisfaction with content and interface design to reflect continuance intention to use a government e-learning system," *Comput. Human Behav.*, vol. 66, pp. 353–362, 2017.

[78] R. Wang, L. Chen, and I. Solheim, "Modeling dyslexic students' motivation for enhanced learning in E-learning systems," *ACM Trans. Interact. Intell. Syst.*, vol. 10, no. 3, pp. 1–34, 2020.

[79] X. Wang, W. Chen, H. Qiu, A. Eldurssi, F. Xie, and J. Shen, "A Survey on the E-learning platforms used during COVID-19," in *2020 11th IEEE Annual Information Technology, Electronics and Mobile Communication Conference (IEMCON)*, 2020, pp. 808–814.

[80] H.-M. Huang, S.-S. Liaw, and C.-M. Lai, "Exploring learner acceptance of the use of virtual reality in medical education: a case study of desktop and projection-based display systems," *Interact. Learn. Environ.*, vol. 24, no. 1, pp. 3–19, 2016.

[81] J.-H. Wu and Y.-M. Wang, "Measuring KMS success: A respecification of the DeLone and McLean's model," *Inf. Manag.*, vol. 43, no. 6, pp. 728–739, 2006.

[82] S.-H. Liu, H.-L. Liao, and J. A. Pratt, "Impact of media richness and flow on e-learning technology acceptance," *Comput. Educ.*, vol. 52, no. 3, pp. 599–607, 2009.

[83] J.-H. Wu, R. D. Tennyson, and T.-L. Hsia, "A study of student satisfaction in a blended e-learning system environment," *Comput. Educ.*, vol. 55, no. 1, pp. 155–164, 2010.

[84] A. Y. Alsabawy, A. Cater-Steel, and J. Soar, "Determinants of perceived usefulness of e-learning systems," *Comput. Human Behav.*, vol. 64, pp. 843–858, 2016.

[85] W. A. Cidral, T. Oliveira, M. Di Felice, and M. Aparicio, "E-learning success determinants: Brazilian empirical study," *Comput. Educ.*, vol. 122, pp. 273–290, 2018.

[86] R. S. Sumi and G. Kabir, "Satisfaction of e-learners with electronic learning service quality using the servqual model," *J. Open Innov. Technol. Mark. Complex.*, vol. 7, no. 4, p. 227, 2021.

[87] U. Haryaka, F. Agus, and A. H. Kridalaksana, "User satisfaction model for e-learning using smartphone," *Procedia Comput. Sci.*, vol. 116, pp. 373–380, 2017.

[88] G. J. Udo, K. K. Bagchi, and P. J. Kirs, "Using SERVQUAL to assess the quality of e-learning experience," *Comput. Human Behav.*, vol. 27, no. 3, pp. 1272–1283, 2011.

[89] P. Dangaiso, F. Makudza, and H. Hogo, "Modelling perceived e-learning service quality, student satisfaction and loyalty. A higher education perspective," *Cogent Educ.*, vol. 9, no. 1, p. 2145805, 2022.