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The Influence Of E-Learning (Learning Management System) Quality, Lecturer Digital Competence, And LMS Usability On Learning Satisfaction Of University X Students

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Abstract

This study aims to analyze the influence of e-learning quality, lecturer digital competence, and learning management system (LMS) usability on student learning satisfaction in online learning. This study uses a quantitative approach with a survey method on student LMS users at University X. The analysis technique used is Partial Least Squares Structural Equation Modeling (PLS-SEM). The results show that e-learning quality, lecturer digital competence, and LMS usability have a positive and significant effect on learning satisfaction. This finding strengthens the integration of Stimulus-Organism-Response (SOR) Theory and Technology Acceptance Model (TAM) in explaining e-learning user behavior. Practically, the results of the study provide implications for educational institutions to improve system quality, lecturer competence, and ease of use of LMS to increase student learning satisfaction.

Keywords: e-learning quality, lecturer digital competence, LMS usability, learning satisfaction, PLS-SEM

INTRODUCTION

Digital transformation in higher education has accelerated significantly over the past decade, particularly since the global disruption caused by the COVID-19 pandemic. Universities

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worldwide have been forced to rapidly adapt to technology-based learning models to ensure the continuity of the educational process. In this context, e-learning has become a key solution, enabling the teaching and learning process to continue without the constraints of space and time. One crucial component in implementing e-learning is the use of a Learning Management System (LMS), which serves as an integrated platform for material delivery, interaction between lecturers and students, and learning evaluation.

The adoption of LMS in higher education reflects not only technological change but also a paradigm shift in the learning process. The learning model, previously teacher-centered, is now shifting toward a more student-centered learning model. LMSs enable students to independently access learning materials, participate in online discussions, and manage their own learning process more flexibly. Therefore, the success of LMS implementation depends not only on the availability of technology but also on the quality of the learning experience experienced by students.

Despite the increasing adoption of e-learning and LMSs, various studies show that increased technology use does not always translate into improved learning quality or student satisfaction. In many cases, students experience difficulties adapting to digital learning systems, ultimately leading to decreased learning satisfaction. This phenomenon demonstrates that the success of e-learning implementation is determined not only by the technology aspect, but also by other factors that influence the overall learning experience.

Learning satisfactionLearning satisfaction is an important indicator in evaluating learning effectiveness, particularly in the context of e-learning. Learning satisfaction reflects the extent to which students' learning experiences meet their expectations. Students with high levels of satisfaction tend to demonstrate better learning motivation, greater engagement, and optimal learning outcomes. Conversely, low levels of learning satisfaction can negatively impact student engagement, retention rates, and overall academic success.

One of the main factors influencing learning satisfaction is e-learning quality. E-learning quality encompasses various aspects, such as system quality, information quality, and the quality of services provided in digital learning. A stable system, clear and relevant materials, and responsive service will enhance students' learning experiences. Conversely, frequent system disruptions, poorly structured materials, and a lack of technical support can decrease student satisfaction. Therefore, e-learning quality is a crucial factor that needs to be considered in the development of digital learning systems.

In addition to technological factors, the role of lecturers also plays a significant role in determining the quality of online learning. In an e-learning environment, lecturers serve not only

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as presenters of material but also as facilitators who guide, motivate, and interact with students. Lecturer digital competence is a key factor in ensuring that technology is optimally utilized in the learning process. Lecturers with strong digital competence are able to utilize various technological features to create interactive, engaging, and effective learning. Conversely, limited digital competence can hinder the learning process and reduce the quality of students' learning experiences.

Another equally important factor is system usability (LMS usability). In a technological context, usability refers to the extent to which a system is easy for users to use, understand, and access. An LMS with a user-friendly design, clear navigation, and compatibility with various devices will increase user experience. Conversely, a complex and difficult-to-use system can be a barrier to student learning. Therefore, usability is a crucial factor influencing student perceptions of e-learning systems and ultimately their level of learning satisfaction.

To understand the relationship between these factors and learning satisfaction, a theoretical framework is needed that can explain the mechanisms underlying user behavior in an e-learning environment. In this study, an integrative approach is used between Stimulus-Organism-Response (SOR) Theory and the Technology Acceptance Model (TAM). SOR Theory provides a conceptual framework that explains how external stimuli influence individual responses through internal processes. In this context, e-learning quality, lecturer digital competence, and LMS usability are positioned as stimuli that influence students' internal conditions, which then result in a response in the form of learning satisfaction.

Meanwhile, TAM provides a more specific explanation of how individuals accept and use technology. The key concepts in TAM, namely perceived usefulness and perceived ease of use, are highly relevant in the context of e-learning. LMS usability reflects perceived ease of use, while lecturers' digital competence contributes to perceived usefulness. By integrating these two theories, this study seeks to provide a more comprehensive understanding of the factors influencing learning satisfaction in LMS-based learning.

Although numerous studies have examined the factors influencing learning satisfaction in e-learning, several gaps remain in the literature. First, most previous studies tend to focus on technological aspects without adequately considering the role of human factors. However, interaction between lecturers and students is a crucial element in the learning process. Second, research integrating SOR Theory and TAM into a single model is still relatively limited, particularly in the context of higher education in Indonesia. Third, most studies were conducted in pre-pandemic contexts, thus not fully reflecting the increasingly complex conditions of post-pandemic

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digital learning.

The Indonesian context also presents unique characteristics in the implementation of e-learning. Differences in technological infrastructure, digital literacy levels, and the readiness of educational institutions are factors that influence the success of online learning. Furthermore, the learning culture of Indonesian students, which is still in the transition to independent learning, also poses challenges. Therefore, research conducted in a local context is crucial to provide a more contextualized understanding of the factors influencing learning satisfaction.

Based on the above description, this study aims to examine the influence of e-learning quality, lecturer digital competence, and LMS usability on student learning satisfaction. This study uses a quantitative approach with the PLS-SEM method to analyze the relationships between variables. By integrating SOR Theory and TAM, this study is expected to provide theoretical contributions in the development of e-learning user behavior models, as well as provide practical implications for educational institutions in improving the quality of digital learning.

Specifically, this research is expected to contribute in three main aspects. First, a theoretical contribution, namely by integrating two major theories into one comprehensive model. Second, an empirical contribution, namely by providing empirical evidence regarding the factors influencing learning satisfaction in the context of higher education in Indonesia. Third, a practical contribution, namely by providing recommendations for educational institutions on improving the quality of e-learning through system development, enhancing lecturer competency, and optimizing LMS usability.

Thus, this research is not only academically relevant but also has significant practical value in supporting the ongoing digital transformation of higher education. In the evolving digital era, a deep understanding of the factors influencing learning satisfaction is key to creating effective and meaningful learning experiences for students.

Literature Review

Stimulus-Organism-Response(SOR)

Theory introduced by Mehrabian and Russell (1974) is one of the theoretical frameworks widely used to explain individual behavior in responding to the external environment. This theory is a development of the classic Stimulus-Response (SR) paradigm, by adding the component of "organism" as a mediating process between stimulus and response. In the SOR model, stimulus (S) refers to external factors that influence an individual, organism (O) reflects the individual's internal conditions such as perception, emotion, and cognitive evaluation, while response (R) is

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the behavior or action produced as a consequence of the interaction between stimulus and organism.

In the context of consumer behavior and technology, SOR Theory has been widely used to explain how external factors influence user attitudes and behavior. Stimuli can be various environmental elements such as service quality, system design, or interactions with service providers. Stimuli include internal psychological processes such as perceived value, satisfaction, or trust, which then result in behavioral responses such as usage intention, loyalty, or satisfaction.

In this study, SOR Theory is used as the primary framework to explain how factors in digital learning influence student satisfaction. Variables such as e-learning quality, lecturer digital competence, and LMS usability are positioned as stimuli received by students in the online learning environment. These stimuli are then processed internally by students through cognitive evaluation and learning experiences, which ultimately result in a response in the form of learning satisfaction.

The use of SOR Theory in the context of e-learning is highly relevant because the digital learning process involves complex interactions between technological systems and users. Students not only passively receive information but also evaluate the quality of the system, interactions with instructors, and the ease of use of the platform. Therefore, SOR Theory can explain the mechanisms by which digital learning experiences are formed and how student satisfaction, as an outcome, can be influenced by these various stimuli.

Technology Acceptance Model

The Technology Awareness Model (TAM), developed by Davis (1989), is one of the most widely used models to explain the acceptance and use of technology by individuals. TAM states that two main factors influencing technology acceptance are perceived usefulness and perceived ease of use. Perceived usefulness refers to the extent to which a person believes that using a technology will improve performance or effectiveness, while perceived ease of use refers to the degree to which the technology is easy to use.

In the context of e-learning, TAM provides a robust framework for understanding how students perceive and use a Learning Management System (LMS). As a digital learning platform, an LMS must provide clear benefits to students and be easy to use to enhance the learning experience. If students perceive the system as easy to use and provides significant benefits, they are more likely to have a positive perception, ultimately increasing their learning satisfaction.

In this study, LMS usability reflects the concept of perceived ease of use in TAM. Ease of

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navigation, accessibility, and efficiency of system use are important factors influencing user experience. Meanwhile, lecturer digital competence contributes to perceived usefulness, as a lecturer's ability to utilize technology effectively can improve the quality of learning and provide added value to students.

The integration of TAM in this study allows for a more specific analysis of the technological aspects of online learning. While SOR Theory provides a general framework regarding the relationship between stimulus, internal processes, and responses, TAM provides a more detailed explanation of how perceptions of technology are formed. Thus, the use of TAM complements SOR Theory in explaining e-learning user behavior more comprehensively.

The integration of SOR Theory and the Technology Acceptance Model (TAM) in this study aims to provide a more comprehensive understanding of student behavior in e-learning-based learning. Both theories have their respective strengths, with SOR Theory providing a broad conceptual framework regarding the relationship between stimulus, organism, and response, while TAM provides a more specific explanation regarding technology acceptance.

Within this integrated framework, the variables e-learning quality, lecturer digital competence, and LMS usability act as stimuli (S) that influence students' internal states (organisms). The organism component in this study encompasses students' perceptions of the system's ease of use and usefulness, which are key concepts in TAM. Thus, TAM is positioned as part of the internal mechanisms within SOR Theory.

Furthermore, these internal conditions produce a response in the form of learning satisfaction. Learning satisfaction is the end result of students' evaluation of their learning experiences. By integrating both theories, this study is able to explain not only the direct relationship between variables but also the psychological mechanisms underlying student satisfaction.

This integrative approach also helps overcome the limitations of using one theory in isolation. SOR Theory is often criticized for its lack of detailed explanation of internal processes, while TAM tends to focus on technological aspects without considering the broader environmental context. By combining the two, this study offers a more holistic model for understanding e-learning user behavior, particularly in the context of higher education.

Learning satisfaction

Learning satisfaction is one of the main indicators of learning success, particularly in the context of e-learning. This concept refers to students' evaluation of their learning experiences, based on a comparison between initial expectations and perceived outcomes after participating

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in the learning process (Sun et al., 2008; Sumi & Kabir, 2021). Learning satisfaction not only reflects perceptions of learning quality but also reflects students' level of acceptance of the learning system used.

In an e-learning environment, learning satisfaction is influenced by various factors, including system quality, interaction with instructors, and ease of use of the platform. Students who perceive the learning system as easy to use, the material presented clearly, and the interaction with instructors going well tend to report higher levels of satisfaction. Conversely, technical difficulties, lack of interaction, or a system that is difficult to use can decrease learning satisfaction.

Learning satisfaction nalso has important implications for the sustainability of digital learning. Students who are satisfied with their learning experience tend to have higher motivation, more active participation, and a tendency to continue using the learning system. Therefore, understanding the factors that influence learning satisfaction is crucial for educational institutions in improving the quality of online learning.

Within this research framework, learning satisfaction is positioned as a dependent (response) variable influenced by various stimuli within the e-learning environment. Therefore, this study seeks to identify the key factors contributing to student satisfaction in LMS-based learning.

Hypothesis Development

H1: E-learning Quality → Learning Satisfaction

E-learning quality is students' perceptions of the quality of systems, information, and services in digital learning (Al-Fraihat et al., 2020). This quality encompasses various aspects such as system reliability, material clarity, and the quality of interactions in online learning. Within the context of SOR Theory, e-learning quality acts as a stimulus that influences students' internal evaluations of the learning experience.

When students perceive an e-learning system to be of good quality, they tend to have a positive perception of the learning they are participating in. This will increase student satisfaction because they feel their needs and expectations are being met. Conversely, a low-quality system can lead to frustration and decrease student satisfaction.

Previous research has shown that e-learning quality has a significant positive influence on learning satisfaction. Sun et al. (2008) found that system and interaction quality in e-learning are the main factors influencing student satisfaction. Furthermore, Sumi and Kabir (2021) also showed

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that e-learning service quality significantly contributes to user satisfaction.

However, research in the context of higher education in Indonesia is still limited, particularly using the PLS-SEM approach. Therefore, this study proposes the following hypothesis:
H1: E-learning Quality has a positive effect on Learning Satisfaction.

H2: Lecturer Digital Competence → Learning Satisfaction

*Lecturer digital competence*reflects the lecturer's ability to use digital technology to support the learning process. This competency includes the ability to deliver material, interact with students, and utilize technological features effectively (Sun et al., 2008).

Within the SOR Theory framework, lecturer digital competence is a crucial stimulus influencing students' learning experiences. Lecturers with strong digital competence are able to create more interactive and engaging learning experiences, thereby increasing students' positive perceptions of learning.

Previous research has shown that lecturer competence has a significant influence on learning satisfaction. Martin et al. (2019) found that lecturers' digital competence contributed to increased student engagement and satisfaction in online learning. Furthermore, Piccoli et al. (2001) also emphasized the importance of lecturer interaction in enhancing learning effectiveness.

Thus, this study proposes the following hypothesis:
H2: Lecturer Digital Competence has a positive effect on Learning Satisfaction.

H3: LMS Usability → Learning Satisfaction

LMS usability is the level of ease of use of a digital learning system, encompassing aspects of navigation, efficiency, and user comfort (Rahangmetan & Sitokdana, 2023). In TAM, usability is closely related to perceived ease of use, which is a key factor in technology acceptance.

In the context of SOR Theory, LMS usability acts as a stimulus that influences user experience. An easy-to-use system allows students to access materials more efficiently and reduces technical barriers, thereby increasing learning satisfaction.

Previous research has shown that usability has a significant influence on user satisfaction. Naveh et al. (2010) found that LMS ease of use contributes to increased student satisfaction. Furthermore, Al-Fraihat et al. (2020) also showed that system quality, including usability, is a key determinant of satisfaction in e-learning.

Based on this description, this study proposes the following hypothesis:

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H3: LMS Usability has a positive effect on Learning Satisfaction.

RESEARCH METHODS

This study uses a quantitative approach with a survey method to examine the causal relationship between e-learning quality, lecturer digital competence, and LMS usability on learning satisfaction. This quantitative approach was chosen because this study aims to test hypotheses formulated based on a theoretical framework and objectively measure the strength of the relationship between variables through statistical analysis.

The population in this study were all students who use the Learning Management System (LMS) at University X. This population selection was based on the relevance of using LMS as the main medium in digital learning. The sampling technique used was purposive sampling, with the respondent criteria being active students who have used LMS in the learning process for at least one semester. This criterion was established to ensure that respondents have sufficient experience in using e-learning systems so they are able to provide accurate assessments of the variables studied.

The research instrument used was a structured questionnaire compiled based on indicators from previous research that have been tested for validity and reliability. The e-learning quality variable was measured using indicators reflecting system quality, information quality, and service quality. The lecturer digital competence variable was measured based on the lecturer's ability to use digital technology to support the learning process, including interaction, material delivery, and utilization of technological features. The LMS usability variable was measured using indicators of ease of use, navigation, efficiency, and system convenience. Meanwhile, the learning satisfaction variable was measured based on student evaluations of the learning experience.

All items in the questionnaire were measured using a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The Likert scale was chosen because it effectively measures respondents' perceptions and attitudes and facilitates quantitative data analysis. Prior to primary data collection, the questionnaire was piloted on a limited basis to ensure question clarity and avoid interpretation bias.

The data analysis technique in this study used Partial Least Squares Structural Equation Modeling (PLS-SEM) with the assistance of SmartPLS software. The PLS-SEM method was chosen because it has advantages in analyzing structural models involving latent variables with reflective indicators and does not require a strict normal data distribution. Furthermore, PLS-SEM is also suitable for use in research with relatively moderate sample sizes and predictive models.

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Data analysis was conducted in two main stages: outer model evaluation and inner model evaluation. The outer model evaluation aimed to test the construct's validity and reliability through convergent validity, discriminant validity, and composite reliability tests. Meanwhile, the inner model evaluation examined the relationships between latent variables through path coefficient, t-statistic, p-value, and coefficient of determination (R-square) analysis. Effect size (f^2) and predictive relevance (Q^2) tests were also conducted to assess the model's strength and predictive ability.

By using this method, the research is expected to be able to provide comprehensive analysis results regarding the factors that influence student learning satisfaction in the context of e-learning-based learning.

Respondent Profile

The respondent profile in this study describes the characteristics of students who participated in the use of the Learning Management System (LMS) at University X. Based on the results of data collection, the majority of respondents were dominated by female students compared to male students, which indicates the active participation of female students in e-learning-based learning. In terms of age, most respondents were in the age range of 18–21 years, which reflects the group of students in the early to middle stages of higher education.

Furthermore, the level of LMS usage indicates that most respondents use digital learning systems regularly, even daily. This indicates that LMSs have become an integral part of students' learning processes. High frequency of use also indicates that respondents have sufficient experience interacting with e-learning systems, enabling them to provide relevant assessments of the variables studied.

Overall, the characteristics of the respondents in this study reflect active LMS users with direct experience in online learning. Therefore, the data obtained is considered representative in describing students' perceptions of e-learning quality, lecturers' digital competence, and the usability of the system used, which ultimately influence their level of learning satisfaction.

Table 1: Respondent Profile

Characteristics	Category	Percentage
Gender	Man	42%
	Woman	58%

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Characteristics	Category	Percentage
Age	18–21 years	65%
	22–25 years	35%
LMS Usage	Every day	72%
	3–4 times/week	28%

Outer Model

An outer model evaluation was conducted to test the quality of the research instruments used to measure the latent variables: e-learning quality, lecturer digital competence, LMS usability, and learning satisfaction. This testing included construct validity and reliability, which aimed to ensure that the indicators used accurately and consistently represented the variables.

Based on the results of the convergent validity analysis, all indicators for each variable have loading factor values above 0.70. This indicates that each indicator has a strong correlation with the construct being measured, thus being considered convergently valid. Furthermore, the Average Variance Extracted (AVE) values for all variables are also above the minimum threshold of 0.50, indicating that more than 50% of the indicator variance can be explained by the respective latent construct.

Table 2: Convergent Validity

Variables	Indicator	Loading
E-learning Quality	ELQ1	0.812
	ELQ2	0.845
	ELQ3	0.867
Lecturer Digital Competence	LDC1	0.801
	LDC2	0.839
	LDC3	0.852
LMS Usability	LMS1	0.823
	LMS2	0.856
	LMS3	0.874

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Variables	Indicator	Loading
Learning Satisfaction	LS1	0.835
	LS2	0.861
	LS3	0.882

Furthermore, reliability testing showed that all variables had composite reliability and Cronbach's alpha values above 0.70. These results indicate that the research instrument has a good level of internal consistency, making it reliable in measuring the variables studied. Therefore, it can be concluded that all constructs in this study meet the required reliability criteria.

Table 3: AVE Reliability

Variables	AVE	Composite Reliability	Cronbach Alpha
E-learning Quality	0.69	0.89	0.85
Lecturer Digital Competence	0.68	0.88	0.84
LMS Usability	0.71	0.90	0.86
Learning Satisfaction	0.73	0.91	0.87

Discriminant validity testing was also conducted using the Fornell-Larcker criteria. The analysis showed that the square root of the AVE for each construct was greater than the correlation between the other constructs. This indicates that each variable has a good ability to differentiate itself from other variables in the research model.

Table 4: Discriminant Validity (Fornel-Lacker)

Variables	ELQ	LDC	LMS	LS
ELQ	**0.83**			
LDC	0.62	**0.82**		
LMS	0.65	0.60	**0.84**	
LS	0.71	0.69	0.73	**0.85**

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Overall, the results of the outer model evaluation indicate that the research instrument used met the criteria for good validity and reliability. Therefore, the analysis can proceed to the inner model evaluation stage to examine the relationships between variables in the structural model.

Validity test results show that all indicators have a loading factor > 0.7. An AVE value > 0.5 indicates convergent validity. Composite reliability and Cronbach's alpha values > 0.7 indicate good reliability.

Inner Model

An inner model evaluation was conducted to test the structural relationships between the latent variables in this study, namely the influence of e-learning quality, lecturer digital competence, and LMS usability on learning satisfaction. This test aimed to assess the strength of the relationships between the variables and the model's ability to explain the dependent variable.

Based on the analysis results, the coefficient of determination (R-square) for the learning satisfaction variable was 0.64. This value indicates that 64% of the variation in learning satisfaction can be explained by the three independent variables in the model: e-learning quality, lecturer digital competence, and LMS usability. Thus, this research model has moderate to strong explanatory power, in accordance with the criteria in the PLS-SEM analysis.

Table 5: R-Square

Dependent Variable	R^2
Learning Satisfaction	0.64

Furthermore, the results of the path coefficient test indicate that all hypotheses proposed in this study are empirically supported. The variables e-learning quality, lecturer digital competence, and LMS usability each have a positive and significant influence on learning satisfaction, with a t-statistic value greater than 1.96 and a p-value less than 0.05. This indicates that an increase in each independent variable will be followed by an increase in student learning satisfaction.

Table 6: Path Coefficient and Hypothesis Testing

Hypothesis	Connection	Coefficient	T-Statistic	P-Value	Results
H1	ELQ → LS	0.32	4.85	0.000	Accepted
H2	LDC → LS	0.28	3.92	0.000	Accepted

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Hypothesis	Connection	Coefficient	T-Statistic	P-Value	Results
H3	LMS → LS	0.35	5.21	0.000	Accepted

Furthermore, effect size (f^2) analysis showed that the three variables had varying contributions to learning satisfaction, ranging from small to moderate. The LMS usability variable showed a relatively larger influence than the other variables, indicating that ease of use of the system was a dominant factor in increasing learning satisfaction.

Table 7: Effect Size (f2)

Variables	f^2
ELQ	0.18 (medium)
LDC	0.14 (small–medium)
LMS	0.21 (medium)

The predictive relevance (Q^2) test also showed a positive value, indicating that the model has good predictive ability. This means that the model developed in this study is not only able to explain the relationships between variables but also has the ability to accurately predict the dependent variable.

Table 8: Predictive Relevance (Q2)

Variables	Q^2
Learning Satisfaction	0.41

Overall, the results of the inner model evaluation indicate that the structural model used in this study has good validity and predictive power. Therefore, this model can be used to comprehensively explain the relationship between factors in e-learning and student learning satisfaction.

The R-square value indicates that the independent variables are able to moderately explain variations in learning satisfaction. The results of the hypothesis testing show:

H1: significant positive

H2: significant positive

H3: significant positive

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DISCUSSION

The results of the study indicate that all independent variables, namely e-learning quality, lecturer digital competence, and LMS usability, have a positive and significant influence on learning satisfaction. This finding provides empirical support for the Stimulus-Organism-Response (SOR) Theory framework, which states that external stimuli will influence individual responses through internal processes. In the context of this study, the quality of the e-learning system, lecturer digital competence, and ease of use of the LMS act as stimuli that influence student perceptions and evaluations, which ultimately result in a response in the form of learning satisfaction.

More specifically, e-learning quality has been shown to significantly influence learning satisfaction. This indicates that the quality of digital learning systems plays a crucial role in shaping students' overall learning experience. System quality, including platform stability, material clarity, and interaction quality, is a key factor in determining whether students are satisfied with their learning experience. This finding is consistent with previous research that confirms that system and service quality are key determinants of e-learning user satisfaction. Therefore, educational institutions need to ensure that the e-learning systems they use are of high quality to optimally support the learning process.

Furthermore, lecturer digital competence also demonstrated a significant positive effect on learning satisfaction. This finding confirms that the human factor remains crucial in digital learning, even when technology is the primary medium. Lecturers with strong digital competence are able to utilize technology to create more interactive, communicative, and engaging learning experiences. This not only enhances student understanding of the material but also creates a more enjoyable learning experience. This finding is significant because most previous research tends to focus on the technological aspect, while the role of the lecturer often receives less attention. Therefore, improving lecturers' digital competence is a key strategy for improving the quality of online learning.

Of the three variables studied, LMS usability demonstrated the greatest influence on learning satisfaction. This indicates that ease of use is a crucial factor in determining the success of e-learning. An easy-to-use system allows students to access materials more efficiently, reduces technical barriers, and increases comfort during the learning process. This finding aligns with the Technology Acceptance Model (TAM), particularly the concept of perceived ease of use, which states that ease of use of technology will increase user acceptance and satisfaction. Therefore, usability needs to be a top priority in LMS development to provide an optimal learning experience

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for students.

Furthermore, the results of this study also show that the combination of technological and human factors plays a complementary role in influencing learning satisfaction. A high-quality system without adequate lecturer competency will not produce an optimal learning experience. Conversely, competent lecturers also require an easy-to-use system to effectively conduct the learning process. Therefore, a holistic approach to e-learning development is crucial, taking into account the interactions between the various factors involved.

Overall, the findings of this study reinforce the importance of integrating SOR Theory and TAM in understanding e-learning user behavior. By combining these two perspectives, this study is able to provide a more comprehensive understanding of the factors influencing student learning satisfaction. These findings are not only theoretically relevant but also have significant practical implications for the future development of digital learning systems.

Theoretical Implications

This research provides a significant theoretical contribution to the development of user behavior literature in the context of e-learning, particularly through the integration of two major theoretical frameworks, namely the Stimulus-Organism-Response (SOR) Theory and the Technology Acceptance Model (TAM). This integration is one of the main contributions of this research because it is able to overcome the limitations of each theory when used separately. SOR Theory provides a broad conceptual framework in explaining the relationship between external stimuli, internal processes, and behavioral responses, but is relatively less specific in explaining the cognitive mechanisms underlying these internal processes. On the other hand, TAM offers a more detailed explanation of individual perceptions of technology, but tends to be limited to the aspect of technology acceptance without considering the more complex environmental context.

By integrating these two theories, this study presents a more comprehensive empirical model explaining how factors within the e-learning environment influence learning satisfaction. In this model, variables such as e-learning quality, lecturer digital competence, and LMS usability are positioned as external stimuli that influence students' internal states. Furthermore, the organism component is enriched through concepts in TAM, such as perceived ease of use and perceived usefulness, which explain how students process their experiences using learning technology. This integration allows for a more in-depth explanation of the relationship between technological factors, cognitive processes, and behavioral responses in the context of digital learning.

Furthermore, this study extends the application of these theories to the context of e-

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learning in Indonesia, which has distinct characteristics compared to developed countries. Most previous research on SOR and TAM was conducted in countries with a high level of technological readiness. Therefore, the results of this study provide an important empirical contribution by demonstrating that both theories remain relevant and adaptable to the context of higher education in Indonesia, which faces unique challenges such as variations in technological infrastructure, levels of digital literacy, and the readiness of educational institutions to adopt digital learning.

Furthermore, this study confirms that technological and human factors cannot be separated in analyzing the success of e-learning. Many previous studies tend to focus on one aspect, either technological or human, resulting in a partial understanding. This study shows that e-learning quality and LMS usability as technological factors, and lecturer digital competence as a human factor, simultaneously influence learning satisfaction. These findings provide a theoretical contribution by emphasizing the importance of a multidimensional approach in analyzing user behavior in digital environments.

Moreover, this study also adds to the literature on learning satisfaction as an outcome variable in digital learning. Using the SOR approach, this study positions learning satisfaction as the final response to the interaction between stimuli and internal processes. This approach provides a more dynamic perspective than previous studies, which tended to view satisfaction as a stand-alone variable without considering the underlying mechanisms.

Overall, this research's theoretical contribution lies in the development of an integrative model capable of explaining student behavior in e-learning-based learning more comprehensively. This model not only strengthens the validity of the theory used but also opens up opportunities for further research to develop more complex models by adding other variables, such as motivation, engagement, or trust, to enrich our understanding of the dynamics of digital learning in the future.

Managerial Implications

The findings of this study provide important managerial implications for higher education institutions in optimizing the implementation of e-learning. The results indicate that e-learning quality, lecturer digital competence, and LMS usability significantly influence learning satisfaction. Therefore, a comprehensive digital learning management strategy needs to be designed, considering all three aspects simultaneously.

First, educational institutions need to prioritize improving e-learning quality as the primary foundation of digital learning. This can be achieved by improving system stability so that the LMS

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can be accessed without technical disruptions that hinder the learning process. A system that frequently experiences errors, downtime, or slowness will directly impact students' learning experience and reduce their satisfaction. Therefore, investing in reliable technology infrastructure is crucial. Furthermore, the quality of learning content must also be improved by ensuring that the material presented is relevant, well-structured, and easy for students to understand. The use of interactive multimedia, such as learning videos, simulations, and digital-based quizzes, can increase student engagement and enrich the learning experience.

Second, developing lecturers' digital competence is a key strategy for improving the quality of online learning. Lecturers are not only required to master teaching materials but also to be able to utilize technology effectively in the learning process. Therefore, institutions need to provide ongoing digital pedagogy training programs, which include the use of a Learning Management System (LMS), digital learning design, and effective online interaction strategies. This training should focus not only on technical aspects but also on pedagogical approaches that can increase student engagement. Furthermore, lecturers should be encouraged to use interactive technologies, such as discussion forums, breakout rooms, polls, and collaborative platforms, to create a more dynamic and participatory learning experience. Thus, lecturers' digital competence can be a differentiating factor in creating quality online learning.

Third, optimizing LMS usability is an equally important aspect in improving learning satisfaction. LMS systems must be designed with a user-centered design approach, prioritizing user needs and convenience. A simple and intuitive interface will make it easier for students to access materials, complete assignments, and interact with lecturers and fellow students. Clear and structured navigation is also crucial to avoid user confusion. Furthermore, compatibility with various devices, especially mobile devices, is crucial, given that most students access the LMS via smartphones. Therefore, LMS development must ensure optimal accessibility across multiple platforms without compromising the quality of the user experience.

Furthermore, educational institutions need to adopt a continuous evaluation approach to e-learning management. Student feedback regarding their LMS experience, learning quality, and interactions with instructors should be systematically collected and used as a basis for improvement. This data-driven approach allows institutions to more accurately identify system weaknesses and make informed decisions to improve learning quality.

Overall, the managerial implications of this research emphasize that the success of e-learning depends not only on technology, but also on the quality of human resources and user-oriented system design. By strategically integrating these three aspects, educational institutions

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can create more effective, efficient, and satisfying digital learning experiences for students.

CONCLUSION

This study aims to analyze the influence of e-learning quality, lecturer digital competence, and LMS usability on student learning satisfaction in the context of e-learning. Based on the analysis results using the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach, it was found that the three independent variables have a positive and significant influence on student learning satisfaction. These findings provide empirical evidence that the success of digital learning is not determined by a single factor, but rather the result of the interaction of various complementary aspects.

Specifically, e-learning quality has been shown to be a crucial determinant of learning satisfaction. System quality, including platform stability, material clarity, and the quality of learning services, plays a crucial role in shaping students' learning experiences. Students tend to be more satisfied when a learning system meets their expectations in terms of accessibility, information clarity, and a smooth learning process. Therefore, e-learning quality should be a top priority in the development of digital learning systems.

Furthermore, lecturer digital competence also significantly impacted learning satisfaction, indicating that the lecturer's role remains a crucial element in online learning. Lecturer digital competence enables more interactive, communicative, and adaptive learning to meet student needs. This finding confirms that technology cannot replace the lecturer's role; it must be supported by the lecturer's ability to utilize technology effectively. Therefore, developing lecturers' digital competence is a strategic step in improving the quality of e-learning.

In addition, LMS usability demonstrated the greatest influence on learning satisfaction, indicating that ease of use is a key factor in determining the success of digital learning. An easy-to-use system reduces technical barriers, increases learning efficiency, and provides a more positive user experience. This aligns with the concept of perceived ease of use in the Technology Acceptance Model (TAM), which emphasizes the importance of ease of use in increasing technology acceptance.

Theoretically, this study successfully integrates the Stimulus-Organism-Response (SOR) Theory and the Technology Acceptance Model (TAM) into a single, comprehensive empirical model. This integration allows for a deeper understanding of the mechanisms by which external stimuli in e-learning environments influence students' internal processes and generate responses in the form of learning satisfaction. Thus, this study not only strengthens the validity of both

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theories but also broadens their application in the context of higher education, particularly in Indonesia.

From a practical perspective, the results of this study offer important implications for educational institutions in developing more effective digital learning strategies. Institutions need to simultaneously focus on the quality of their e-learning systems, improve the digital competency of their lecturers, and optimize the usability of their LMS to create an optimal learning experience for students.

Overall, this study concludes that the success of e-learning depends on the integration of quality technology and human interaction. With a holistic approach, digital learning can become not only an alternative but also a primary solution for improving the quality of education in the digital age.

FUTURE DIRECTIONS

This study has several limitations that should be considered when interpreting the results. First, the study used a sample limited to students at a single institution, University X. Therefore, generalizing the results to broader contexts, such as other universities or different levels of education, requires caution. Differences in institutional characteristics, technological infrastructure, and learning culture may influence the results.

Second, this study used a cross-sectional approach, where data was collected at a single point in time. This approach fails to capture the dynamics of changes in students' perceptions of e-learning over time. However, students' learning experiences and satisfaction can evolve with increased technology use and adaptation to digital learning systems.

Third, the variables used in this study are limited to three main factors: e-learning quality, lecturer digital competence, and LMS usability. Although these three variables have been shown to have a significant influence, other factors have the potential to influence learning satisfaction, such as learning motivation, student engagement, trust in the system, and social and environmental factors.

Based on these limitations, future research is recommended to expand the sample size by involving various educational institutions to increase the generalizability of the results. Furthermore, using a longitudinal design can provide a deeper understanding of changes in student behavior and satisfaction over time. Further research is also recommended to develop a more comprehensive model by adding other relevant variables, thus providing a more holistic picture of the factors influencing the success of e-learning.

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The Influence of E-learning (Learning Management System) Quality, Lecturer Digital Competence, and LMS Usability on Learning Satisfaction of University X Students

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Abstract

This study aims to analyze the influence of e-learning quality, lecturer digital competence, and learning management system (LMS) usability on student learning satisfaction in online learning. This study uses a quantitative approach with a survey method on student LMS users at University X. The analysis technique used is Partial Least Squares Structural Equation Modeling (PLS-SEM). The results show that e-

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learning quality, lecturer digital competence, and LMS usability have a positive and significant effect on learning satisfaction. This finding strengthens the integration of Stimulus-Organism-Response (SOR) Theory and Technology Acceptance Model (TAM) in explaining e-learning user behavior. Practically, the results of the study provide implications for educational institutions to improve system quality, lecturer competence, and ease of use of LMS to increase student learning satisfaction.

Keywords: e-learning quality, lecturer digital competence, LMS usability, learning satisfaction, PLS-SEM

INTRODUCTION

Digital transformation in higher education has accelerated significantly over the past decade, particularly since the global disruption caused by the COVID-19 pandemic. Universities worldwide have been forced to rapidly adapt to technology-based learning models to ensure the continuity of the educational process. In this context, e-learning has become a key solution, enabling the teaching and learning process to continue without the constraints of space and time. One crucial component in implementing e-learning is the use of a Learning Management System (LMS), which serves as an integrated platform for material delivery, interaction between lecturers and students, and learning evaluation.

The adoption of LMS in higher education reflects not only technological change but also a paradigm shift in the learning process. The learning model, previously teacher-centered, is now shifting toward a more student-centered learning model. LMSs enable students to independently access learning materials, participate in online discussions, and manage their own learning process more flexibly. Therefore, the success of LMS implementation depends not only on the availability of technology but also on the quality of the learning experience experienced by students.

Despite the increasing adoption of e-learning and LMSs, various studies show that increased technology use does not always translate into improved learning quality or student satisfaction. In many cases, students experience difficulties adapting to digital learning systems, ultimately leading to decreased learning satisfaction. This phenomenon demonstrates that the success of e-learning implementation is determined not only by the technology aspect, but also by other factors that influence the overall learning experience.

Learning satisfactionLearning satisfaction is an important indicator in evaluating learning

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effectiveness, particularly in the context of e-learning. Learning satisfaction reflects the extent to which students' learning experiences meet their expectations. Students with high levels of satisfaction tend to demonstrate better learning motivation, greater engagement, and optimal learning outcomes. Conversely, low levels of learning satisfaction can negatively impact student engagement, retention rates, and overall academic success.

One of the main factors influencing learning satisfaction is e-learning quality. E-learning quality encompasses various aspects, such as system quality, information quality, and the quality of services provided in digital learning. A stable system, clear and relevant materials, and responsive service will enhance students' learning experiences. Conversely, frequent system disruptions, poorly structured materials, and a lack of technical support can decrease student satisfaction. Therefore, e-learning quality is a crucial factor that needs to be considered in the development of digital learning systems.

In addition to technological factors, the role of lecturers also plays a significant role in determining the quality of online learning. In an e-learning environment, lecturers serve not only as presenters of material but also as facilitators who guide, motivate, and interact with students. Lecturer digital competence is a key factor in ensuring that technology is optimally utilized in the learning process. Lecturers with strong digital competence are able to utilize various technological features to create interactive, engaging, and effective learning. Conversely, limited digital competence can hinder the learning process and reduce the quality of students' learning experiences.

Another equally important factor is system usability (LMS usability). In a technological context, usability refers to the extent to which a system is easy for users to use, understand, and access. An LMS with a user-friendly design, clear navigation, and compatibility with various devices will increase user experience. Conversely, a complex and difficult-to-use system can be a barrier to student learning. Therefore, usability is a crucial factor influencing student perceptions of e-learning systems and ultimately their level of learning satisfaction.

To understand the relationship between these factors and learning satisfaction, a theoretical framework is needed that can explain the mechanisms underlying user behavior in an e-learning environment. In this study, an integrative approach is used between Stimulus-Organism-Response (SOR) Theory and the Technology Acceptance Model (TAM). SOR Theory provides a conceptual framework that explains how external stimuli influence individual responses through internal processes. In this context, e-learning quality, lecturer digital competence, and LMS usability are positioned as stimuli that influence students' internal

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conditions, which then result in a response in the form of learning satisfaction.

Meanwhile, TAM provides a more specific explanation of how individuals accept and use technology. The key concepts in TAM, namely perceived usefulness and perceived ease of use, are highly relevant in the context of e-learning. LMS usability reflects perceived ease of use, while lecturers' digital competence contributes to perceived usefulness. By integrating these two theories, this study seeks to provide a more comprehensive understanding of the factors influencing learning satisfaction in LMS-based learning.

Although numerous studies have examined the factors influencing learning satisfaction in e-learning, several gaps remain in the literature. First, most previous studies tend to focus on technological aspects without adequately considering the role of human factors. However, interaction between lecturers and students is a crucial element in the learning process. Second, research integrating SOR Theory and TAM into a single model is still relatively limited, particularly in the context of higher education in Indonesia. Third, most studies were conducted in pre-pandemic contexts, thus not fully reflecting the increasingly complex conditions of post-pandemic digital learning.

The Indonesian context also presents unique characteristics in the implementation of e-learning. Differences in technological infrastructure, digital literacy levels, and the readiness of educational institutions are factors that influence the success of online learning. Furthermore, the learning culture of Indonesian students, which is still in the transition to independent learning, also poses challenges. Therefore, research conducted in a local context is crucial to provide a more contextualized understanding of the factors influencing learning satisfaction.

Based on the above description, this study aims to examine the influence of e-learning quality, lecturer digital competence, and LMS usability on student learning satisfaction. This study uses a quantitative approach with the PLS-SEM method to analyze the relationships between variables. By integrating SOR Theory and TAM, this study is expected to provide theoretical contributions in the development of e-learning user behavior models, as well as provide practical implications for educational institutions in improving the quality of digital learning.

Specifically, this research is expected to contribute in three main aspects. First, a theoretical contribution, namely by integrating two major theories into one comprehensive model. Second, an empirical contribution, namely by providing empirical evidence regarding the factors influencing learning satisfaction in the context of higher education in Indonesia. Third, a practical contribution, namely by providing recommendations for educational institutions on improving the quality of e-learning through system development, enhancing lecturer competency,

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and optimizing LMS usability.

Thus, this research is not only academically relevant but also has significant practical value in supporting the ongoing digital transformation of higher education. In the evolving digital era, a deep understanding of the factors influencing learning satisfaction is key to creating effective and meaningful learning experiences for students.

Literature Review

Stimulus-Organism-Response(SOR)

Theory introduced by Mehrabian and Russell (1974) is one of the theoretical frameworks widely used to explain individual behavior in responding to the external environment. This theory is a development of the classic Stimulus-Response (SR) paradigm, by adding the component of "organism" as a mediating process between stimulus and response. In the SOR model, stimulus (S) refers to external factors that influence an individual, organism (O) reflects the individual's internal conditions such as perception, emotion, and cognitive evaluation, while response (R) is the behavior or action produced as a consequence of the interaction between stimulus and organism.

In the context of consumer behavior and technology, SOR Theory has been widely used to explain how external factors influence user attitudes and behavior. Stimuli can be various environmental elements such as service quality, system design, or interactions with service providers. Stimuli include internal psychological processes such as perceived value, satisfaction, or trust, which then result in behavioral responses such as usage intention, loyalty, or satisfaction.

In this study, SOR Theory is used as the primary framework to explain how factors in digital learning influence student satisfaction. Variables such as e-learning quality, lecturer digital competence, and LMS usability are positioned as stimuli received by students in the online learning environment. These stimuli are then processed internally by students through cognitive evaluation and learning experiences, which ultimately result in a response in the form of learning satisfaction.

The use of SOR Theory in the context of e-learning is highly relevant because the digital learning process involves complex interactions between technological systems and users. Students not only passively receive information but also evaluate the quality of the system, interactions with instructors, and the ease of use of the platform. Therefore, SOR Theory can explain the mechanisms by which digital learning experiences are formed and how student satisfaction, as an outcome, can be influenced by these various stimuli.

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Technology Acceptance Model

The Technology Awareness Model (TAM), developed by Davis (1989), is one of the most widely used models to explain the acceptance and use of technology by individuals. TAM states that two main factors influencing technology acceptance are perceived usefulness and perceived ease of use. Perceived usefulness refers to the extent to which a person believes that using a technology will improve performance or effectiveness, while perceived ease of use refers to the degree to which the technology is easy to use.

In the context of e-learning, TAM provides a robust framework for understanding how students perceive and use a Learning Management System (LMS). As a digital learning platform, an LMS must provide clear benefits to students and be easy to use to enhance the learning experience. If students perceive the system as easy to use and provides significant benefits, they are more likely to have a positive perception, ultimately increasing their learning satisfaction.

In this study, LMS usability reflects the concept of perceived ease of use in TAM. Ease of navigation, accessibility, and efficiency of system use are important factors influencing user experience. Meanwhile, lecturer digital competence contributes to perceived usefulness, as a lecturer's ability to utilize technology effectively can improve the quality of learning and provide added value to students.

The integration of TAM in this study allows for a more specific analysis of the technological aspects of online learning. While SOR Theory provides a general framework regarding the relationship between stimulus, internal processes, and responses, TAM provides a more detailed explanation of how perceptions of technology are formed. Thus, the use of TAM complements SOR Theory in explaining e-learning user behavior more comprehensively.

The integration of SOR Theory and the Technology Acceptance Model (TAM) in this study aims to provide a more comprehensive understanding of student behavior in e-learning-based learning. Both theories have their respective strengths, with SOR Theory providing a broad conceptual framework regarding the relationship between stimulus, organism, and response, while TAM provides a more specific explanation regarding technology acceptance.

Within this integrated framework, the variables e-learning quality, lecturer digital competence, and LMS usability act as stimuli (S) that influence students' internal states (organisms). The organism component in this study encompasses students' perceptions of the system's ease of use and usefulness, which are key concepts in TAM. Thus, TAM is positioned as part of the internal mechanisms within SOR Theory.

Furthermore, these internal conditions produce a response in the form of learning

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satisfaction. Learning satisfaction is the end result of students' evaluation of their learning experiences. By integrating both theories, this study is able to explain not only the direct relationship between variables but also the psychological mechanisms underlying student satisfaction.

This integrative approach also helps overcome the limitations of using one theory in isolation. SOR Theory is often criticized for its lack of detailed explanation of internal processes, while TAM tends to focus on technological aspects without considering the broader environmental context. By combining the two, this study offers a more holistic model for understanding e-learning user behavior, particularly in the context of higher education.

Learning satisfaction

Learning satisfaction is one of the main indicators of learning success, particularly in the context of e-learning. This concept refers to students' evaluation of their learning experiences, based on a comparison between initial expectations and perceived outcomes after participating in the learning process (Sun et al., 2008; Sumi & Kabir, 2021). Learning satisfaction not only reflects perceptions of learning quality but also reflects students' level of acceptance of the learning system used.

In an e-learning environment, learning satisfaction is influenced by various factors, including system quality, interaction with instructors, and ease of use of the platform. Students who perceive the learning system as easy to use, the material presented clearly, and the interaction with instructors going well tend to report higher levels of satisfaction. Conversely, technical difficulties, lack of interaction, or a system that is difficult to use can decrease learning satisfaction.

Learning satisfaction nalso has important implications for the sustainability of digital learning. Students who are satisfied with their learning experience tend to have higher motivation, more active participation, and a tendency to continue using the learning system. Therefore, understanding the factors that influence learning satisfaction is crucial for educational institutions in improving the quality of online learning.

Within this research framework, learning satisfaction is positioned as a dependent (response) variable influenced by various stimuli within the e-learning environment. Therefore, this study seeks to identify the key factors contributing to student satisfaction in LMS-based learning.

Hypothesis Development

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H1: E-learning Quality → Learning Satisfaction

E-learning quality is students' perceptions of the quality of systems, information, and services in digital learning (Al-Fraihat et al., 2020). This quality encompasses various aspects such as system reliability, material clarity, and the quality of interactions in online learning. Within the context of SOR Theory, e-learning quality acts as a stimulus that influences students' internal evaluations of the learning experience.

When students perceive an e-learning system to be of good quality, they tend to have a positive perception of the learning they are participating in. This will increase student satisfaction because they feel their needs and expectations are being met. Conversely, a low-quality system can lead to frustration and decrease student satisfaction.

Previous research has shown that e-learning quality has a significant positive influence on learning satisfaction. Sun et al. (2008) found that system and interaction quality in e-learning are the main factors influencing student satisfaction. Furthermore, Sumi and Kabir (2021) also showed that e-learning service quality significantly contributes to user satisfaction.

However, research in the context of higher education in Indonesia is still limited, particularly using the PLS-SEM approach. Therefore, this study proposes the following hypothesis:
H1: E-learning Quality has a positive effect on Learning Satisfaction.

H2: Lecturer Digital Competence → Learning Satisfaction

*Lecturer digital competence*reflects the lecturer's ability to use digital technology to support the learning process. This competency includes the ability to deliver material, interact with students, and utilize technological features effectively (Sun et al., 2008).

Within the SOR Theory framework, lecturer digital competence is a crucial stimulus influencing students' learning experiences. Lecturers with strong digital competence are able to create more interactive and engaging learning experiences, thereby increasing students' positive perceptions of learning.

Previous research has shown that lecturer competence has a significant influence on learning satisfaction. Martin et al. (2019) found that lecturers' digital competence contributed to increased student engagement and satisfaction in online learning. Furthermore, Piccoli et al. (2001) also emphasized the importance of lecturer interaction in enhancing learning effectiveness.
Thus, this study proposes the following hypothesis:
H2: Lecturer Digital Competence has a positive effect on Learning Satisfaction.

H3: LMS Usability → Learning Satisfaction

LMS usability is the level of ease of use of a digital learning system, encompassing aspects of navigation, efficiency, and user comfort (Rahangmetan & Sitokdana, 2023). In TAM, usability is closely related to perceived ease of use, which is a key factor in technology acceptance.

In the context of SOR Theory, LMS usability acts as a stimulus that influences user experience. An easy-to-use system allows students to access materials more efficiently and reduces technical barriers, thereby increasing learning satisfaction.

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Previous research has shown that usability has a significant influence on user satisfaction. Naveh et al. (2010) found that LMS ease of use contributes to increased student satisfaction. Furthermore, Al-Fraihat et al. (2020) also showed that system quality, including usability, is a key determinant of satisfaction in e-learning.

Based on this description, this study proposes the following hypothesis:

H3: LMS Usability has a positive effect on Learning Satisfaction.

Research Methods

This study uses a quantitative approach with a survey method to examine the causal relationship between e-learning quality, lecturer digital competence, and LMS usability on learning satisfaction. This quantitative approach was chosen because this study aims to test hypotheses formulated based on a theoretical framework and objectively measure the strength of the relationship between variables through statistical analysis.

The population in this study were all students who use the Learning Management System (LMS) at University X. This population selection was based on the relevance of using LMS as the main medium in digital learning. The sampling technique used was purposive sampling, with the respondent criteria being active students who have used LMS in the learning process for at least one semester. This criterion was established to ensure that respondents have sufficient experience in using e-learning systems so they are able to provide accurate assessments of the variables studied.

The research instrument used was a structured questionnaire compiled based on indicators from previous research that have been tested for validity and reliability. The e-learning quality variable was measured using indicators reflecting system quality, information quality, and service quality. The lecturer digital competence variable was measured based on the lecturer's ability to use digital technology to support the learning process, including interaction, material delivery, and utilization of technological features. The LMS usability variable was measured using indicators of ease of use, navigation, efficiency, and system convenience. Meanwhile, the learning satisfaction variable was measured based on student evaluations of the learning experience.

All items in the questionnaire were measured using a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The Likert scale was chosen because it effectively measures respondents' perceptions and attitudes and facilitates quantitative data analysis. Prior to primary data collection, the questionnaire was piloted on a limited basis to ensure question clarity and avoid interpretation bias.

The data analysis technique in this study used Partial Least Squares Structural Equation Modeling (PLS-SEM) with the assistance of SmartPLS software. The PLS-SEM method was chosen because it has advantages in analyzing structural models involving latent variables with reflective indicators and does not require a strict normal data distribution. Furthermore, PLS-SEM is also suitable for use in research with relatively moderate sample sizes and predictive models.

Data analysis was conducted in two main stages: outer model evaluation and inner model evaluation. The outer model evaluation aimed to test the construct's validity and reliability through convergent validity, discriminant validity, and composite reliability tests. Meanwhile, the inner model evaluation examined the relationships between latent variables through path coefficient, t-

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statistic, p-value, and coefficient of determination (R-square) analysis. Effect size (f^2) and predictive relevance (Q^2) tests were also conducted to assess the model's strength and predictive ability.

By using this method, the research is expected to be able to provide comprehensive analysis results regarding the factors that influence student learning satisfaction in the context of e-learning-based learning.

Respondent Profile

The respondent profile in this study describes the characteristics of students who participated in the use of the Learning Management System (LMS) at University X. Based on the results of data collection, the majority of respondents were dominated by female students compared to male students, which indicates the active participation of female students in e-learning-based learning. In terms of age, most respondents were in the age range of 18–21 years, which reflects the group of students in the early to middle stages of higher education.

Furthermore, the level of LMS usage indicates that most respondents use digital learning systems regularly, even daily. This indicates that LMSs have become an integral part of students' learning processes. High frequency of use also indicates that respondents have sufficient experience interacting with e-learning systems, enabling them to provide relevant assessments of the variables studied.

Overall, the characteristics of the respondents in this study reflect active LMS users with direct experience in online learning. Therefore, the data obtained is considered representative in describing students' perceptions of e-learning quality, lecturers' digital competence, and the usability of the system used, which ultimately influence their level of learning satisfaction.

Table 1: Respondent Profile

Characteristics	Category	Percentage
Gender	Man	42%
	Woman	58%
Age	18–21 years	65%
	22–25 years	35%
LMS Usage	Every day	72%
	3–4 times/week	28%

Outer Model

An outer model evaluation was conducted to test the quality of the research instruments used to measure the latent variables: e-learning quality, lecturer digital competence, LMS usability, and learning satisfaction. This testing included construct validity and reliability, which aimed to ensure that the indicators used accurately and consistently represented the variables.

Based on the results of the convergent validity analysis, all indicators for each variable have loading factor values above 0.70. This indicates that each indicator has a strong correlation with the construct being measured, thus being considered convergently valid. Furthermore, the Average

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Variance Extracted (AVE) values for all variables are also above the minimum threshold of 0.50, indicating that more than 50% of the indicator variance can be explained by the respective latent construct.

Table 2: Convergent Validity

Variables	Indicator	Loading
E-learning Quality	ELQ1	0.812
	ELQ2	0.845
	ELQ3	0.867
Lecturer Digital Competence	LDC1	0.801
	LDC2	0.839
	LDC3	0.852
LMS Usability	LMS1	0.823
	LMS2	0.856
	LMS3	0.874
Learning Satisfaction	LS1	0.835
	LS2	0.861
	LS3	0.882

Furthermore, reliability testing showed that all variables had composite reliability and Cronbach's alpha values above 0.70. These results indicate that the research instrument has a good level of internal consistency, making it reliable in measuring the variables studied. Therefore, it can be concluded that all constructs in this study meet the required reliability criteria.

Table 3: AVE Reliability

Variables	AVE	Composite Reliability	Cronbach Alpha
E-learning Quality	0.69	0.89	0.85
Lecturer Digital Competence	0.68	0.88	0.84
LMS Usability	0.71	0.90	0.86
Learning Satisfaction	0.73	0.91	0.87

Discriminant validity testing was also conducted using the Fornell-Larcker criteria. The analysis showed that the square root of the AVE for each construct was greater than the correlation between the other constructs. This indicates that each variable has a good ability to differentiate itself from other variables in the research model.

Table 4: Discriminant Validity (Fornel-Lacker)

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Variables	ELQ	LDC	LMS	LS
ELQ	**0.83**			
LDC	0.62	**0.82**		
LMS	0.65	0.60	**0.84**	
LS	0.71	0.69	0.73	**0.85**

Overall, the results of the outer model evaluation indicate that the research instrument used met the criteria for good validity and reliability. Therefore, the analysis can proceed to the inner model evaluation stage to examine the relationships between variables in the structural model.

Validity test results show that all indicators have a loading factor > 0.7. An AVE value > 0.5 indicates convergent validity. Composite reliability and Cronbach's alpha values > 0.7 indicate good reliability.

Inner Model

An inner model evaluation was conducted to test the structural relationships between the latent variables in this study, namely the influence of e-learning quality, lecturer digital competence, and LMS usability on learning satisfaction. This test aimed to assess the strength of the relationships between the variables and the model's ability to explain the dependent variable.

Based on the analysis results, the coefficient of determination (R-square) for the learning satisfaction variable was 0.64. This value indicates that 64% of the variation in learning satisfaction can be explained by the three independent variables in the model: e-learning quality, lecturer digital competence, and LMS usability. Thus, this research model has moderate to strong explanatory power, in accordance with the criteria in the PLS-SEM analysis.

Table 5: R-Square

Dependent Variable	R^2
Learning Satisfaction	0.64

Furthermore, the results of the path coefficient test indicate that all hypotheses proposed in this study are empirically supported. The variables e-learning quality, lecturer digital competence, and LMS usability each have a positive and significant influence on learning satisfaction, with a t-statistic value greater than 1.96 and a p-value less than 0.05. This indicates that an increase in each independent variable will be followed by an increase in student learning satisfaction.

Table 6: Path Coefficient and Hypothesis Testing

Hypothesis	Connection	Coefficient	T-Statistic	P-Value	Results
H1	ELQ → LS	0.32	4.85	0.000	Accepted
H2	LDC → LS	0.28	3.92	0.000	Accepted
H3	LMS → LS	0.35	5.21	0.000	Accepted

Furthermore, effect size (f^2) analysis showed that the three variables had varying contributions to learning satisfaction, ranging from small to moderate. The LMS usability variable showed a relatively larger influence than the other variables, indicating that ease of use of the

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system was a dominant factor in increasing learning satisfaction.

Table 7: Effect Size (f2)

Variables	f^2
ELQ	0.18 (medium)
LDC	0.14 (small–medium)
LMS	0.21 (medium)

The predictive relevance (Q^2) test also showed a positive value, indicating that the model has good predictive ability. This means that the model developed in this study is not only able to explain the relationships between variables but also has the ability to accurately predict the dependent variable.

Table 8: Predictive Relevance (Q2)

Variables	Q^2
Learning Satisfaction	0.41

Overall, the results of the inner model evaluation indicate that the structural model used in this study has good validity and predictive power. Therefore, this model can be used to comprehensively explain the relationship between factors in e-learning and student learning satisfaction.

The R-square value indicates that the independent variables are able to moderately explain variations in learning satisfaction. The results of the hypothesis testing show:
H1: significant positive
H2: significant positive
H3: significant positive

DISCUSSION

The results of the study indicate that all independent variables, namely e-learning quality, lecturer digital competence, and LMS usability, have a positive and significant influence on learning satisfaction. This finding provides empirical support for the Stimulus-Organism-Response (SOR) Theory framework, which states that external stimuli will influence individual responses through internal processes. In the context of this study, the quality of the e-learning system, lecturer digital competence, and ease of use of the LMS act as stimuli that influence student perceptions and evaluations, which ultimately result in a response in the form of learning satisfaction.

More specifically, e-learning quality has been shown to significantly influence learning satisfaction. This indicates that the quality of digital learning systems plays a crucial role in shaping students' overall learning experience. System quality, including platform stability, material clarity, and interaction quality, is a key factor in determining whether students are satisfied with their

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learning experience. This finding is consistent with previous research that confirms that system and service quality are key determinants of e-learning user satisfaction. Therefore, educational institutions need to ensure that the e-learning systems they use are of high quality to optimally support the learning process.

Furthermore, lecturer digital competence also demonstrated a significant positive effect on learning satisfaction. This finding confirms that the human factor remains crucial in digital learning, even when technology is the primary medium. Lecturers with strong digital competence are able to utilize technology to create more interactive, communicative, and engaging learning experiences. This not only enhances student understanding of the material but also creates a more enjoyable learning experience. This finding is significant because most previous research tends to focus on the technological aspect, while the role of the lecturer often receives less attention. Therefore, improving lecturers' digital competence is a key strategy for improving the quality of online learning.

Of the three variables studied, LMS usability demonstrated the greatest influence on learning satisfaction. This indicates that ease of use is a crucial factor in determining the success of e-learning. An easy-to-use system allows students to access materials more efficiently, reduces technical barriers, and increases comfort during the learning process. This finding aligns with the Technology Acceptance Model (TAM), particularly the concept of perceived ease of use, which states that ease of use of technology will increase user acceptance and satisfaction. Therefore, usability needs to be a top priority in LMS development to provide an optimal learning experience for students.

Furthermore, the results of this study also show that the combination of technological and human factors plays a complementary role in influencing learning satisfaction. A high-quality system without adequate lecturer competency will not produce an optimal learning experience. Conversely, competent lecturers also require an easy-to-use system to effectively conduct the learning process. Therefore, a holistic approach to e-learning development is crucial, taking into account the interactions between the various factors involved.

Overall, the findings of this study reinforce the importance of integrating SOR Theory and TAM in understanding e-learning user behavior. By combining these two perspectives, this study is able to provide a more comprehensive understanding of the factors influencing student learning satisfaction. These findings are not only theoretically relevant but also have significant practical implications for the future development of digital learning systems.

Theoretical Implications

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This research provides a significant theoretical contribution to the development of user behavior literature in the context of e-learning, particularly through the integration of two major theoretical frameworks, namely the Stimulus-Organism-Response (SOR) Theory and the Technology Acceptance Model (TAM). This integration is one of the main contributions of this research because it is able to overcome the limitations of each theory when used separately. SOR Theory provides a broad conceptual framework in explaining the relationship between external stimuli, internal processes, and behavioral responses, but is relatively less specific in explaining the cognitive mechanisms underlying these internal processes. On the other hand, TAM offers a more detailed explanation of individual perceptions of technology, but tends to be limited to the aspect of technology acceptance without considering the more complex environmental context.

By integrating these two theories, this study presents a more comprehensive empirical model explaining how factors within the e-learning environment influence learning satisfaction. In this model, variables such as e-learning quality, lecturer digital competence, and LMS usability are positioned as external stimuli that influence students' internal states. Furthermore, the organism component is enriched through concepts in TAM, such as perceived ease of use and perceived usefulness, which explain how students process their experiences using learning technology. This integration allows for a more in-depth explanation of the relationship between technological factors, cognitive processes, and behavioral responses in the context of digital learning.

Furthermore, this study extends the application of these theories to the context of e-learning in Indonesia, which has distinct characteristics compared to developed countries. Most previous research on SOR and TAM was conducted in countries with a high level of technological readiness. Therefore, the results of this study provide an important empirical contribution by demonstrating that both theories remain relevant and adaptable to the context of higher education in Indonesia, which faces unique challenges such as variations in technological infrastructure, levels of digital literacy, and the readiness of educational institutions to adopt digital learning.

Furthermore, this study confirms that technological and human factors cannot be separated in analyzing the success of e-learning. Many previous studies tend to focus on one aspect, either technological or human, resulting in a partial understanding. This study shows that e-learning quality and LMS usability as technological factors, and lecturer digital competence as a human factor, simultaneously influence learning satisfaction. These findings provide a theoretical contribution by emphasizing the importance of a multidimensional approach in analyzing user

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behavior in digital environments.

Moreover, this study also adds to the literature on learning satisfaction as an outcome variable in digital learning. Using the SOR approach, this study positions learning satisfaction as the final response to the interaction between stimuli and internal processes. This approach provides a more dynamic perspective than previous studies, which tended to view satisfaction as a stand-alone variable without considering the underlying mechanisms.

Overall, this research's theoretical contribution lies in the development of an integrative model capable of explaining student behavior in e-learning-based learning more comprehensively. This model not only strengthens the validity of the theory used but also opens up opportunities for further research to develop more complex models by adding other variables, such as motivation, engagement, or trust, to enrich our understanding of the dynamics of digital learning in the future.

Managerial Implications

The findings of this study provide important managerial implications for higher education institutions in optimizing the implementation of e-learning. The results indicate that e-learning quality, lecturer digital competence, and LMS usability significantly influence learning satisfaction. Therefore, a comprehensive digital learning management strategy needs to be designed, considering all three aspects simultaneously.

First, educational institutions need to prioritize improving e-learning quality as the primary foundation of digital learning. This can be achieved by improving system stability so that the LMS can be accessed without technical disruptions that hinder the learning process. A system that frequently experiences errors, downtime, or slowness will directly impact students' learning experience and reduce their satisfaction. Therefore, investing in reliable technology infrastructure is crucial. Furthermore, the quality of learning content must also be improved by ensuring that the material presented is relevant, well-structured, and easy for students to understand. The use of interactive multimedia, such as learning videos, simulations, and digital-based quizzes, can increase student engagement and enrich the learning experience.

Second, developing lecturers' digital competence is a key strategy for improving the quality of online learning. Lecturers are not only required to master teaching materials but also to be able to utilize technology effectively in the learning process. Therefore, institutions need to provide ongoing digital pedagogy training programs, which include the use of a Learning Management System (LMS), digital learning design, and effective online interaction strategies. This training should focus not only on technical aspects but also on pedagogical approaches that can increase

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student engagement. Furthermore, lecturers should be encouraged to use interactive technologies, such as discussion forums, breakout rooms, polls, and collaborative platforms, to create a more dynamic and participatory learning experience. Thus, lecturers' digital competence can be a differentiating factor in creating quality online learning.

Third, optimizing LMS usability is an equally important aspect in improving learning satisfaction. LMS systems must be designed with a user-centered design approach, prioritizing user needs and convenience. A simple and intuitive interface will make it easier for students to access materials, complete assignments, and interact with lecturers and fellow students. Clear and structured navigation is also crucial to avoid user confusion. Furthermore, compatibility with various devices, especially mobile devices, is crucial, given that most students access the LMS via smartphones. Therefore, LMS development must ensure optimal accessibility across multiple platforms without compromising the quality of the user experience.

Furthermore, educational institutions need to adopt a continuous evaluation approach to e-learning management. Student feedback regarding their LMS experience, learning quality, and interactions with instructors should be systematically collected and used as a basis for improvement. This data-driven approach allows institutions to more accurately identify system weaknesses and make informed decisions to improve learning quality.

Overall, the managerial implications of this research emphasize that the success of e-learning depends not only on technology, but also on the quality of human resources and user-oriented system design. By strategically integrating these three aspects, educational institutions can create more effective, efficient, and satisfying digital learning experiences for students.

CONCLUSION

This study aims to analyze the influence of e-learning quality, lecturer digital competence, and LMS usability on student learning satisfaction in the context of e-learning. Based on the analysis results using the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach, it was found that the three independent variables have a positive and significant influence on student learning satisfaction. These findings provide empirical evidence that the success of digital learning is not determined by a single factor, but rather the result of the interaction of various complementary aspects.

Specifically, e-learning quality has been shown to be a crucial determinant of learning satisfaction. System quality, including platform stability, material clarity, and the quality of learning services, plays a crucial role in shaping students' learning experiences. Students tend to

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be more satisfied when a learning system meets their expectations in terms of accessibility, information clarity, and a smooth learning process. Therefore, e-learning quality should be a top priority in the development of digital learning systems.

Furthermore, lecturer digital competence also significantly impacted learning satisfaction, indicating that the lecturer's role remains a crucial element in online learning. Lecturer digital competence enables more interactive, communicative, and adaptive learning to meet student needs. This finding confirms that technology cannot replace the lecturer's role; it must be supported by the lecturer's ability to utilize technology effectively. Therefore, developing lecturers' digital competence is a strategic step in improving the quality of e-learning.

In addition, LMS usability demonstrated the greatest influence on learning satisfaction, indicating that ease of use is a key factor in determining the success of digital learning. An easy-to-use system reduces technical barriers, increases learning efficiency, and provides a more positive user experience. This aligns with the concept of perceived ease of use in the Technology Acceptance Model (TAM), which emphasizes the importance of ease of use in increasing technology acceptance.

Theoretically, this study successfully integrates the Stimulus-Organism-Response (SOR) Theory and the Technology Acceptance Model (TAM) into a single, comprehensive empirical model. This integration allows for a deeper understanding of the mechanisms by which external stimuli in e-learning environments influence students' internal processes and generate responses in the form of learning satisfaction. Thus, this study not only strengthens the validity of both theories but also broadens their application in the context of higher education, particularly in Indonesia.

From a practical perspective, the results of this study offer important implications for educational institutions in developing more effective digital learning strategies. Institutions need to simultaneously focus on the quality of their e-learning systems, improve the digital competency of their lecturers, and optimize the usability of their LMS to create an optimal learning experience for students.

Overall, this study concludes that the success of e-learning depends on the integration of quality technology and human interaction. With a holistic approach, digital learning can become not only an alternative but also a primary solution for improving the quality of education in the digital age.

FUTURE DIRECTIONS

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This study has several limitations that should be considered when interpreting the results. First, the study used a sample limited to students at a single institution, University X. Therefore, generalizing the results to broader contexts, such as other universities or different levels of education, requires caution. Differences in institutional characteristics, technological infrastructure, and learning culture may influence the results.

Second, this study used a cross-sectional approach, where data was collected at a single point in time. This approach fails to capture the dynamics of changes in students' perceptions of e-learning over time. However, students' learning experiences and satisfaction can evolve with increased technology use and adaptation to digital learning systems.

Third, the variables used in this study are limited to three main factors: e-learning quality, lecturer digital competence, and LMS usability. Although these three variables have been shown to have a significant influence, other factors have the potential to influence learning satisfaction, such as learning motivation, student engagement, trust in the system, and social and environmental factors.

Based on these limitations, future research is recommended to expand the sample size by involving various educational institutions to increase the generalizability of the results. Furthermore, using a longitudinal design can provide a deeper understanding of changes in student behavior and satisfaction over time. Further research is also recommended to develop a more comprehensive model by adding other relevant variables, thus providing a more holistic picture of the factors influencing the success of e-learning.

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