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Analysis of Success Factor of The E-Learning System Using Delone and Mclean Models

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ABSTRACT

The effectiveness of e-learning systems has become a focal point in modern education, particularly with the global shift towards digital learning environments. This study employs the DeLone and McLean Model, integrating the Technology Self-Efficacy (TSE) variable, to analyze the critical factors influencing e-learning success. Key dimensions, including information quality, system quality, service quality, system use, and user satisfaction, were evaluated through a comprehensive methodology involving Structural Equation Modeling-Partial Least Squares (SEM-PLS). Data collected from 283 high school students in a suburban area reveal significant relationships, highlighting the pivotal roles of technology self-efficacy and system use in driving user satisfaction and overall e-learning success. The findings underscore that system use directly influences educational outcomes, with students' confidence in navigating e-learning platforms emerging as a critical determinant of user satisfaction. Despite these successes, service quality and information accuracy areas present opportunities for refinement to further enhance user engagement and satisfaction. The study also emphasizes the adaptability and scalability of the proposed model for broader applications in diverse educational settings. This research contributes valuable insights into optimizing e-learning systems by addressing user-centric and technical aspects, ultimately supporting more effective digital learning platforms. The integration of TSE with the DeLone and McLean Model provides a robust framework for understanding and improving e-learning systems, offering actionable strategies for educational institutions aiming to align with the evolving demands of 21st-century learning.

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1. INTRODUCTION

E-learning has become an integral part of education, especially during the COVID-19 pandemic, which necessitated a global transition to online learning environments (Fogg, 2021; Jelpan, 2023; Ibrahim et al., 2022). This shift emphasized the significance of self-directed learning (SDL) as a vital skill for students to succeed in e-learning settings. SDL empowers learners to independently identify their learning needs, set goals, and assess their progress—particularly crucial skills when traditional teacher-led methods are unavailable (Chen et al., 2023; Murniati et al., 2022). Research shows that SDL enhances student engagement and motivation, equipping them to navigate the challenges of online education effectively (Azeem, 2023; Chukwunemerem, 2023). Furthermore, e-learning platforms allow students to personalize their learning experiences, fostering self-regulation and resilience (Suwarsono et al., 2024).

The pandemic-induced surge in e-learning technologies highlighted their potential while underscoring the need for learners to develop self-efficacy and intrinsic motivation (Liwanag, 2023; Raouna & Raouna, 2024; Pan, 2020). Effective e-learning systems—characterized by user-friendly interfaces and comprehensive digital resources—can significantly enhance problem-solving skills and academic performance (Harini, 2023). These platforms create accessible, interactive environments that encourage independence and lifelong learning. As educational institutions increasingly adopt e-learning, integrating self-directed learning frameworks ensures that students are academically prepared and equipped to excel in an increasingly digital world (Gupta, 2023; Kim et al., 2020). This adaptability underscores the transformative role of e-learning in addressing the evolving needs of learners globally and redefining the educational landscape.

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A Learning Management System (LMS) is a pivotal platform that integrates educational courses' management, delivery, and tracking, fostering a structured and efficient learning environment for students (Oktarin et al., 2023). Its adoption underscores the flexibility it offers, enabling learners to access resources anytime and anywhere—an essential feature during the shift from traditional to online learning ("Enhancing E-Learning System through Learning Management System (LMS) Technologies: Reshape the Learner Experience," 2023). However, despite these advantages, many LMS platforms face challenges in optimization, with certain features requiring further refinement to enhance usability and improve learning outcomes (Rust, 2023).

The Delone and McLean Information Systems (IS) Success Model provides a comprehensive framework for evaluating the effectiveness of LMS platforms. This model emphasizes key dimensions such as information quality, system quality, service quality, and user satisfaction. Unlike the Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT), which primarily focus on user behavior, the Delone and McLean model evaluates broader aspects of system success, offering valuable insights into areas needing improvement (Mihardi et al., 2022).

Leveraging this framework allows for systematically identifying and resolving gaps, ensuring the LMS aligns with users' educational and technological needs. Incorporating student feedback and enhancing user-centric features are critical to achieving this goal, as research consistently highlights the strong correlation between user satisfaction and improved academic performance (Liwanag, 2023; Suwarsono et al., 2024).

Research on the success factors of e-learning systems in high schools utilizes the DeLone and McLean Model as a comprehensive framework for evaluating the effectiveness of information systems. This widely recognized model assesses system quality, information quality, service quality, user satisfaction, and net benefits (Rahayu & Setiyani, 2022; Tute et al., 2022). A key innovation in this study is the introduction of Technology Self-Efficacy as a variable, focusing on students' motivation and confidence in using Learning Management Systems (LMS). This variable underscores the role of IT support, training, and platform usability in shaping user experiences, making it a critical component in assessing the effectiveness of e-learning environments (Al-Adwan et al., 2021).

The urgency of optimizing online learning platforms became evident during the COVID-19 pandemic, particularly with the widespread adoption of LMS platforms. Although introduced in 2021, many LMS features require refinement to enhance usability and learning outcomes (Rust, 2023). Addressing these challenges through student feedback and emphasizing Technology Self-Efficacy can significantly boost LMS engagement. This aligns with research highlighting the importance of user-centric approaches in improving e-learning systems (Kim et al., 2012; Mihardi et al., 2022). By systematically evaluating these factors, this study aims to identify improvement areas, address existing research gaps, and advance the design of more effective online learning environments.

The DeLone and McLean Model provides a robust and multifaceted framework for evaluating the success of e-learning systems, encompassing Information Quality, System Quality, Service Quality, System Usage, User Satisfaction, and Net Impact (Seliana et al., 2020; Bakhri, 2021). These dimensions offer a holistic perspective on e-learning platform performance and effectiveness. Information Quality ensures the content is relevant, accurate, and useful, directly influencing user satisfaction and learning outcomes (NAM, 2023; Nalintippayawong et al., 2023). System Quality addresses the technical aspects, such as platform reliability, ease of use, and responsiveness, essential for maintaining user engagement (Millidonis et al., 2023; Tumurchudur & Buyantur, 2022). Additionally, Service Quality focuses on technical and instructional support availability, enabling users to navigate and maximize the platform's features effectively (Anaam et al., 2023; Masa'deh et al., 2023). Integrating these dimensions allows for a comprehensive evaluation of e-learning systems beyond user behavior. By incorporating system performance and educational impact, this approach fosters the development of improved e-learning experiences more responsive to users' needs and educational institutions' goals.

This study investigates the success factors of Learning Management Systems (LMS) in high schools, focusing on key dimensions such as Information Quality, Service Quality, System Quality, Technology Self-Efficacy, System Usage, and overall e-learning success. By evaluating these critical variables, the research aims to identify the LMS's strengths and pinpoint areas for improvement, offering actionable insights to enhance its functionality and user experience.

Understanding how these factors influence interactions between students, educators, and the LMS is essential for addressing challenges such as usability issues, inadequate support, and varying levels of digital competence. By tackling these challenges, the study seeks to improve the LMS's effectiveness, ensuring it meets

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the needs of the educational community while fostering a more efficient and engaging online learning environment.

2. MATERIAL AND METHOD

Information System Success Model Delone and McLean and Ronald D Freeze

This study adopts the DeLone & McLean (1992) model as it is a highly suitable and effective framework for measuring the success of e-learning systems. The model's variables (Information Quality, System Quality, Service Quality, User Satisfaction, Intention to Use, and Net Benefits) align well with key parameters for evaluating the success of information systems. System Quality According to DeLone and McLean, system quality refers to a platform's ability to meet user goals through reliability, loading and downloading speed, and intuitive navigation menus that facilitate user activities. In the context of e-commerce and e-learning platforms, visitors evaluate features such as responsiveness (e.g., transfer time), functionality, availability, dependability, and flexibility.

The model highlights the interconnected relationships between these variables. For instance, Usage significantly influences User Satisfaction, while overall User Satisfaction impacts both individual and organizational outcomes (DeLone & McLean, 2003). Achieving better system and information quality enhances user satisfaction and improves productivity at both individual and organizational levels.

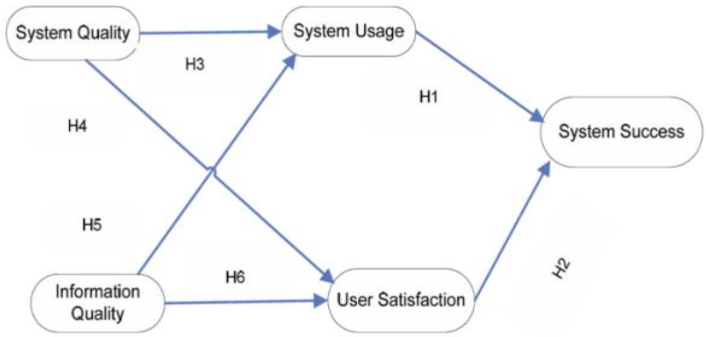

Figure 1. Information System Success Model (Ronald D. Freeze et al., 2010)

According to DeLone and McLean, System Quality refers to a platform's ability to meet user goals through reliability, loading and downloading speed, and intuitive navigation menus, while Information Quality reflects the platform's capacity to provide high-quality services, such as security, ease of use, and responsiveness that align with user expectations; System Use describes the extent to which users intend to and utilize the system to complete tasks, whereas User Satisfaction encompasses overall trust, comfort, and user satisfaction, with System Success determined by the combination of User Satisfaction and System Use, as outlined in the DeLone and McLean model and further developed by Ronal D. Freeze (2010), which highlights the influence of Information Quality on User Satisfaction and System Quality on System Use, excluding Service Quality and Net Benefits.

Technology Self-Efficacy

According to (Pan, 2020), effective factors can show how students' confidence in technology use influences how they receive the learning environment. Therefore, learning and self-efficacy influence each other interactively and dynamically. Self-efficacy in e-learning is considered an intrinsic motivator in terms of long-term intentions. This usually refers to how well users utilize technology. The ability to use technology without facing significant problems is usually called technological self-efficacy. Efficacy and outcome estimates, which are estimates made by users about how they achieved the result, are the two main subsections.

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Research Model

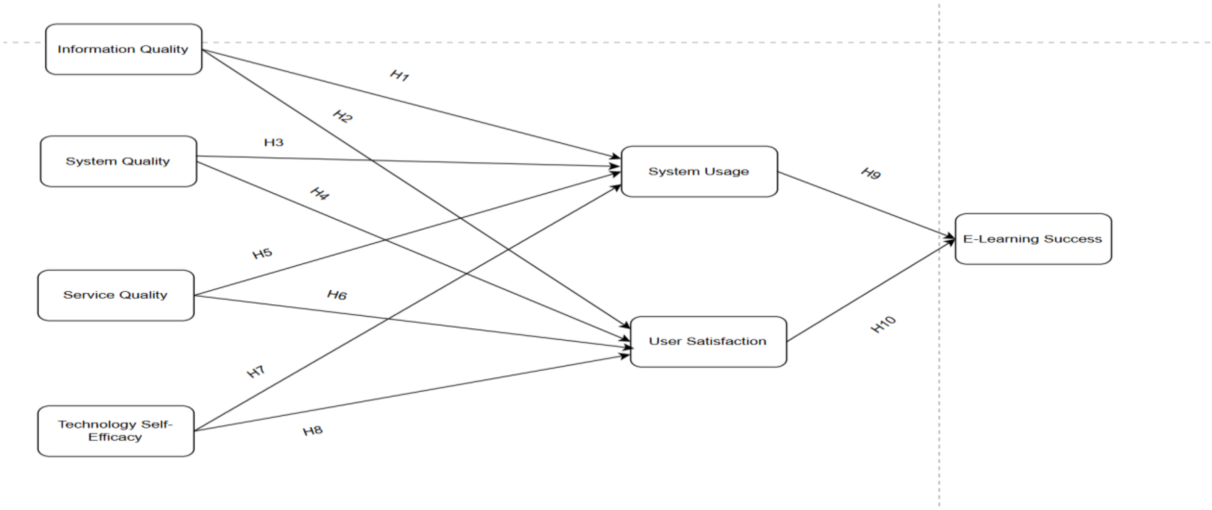

Figure 2. Research Model

The quantitative research design ensures reliability and validity in hypothesis testing by focusing on the number of student respondents utilizing the e-learning system. PLS-SEM (Partial Least Squares-Structural Equation Modeling) was the analytical tool because it can handle complex models involving latent variables, indicators, and intricate relationships. This technique offers notable advantages, such as effectively dealing with imperfect data (e.g., missing values or outliers), providing flexibility in model construction, and maintaining effectiveness even with smaller sample sizes.

Table 1. Research Hypothesis

No.	Research Hypothesis
H1	Ho: Information Quality does not affect System use
	Ha: Information Quality affects System use
H2	Ho: Information Quality does not affect User Satisfaction
	Ha: Information Quality Affects User Satisfaction
H3	Ho: System Quality does not affect System use
	Ha: System Quality affects System use
H4	Ho: System Quality does not affect User Satisfaction
	Ha: System Quality Affects User Satisfaction
H5	Ho: Service Quality does not affect System use
	Ha: Service Quality affects System use
H6	Ho: Service Quality does not affect User Satisfaction
	Ha: Service Quality affects User Satisfaction.
H7	Ho: Technology Self-Efficacy does not affect System use
	Ha: Technology Self-Efficacy affects System use
H8	Ho: Technology Self-Efficacy does not affect User Satisfaction
	Ha: Technology Self-Efficacy Affects User Satisfaction
H9	Ho: System use does not affect E-Learning Success
	Ha: System Use Affects E-Learning Success
H10	Ho: User Satisfaction does not affect E-Learning Success
	Ha: User Satisfaction Affects E-Learning Success

The research variables are defined as follows: Information Quality refers to the accuracy, relevance, and accessibility of information stored, provided, or generated by the system, positively influencing system use and user satisfaction. System Quality reflects the information system's reliability, flexibility, and performance,

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affecting system use and user satisfaction. Service Quality represents the system's ability to deliver reliable, prompt, and accurate services, ensuring effective student support. Technology Self-Efficacy measures students' confidence and competence in navigating LMS features, influencing system use and user satisfaction. System Use captures users' behavioral engagement with the LMS and is influenced by information quality and system quality. User Satisfaction indicates overall satisfaction with the LMS, which is also influenced by information and system quality. Finally, E-Learning Success evaluates the LMS's overall effectiveness, which is determined by the benefits of system use and user satisfaction. These variables provide a comprehensive framework for assessing and improving the LMS in educational settings.

Sample Population

If a study involves a very large population, a representative sample can be taken to reflect the total population accurately. Slovin's formula is instrumental in determining the sample size from the existing population. Applying this method makes the research's conclusions remain valid and reflect the population's characteristics. The Slovin method addresses the risk of a sample size being too small, which may lead to results that fail to represent the population accurately. Conversely, using an excessively large sample could result in unnecessary costs. The formula for calculating sample size using Slovin's method is as follows:

$$n = \frac{N}{(1 + (Nxe^2))}$$

Explanation:
n = Number of samples N = Population e = Error tolerance limit

The application of this method involves determining the error tolerance limit (expressed as a percentage) to increase the accuracy of population representation with smaller samples. A smaller error tolerance requires a larger sample size to maintain accuracy. In this study, the number of active students at a senior high school in a suburban area of a city regency within the Jakarta metropolitan region as of 2024 is nine hundred and sixty-four (964). The maximum proportion value is set at 0.5, with a confidence level of 95% (Zα=1.96) and a margin of error 0.05.
Calculation:

$$n = \frac{964}{(1 + (964x0{,}05^2))}$$
$$n = 282.69$$

.

Table 2. Age Respondent

Age	Respondent
15 years old	80
16 years old	152
17 years old	80
18 years old	1

Table 3. Class Respondent

Class	Respondent
10 Natural Science Program	37
10 Social Sciences Program	20
11 Natural Science Program	132
11 Social Sciences Program	1
12 Natural Science Program	67
12 Social Sciences Program	26

Data Collections

Simple random sampling, a type of probability sampling, is utilized in this research. Data will be collected through an online questionnaire distributed via Google Forms. The study targeted all students from grades 10 to

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12 who used e-learning, comprising 964 students. Using the Slovin method to determine a representative sample size, approximately 283 students were selected.

The questionnaire includes seven variables: Information Quality, System Quality, Service Quality, Technology Self-Efficacy, System Use, User Satisfaction, and E-Learning Success. According to Cherry (2024), a psychometric evaluation system known as the Likert scale is widely employed in research and various fields. This scale is often applied in questionnaires where participants rate their views, feelings, and reactions on a scale, typically ranging from 1 to 5.

The Likert scale is designed to measure attitudes, perceptions, or levels of agreement, providing options to assess judgments, opinions, and behaviors of respondents—students in this case—towards specific statements. Constructing a valid Likert scale requires careful consideration of several important steps to ensure the accuracy and reliability of the results.

Outer Loading

An indicator reflects the strength of the relationship between a latent variable (construct) and the corresponding measure used to evaluate it. Indicators with low external loading values (typically less than 0.4) may not adequately reflect the latent variable and should be removed to improve the model's assessment quality. For external loading values between 0.4 and 0.7, retaining or excluding the indicator depends on further analysis, such as its impact on construct reliability or the Average Variance Extracted (AVE). According to Hair et al. (2019), an external loading value greater than 0.7 indicates that the data is valid.

Table 4. Outer Loading

	ES	IQ	SL	SQ	SU	TS	US
ES1	0.812						
ES2	0.873						
ES3	0.759						
ES4	0.839						
IQ1		0.880					
IQ2		0.819					
IQ3		0.867					
SL1			0.877				
SL2			0.861				
SL3			0.872				
SQ1				0.780			
SQ2				0.766			
SQ3				0.780			
SU1					0.839		
SU2					0.884		
SU3					0.899		
TS1						0.834	
TS2						0.807	
TS3						0.828	
US1							0.883
US2							0.873
US3							0.732

Construct Reliability and Validity

Cronbach's alpha evaluates how well-related indicators measure a latent construct, ensuring the measurement model is valid and reliable. This measure is essential for assessing internal consistency or predictability within an assessment scale. In SmartPLS, Cronbach's alpha helps determine whether criteria composed of hypothetical variables consistently evaluate a given hypothesis. As an indicator of repeatability, Cronbach's alpha reflects the precision with which respondents evaluate a set of indicators or questionnaire items for a specific subject. The value of Cronbach's alpha ranges from 0 to 1, with higher values indicating greater reliability. Values of 0.9 or above indicate excellent reliability, 0.8 to 0.9 reflect strong reliability, 0.7 to 0.8 indicate acceptable reliability, 0.6 to 0.7 suggest poor reliability, and values below 0.6 indicate poor reliability.

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When Cronbach's alpha falls below acceptable levels, researchers may need to re-evaluate the indicators used, considering modifications or eliminations to improve the reliability of the measurement framework.

Table 5. Construct Reliability and Validity

	Cronbach's Alpha	Composite Reliability (rho_a)	Composite Reliability (rho_c)	Average Variance Extracted (AVE)
ES	0.839	0.849	0.892	0.675
IQ	0.818	0.828	0.891	0.732
SL	0.841	0.850	0.904	0.757
SQ	0.668	0.668	0.819	0.601
SU	0.846	0.855	0.907	0.764
TS	0.762	0.765	0.863	0.677
US	0.774	0.784	0.870	0.692

If the alpha value is low, it may indicate poor internal consistency of the measurement. A good Cronbach's alpha value is above 0.7. Similarly, Sarstedt et al. (2017) state that an Average Variance Extracted (AVE) value greater than 0.5 fulfills the requirements for good convergent validity, indicating that the construct explains 50% or more of the variance in its items. Furthermore, Sarstedt et al. (2017) also emphasize that a Composite Reliability (rho c) value exceeding 0.7 signifies that the item variables are reliable. Based on the table above, it is evident that all variables in this study meet the minimum criteria for Cronbach's alpha and composite reliability values, both of which are above 0.7. Therefore, all variables in this study are declared valid.

Discriminant Validity-Cross Loading

Table 6. Discriminant Validity- Cross Loading

	ES	IQ	SL	SQ	SU	TS	US
ES1	0.812	0.540	0.617	0.527	0.616	0.533	0.572
ES2	0.873	0.577	0.575	0.568	0.718	0.570	0.650
ES3	0.759	0.431	0.476	0.450	0.536	0.504	0.531
ES4	0.839	0.542	0.565	0.564	0.669	0.589	0.600
IQ1	0.558	0.880	0.625	0.616	0.552	0.502	0.538
IQ2	0.511	0.819	0.563	0.534	0.476	0.443	0.395
IQ3	0.570	0.867	0.617	0.607	0.553	0.562	0.459
SL1	0.633	0.665	0.877	0.695	0.618	0.635	0.577
SL2	0.569	0.554	0.861	0.563	0.512	0.485	0.490
SL3	0.567	0.609	0.872	0.545	0.506	0.487	0.467
SQ1	0.438	0.569	0.534	0.780	0.496	0.453	0.542
SQ2	0.521	0.407	0.500	0.766	0.487	0.568	0.569
SQ3	0.541	0.626	0.591	0.780	0.518	0.570	0.480
SU1	0.590	0.538	0.518	0.536	0.839	0.596	0.654
SU2	0.671	0.497	0.525	0.542	0.884	0.613	0.682
SU3	0.764	0.582	0.607	0.608	0.899	0.674	0.712
TS1	0.577	0.611	0.594	0.621	0.629	0.834	0.664
TS2	0.548	0.337	0.409	0.512	0.584	0.807	0.557
TS3	0.524	0.490	0.524	0.549	0.561	0.828	0.615
US1	0.592	0.470	0.529	0.650	0.682	0.668	0.883
US2	0.598	0.519	0.543	0.619	0.637	0.657	0.873
US3	0.5607	0.366	0.306	0.426	0.634	0.528	0.732

Discriminant validity in this study was tested by examining the cross-loading values for each indicator (Hanseler, 2015). Cross-loading values indicate how well an indicator measures its respective construct compared to others. Discriminant validity ensures that two constructs are distinct and measure different aspects, providing critical information about the uniqueness of constructs in a model.

Discriminant validity is considered satisfactory if each indicator shows a higher loading value on its corresponding latent variable than on other latent variables. Based on the table above, the cross-loading values demonstrate that all indicators in this study have higher loadings on their respective variables than others, confirming that the indicators are valid. For example, the results show that the variables ES2 (Learning) and ES4

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(Impact) exhibit the highest loadings on the ES construct (E-Learning Success). At the same time, IQ1 (Accuracy) and IQ3 (Timeliness) have the highest loadings on the IQ construct (Information Quality). These findings confirm the discriminant validity of the constructs in this study.

Effect Size

Table 7. Effect Size

	f-square
IQ -> SU	0.028
IQ -> US	0.000
SL -> SU	0.024
SL -> US	0.007
SQ -> SU	0.013
SQ -> US	0.082
SU -> ES	0.328
TS -> SU	0.237
TS -> US	0.314
US -> ES	0.086

Information:

a. f^2 > 0.35, then the effect/influence is large
b. f^2 > 0.15, then the effect/influence is moderate
c. f^2 > 0.02, then the effect/influence is small

According to Inn (2020), this metric evaluates the relative influence of external independent variables on endogenous dependent variables within structural models. It is particularly useful for determining whether an independent variable contributes significantly, moderately, or slightly to explaining the variability of the dependent variable. This allows for a detailed observation of the influence level of each independent variable on the dependent variable.

The results reveal three factors with the greatest influence: SU → ES (System Use on E-Learning Success), TS → SU (Technology Self-Efficacy on System Use), and TS → US (Technology Self-Efficacy on User Satisfaction). These findings highlight the significant roles these relationships play in the structural model.

Method of PLS (Partial Least Square)

Joseph Hair (2022) states that PLS-SEM is particularly useful for forecasting and explaining desired outcomes in structured models through both in-sample and out-of-sample indicators. PLS (Partial Least Squares) can connect independent variable sets with multiple response variables, making it a versatile type of Structural Equation Modeling (SEM). According to Aghimien et al. (2022), PLS-SEM is an effective analytical method as it does not rely on numerous assumptions, distinguishing it from traditional SEM approaches.

SEM is widely recognized as a quasi-standard in marketing and research management for causal analysis of relationships between latent constructs. Specifically, SEM-PLS is a causal modeling method designed to maximize the explained variance of latent dependent constructs (Hair, 2014). To ensure the quality of the measurement model, validity and reliability must be evaluated. For reflective measurement models, composite reliability is deemed satisfactory if it falls between 0.60 and 0.70 in exploratory studies and between 0.70 and 0.90 in confirmatory studies, whereas values below 0.60 indicate poor reliability. The structural equation model (SEM) demonstrates, estimates, and tests relationships between measured and latent variables. As a simultaneous equation model, SEM incorporates various equations containing latent variables, representing multiple concepts or construct indicators (Avkiran, 2018).

Based on the above, it can be concluded that SEM-PLS is a cause-and-effect methodology designed to evaluate the relationships between variables in structural models effectively.

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3. FINDINGS

Loading Factor Result

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The results of the data visualization output generated using the SmartPLS4 application are presented below and can be found in **Figure 3**.

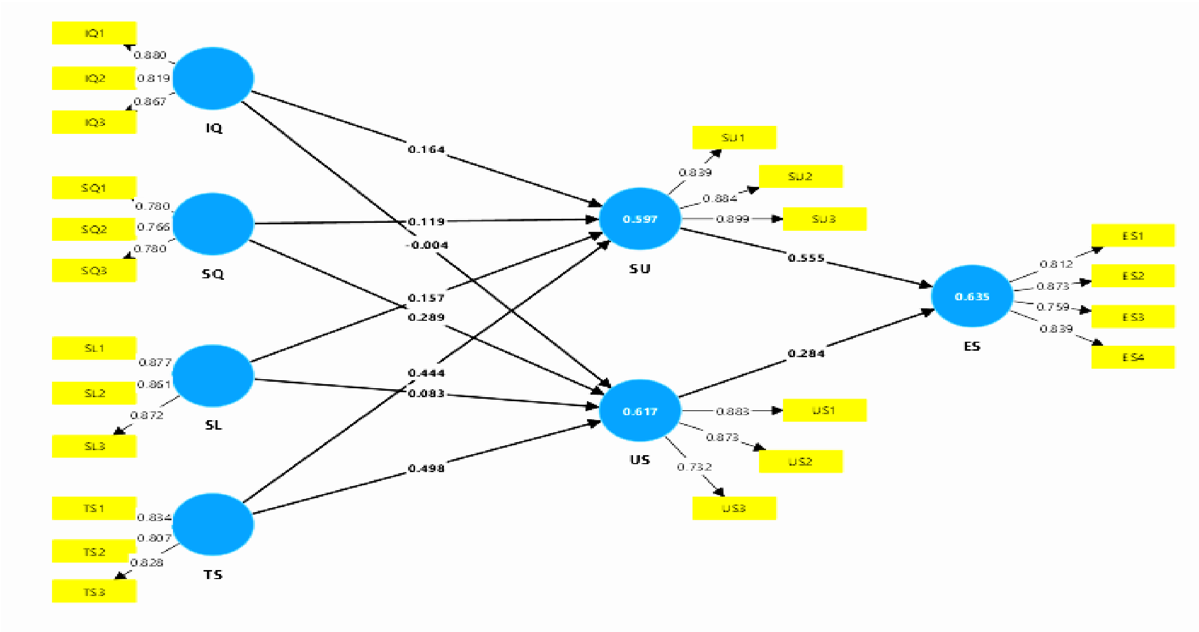

Figure 3. Loading Factor Result

The results of the bootstrapping algorithm analysis reveal that each variable demonstrates distinct values based on the obtained outcomes, highlighting the varying significance and relationships within the model.

Table 8. Loading Factor Result

Variable	Indicator	Loading Factor	Information
Information Quality (IQ)	IQ1	0.880	Valid
	IQ2	0.819	Valid
	IQ3	0.867	Valid
System Quality (SQ)	SQ1	0.780	Valid
	SQ2	0.766	Valid
	SQ3	0.780	Valid
Service Quality (SL)	SL1	0.877	Valid
	SL2	0.861	Valid
	SL3	0.872	Valid
Technology Self-Efficacy (TS)	TS1	0.834	Valid
	TS2	0.807	Valid
	TS3	0.828	Valid
System Use (SU)	SU1	0.839	Valid
	SU2	0.884	Valid
	SU3	0.899	Valid
User Satisfaction (US)	US1	0.883	Valid
	US2	0.873	Valid
	US3	0.732	Valid
E-Learning Success (ES)	ES1	0.812	Valid
	ES2	0.873	Valid
	ES3	0.759	Valid
	ES4	0.839	Valid

Table 8 summarizes the influence of loading factors on the tested hypotheses. The results indicate that

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each variable's AVE (Average Variance Extracted) values meet the required criteria, with a minimum value of 0.5. This confirms that all variables in the study are valid.

Hypothesis Interpretation

H1: Information Quality (IQ) significantly affects System Use (SU). The results indicate a significant positive relationship between Information Quality and System Use. This suggests that the accuracy and relevance of the information provided by the e-learning system strongly influence its utilization. For example, platform features such as forums and subject-specific resources encourage students to use the system. These findings align with previous studies, such as Hermita et al. (2019), which emphasized the role of information quality in promoting system usage, and Mafazi (2021), who found that high-quality information significantly enhances user engagement.

H2: Information Quality (IQ) does not significantly affect User Satisfaction (US). The analysis shows that Information Quality does not significantly impact User Satisfaction. While it influences System Use, the provided information was deemed insufficiently accurate or comprehensive to contribute to meaningful satisfaction. As a result, the hypothesis was rejected. This finding is consistent with prior research, which reported weak evidence supporting a direct relationship between these variables.

H3: System Quality (SQ) does not significantly affect System Use (SU). The results indicate no significant relationship between System Quality and System Use. This implies that the technical reliability and flexibility of the e-learning system do not strongly influence user behavior. The lack of statistical significance led to the rejection of this hypothesis.

H4: System Quality (SQ) significantly affects User Satisfaction (US). System Quality was found to have a significant positive impact on User Satisfaction. Students appreciated the system's ease of use, responsiveness, and ability to meet their needs through regular updates and enhancements. These results align with prior research by Mafazi (2021), which emphasized the role of system quality in driving user satisfaction.

H5: Service Quality (SL) significantly affects System Use (SU). Service Quality positively influences System Use, highlighting the importance of prompt and reliable support services. The IT team's effectiveness in assisting students contributed significantly to adopting and utilizing the e-learning system. These findings are consistent with Mafazi's (2021) work, which underscored the importance of service quality in promoting system use.

H6: Service Quality (SL) does not significantly affect User Satisfaction (US). Unexpectedly, Service Quality showed minimal impact on User Satisfaction. Issues such as slower response times and less satisfactory support services diminished its influence, resulting in weak statistical evidence for this relationship and the rejection of the hypothesis.

H7: Technology Self-Efficacy (TS) significantly affects System Use (SU). Technology Self-Efficacy demonstrated a significant positive impact on System Use. Students with higher confidence and motivation in navigating e-learning features were likelier to use the system effectively. These findings corroborate studies by Wolverton et al. (2020), which identified self-efficacy as a crucial determinant of technology adoption and use.

H8: Technology Self-Efficacy (TS) significantly affects User Satisfaction (US). The results confirm a significant relationship between Technology Self-Efficacy and User Satisfaction. Students' confidence in utilizing system features enhanced their satisfaction levels, consistent with Humaidi et al. (2021), who recognized self-efficacy as a key driver of satisfaction in e-learning environments.

H9: System Use (SU) significantly affects E-Learning Success (ES). System Use significantly influenced E-Learning Success, demonstrating that frequent and effective system usage contributes to achieving educational goals. These findings are supported by Freeze et al. (2010) and Hermita et al. (2019), who established a positive relationship between system use and e-learning success.

H10: User Satisfaction (US) significantly affects E-Learning Success (ES). The study confirmed that User

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Satisfaction is a critical determinant of E-Learning Success. Students' satisfaction with the system's usability and functionality directly impacted their perception of success. These conclusions align with research by Hermita et al. (2019), reinforcing the essential role of satisfaction in e-learning outcomes.

Table 9. Hypothesis Test.

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistic (|O/STDEV|)	P Values
IQ->SU	0.164	0.161	0.079	2.068	0.039
IQ->US	-0.004	-0.005	0.076	0.050	0.960
SL->SU	0.157	0.158	0.077	2.021	0.043
SL->US	0.083	0.083	0.077	1.073	0.283
SQ->SU	0.119	0.122	0.071	1.690	0.091
SQ->US	0.289	0.292	0.075	3.839	0.000
SU->ES	0.555	0.556	0.061	9.143	0.000
TS->SU	0.444	0.444	0.063	6.996	0.000
TS->US	0.498	0.498	0.059	8.396	0.000
US->ES	0.284	0.285	0.064	4.441	0.000

4. Discussion

Overview of Hypothesis Testing Result

The study of e-learning system success factors, analyzed using the DeLone and McLean Model, offers valuable insights into the key relationships influencing the effectiveness of e-learning systems. Seven critical relationships were identified, such as the significant impact of Information Quality on System Use, emphasizing the importance of accurate and relevant information in fostering user engagement. The findings also highlight that System Quality significantly contributes to User Satisfaction, with features like ease of use and responsiveness playing a pivotal role in student contentment. Additionally, Service Quality positively influenced System Use, underlining the need for prompt and reliable technical support. Technology Self-Efficacy emerged as a crucial determinant, positively affecting System Use and User Satisfaction, demonstrating how confidence in using technological tools enhances overall engagement and satisfaction. The strong relationship between System Use and E-Learning Success confirmed that frequent and effective system utilization directly impacts learning outcomes. Lastly, User Satisfaction was strongly linked to E-Learning Success, indicating that student satisfaction is integral to achieving educational goals (Şumuer, 2018; Fuzi, 2023).

Conversely, the study revealed three non-significant relationships: Information and User Satisfaction, Service and User Satisfaction, and System Quality and System Use. These findings suggest that while these factors are part of the framework, their impact may vary due to contextual nuances or implementation quality. For instance, the lack of a significant relationship between Information Quality and User Satisfaction may indicate a need for more tailored or student-relevant information. Similarly, the limited influence of Service Quality on User Satisfaction could point to inadequacies in service delivery mechanisms. These outcomes highlight areas requiring further investigation and improvement to ensure a more holistic and effective e-learning environment. By addressing these gaps and reinforcing the positive factors, educational institutions can significantly enhance the functionality and success of their e-learning systems (Rahman, 2024; Zhou & Yu, 2021).

Significant Relationship

The hypothesis testing in the study of e-learning system success factors identified seven significant relationships, highlighting the interplay of key variables in influencing the effectiveness of e-learning platforms. The relationship between Information Quality and System Use underscores the importance of accurate and

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relevant information in driving platform engagement, aligning with previous studies emphasizing high-quality information as a catalyst for active system usage (Fauziah, 2023; Tute et al., 2022). Similarly, System Quality significantly impacts User Satisfaction, demonstrating that ease of use, reliability, and adaptability are crucial for fostering positive user experiences (Uppal et al., 2017; Idkhan, 2023). Additionally, Service Quality influences System Use, as effective support services enable users to navigate and utilize the platform efficiently, ultimately enhancing their learning outcomes (Aldholay et al., 2018).

The findings further emphasize the critical role of Technology Self-Efficacy in influencing System Use and User Satisfaction, indicating that students' confidence and motivation significantly enhance their interactions with the system (Yakubu & Dasuki, 2018; Zardari et al., 2021). Moreover, the relationships between System Use and E-Learning Success and between User Satisfaction and E-Learning Success highlight that consistent engagement with the system and high satisfaction levels are essential for achieving educational goals (Fauziah, 2023; Idkhan, 2023). These findings underline the multifaceted nature of e-learning system success and offer actionable insights for enhancing educational outcomes.

Non-Significant Relationships

The hypothesis testing in the study identified three non-significant relationships related to the e-learning system, revealing areas for potential improvement. First, the relationship between Information Quality and User Satisfaction was found to be non-significant, suggesting that the system may lack sufficiently accurate or comprehensive information to influence user satisfaction positively. Incomplete or outdated content could diminish the system's perceived value, as highlighted in prior studies emphasizing the importance of high-quality, relevant information for enhancing satisfaction (Al-Fraihat et al., 2020; Kalankesh et al., 2020;). Regular updates and ensuring content alignment with user needs could help address this issue and strengthen the relationship.

Second, the relationship between System Quality and System Use was also non-significant, likely due to limitations in the system's accessibility, user interface, or adaptability. Such shortcomings can reduce user engagement and hinder effective usage, as previous research has demonstrated the critical role of system quality in driving platform use (Seta et al., 2018; Alotaibi & Alshahrani, 2022). Lastly, the relationship between Service Quality and User Satisfaction was non-significant, indicating potential inadequacies in IT support, such as slow response times or insufficient problem resolution. Effective service quality is essential for enhancing satisfaction, and deficiencies in this area can negatively impact the overall user experience (Sari, 2024; Pham et al., 2019). These findings highlight the need for targeted improvements in information accuracy, system functionality, and support services to enhance the e-learning system's overall success.

The Most Significant Relationship

The hypothesis testing in the study of the e-learning system at a high school in a suburban region identified three significant relationships essential to understanding the success of e-learning platforms. First, the relationship between System Use and E-Learning Success (effect size 0.328) demonstrates that consistent engagement with the platform for assignments and educational activities significantly enhances its effectiveness. This finding aligns with prior research emphasizing that regular usage strongly predicts learning outcomes, reinforcing the importance of active participation in achieving educational goals (Azeem, 2023; Pan, 2020).

Second, the relationship between Technology Self-Efficacy and System Use (effect size 0.237) highlights that students' confidence and motivation in using the platform significantly improve their engagement. Previous studies corroborate that higher self-efficacy correlates with a greater willingness to explore and utilize technological tools, fostering more effective system use (Wolverton et al., 2020; Tariq et al., 2018).

Lastly, the relationship between Technology Self-Efficacy and User Satisfaction (effect size 0.314) underscores students' confidence in navigating and utilizing the platform, which enhances their overall satisfaction. This is consistent with research identifying self-efficacy as a key determinant of satisfaction in online learning contexts (Agourram, 2019). These findings collectively emphasize the importance of fostering student confidence and promoting active engagement to optimize the effectiveness and success of e-learning systems.

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Practical Implication

This study makes a significant theoretical contribution by integrating the DeLone and McLean Model (2003), the Ronald D. Freeze Information System Success Model (2010), and additional variables to evaluate e-learning system success. It provides valuable insights into how system quality, information quality, service quality, and technological self-efficacy influence system use, user satisfaction, and the overall success of e-learning platforms. These findings are particularly relevant for educational institutions aiming to enhance digital learning environments and improve student engagement and satisfaction.

The study highlights the effectiveness of the e-learning system implemented via Moodle, which successfully delivers accurate, relevant, and up-to-date materials, encouraging active system use. This aligns with previous research emphasizing the critical role of high-quality information in fostering engagement and academic success (Pham et al., 2019). System quality also emerged as a key determinant of user satisfaction, with attributes such as responsiveness, adaptability, and efficient processing speeds significantly enhancing user experiences (Alhabeeb & Rowley, 2018). However, the study identifies areas for improvement, such as optimizing response time and service reliability, to further enhance overall system performance.

The findings underscore the importance of service quality and technological self-efficacy in shaping system use and user satisfaction. Reliable service delivery and effective IT support are crucial for promoting user engagement (Pham et al., 2019). Moreover, higher levels of technological self-efficacy among students boost their confidence in navigating the platform, improving satisfaction and engagement (Kim et al., 2012). These findings collectively highlight the need for educational institutions to refine system capabilities, provide robust support, and foster technological confidence among users to maximize e-learning success.

5. CONCLUSION

Based on the results of this study, several suggestions can be proposed to enhance the success factors of the E-Learning system at a high school. As technology evolves, it is crucial to identify and focus on factors that significantly influence the effectiveness of E-Learning systems to align with students' learning needs and preferences. Regarding Information Quality, the E-Learning system should present a syllabus, materials, and easy questions for students to comprehend. Efforts should be made to provide accurate, timely, and relevant information to effectively support students' learning experiences. Regular updates are essential to ensure the information remains relevant and beneficial for the student's academic progress. Regarding Service Quality, the application team must provide prompt and reliable support to students facing challenges using the system. Teachers should also actively engage with the E-Learning platform, offering guidance and support to students to foster a more connected and supportive learning environment. For System Quality, the application team should ensure the system is user-friendly and reliable, providing seamless access to various features. Regular updates to improve the user interface, system performance, and visual appeal are necessary to keep the platform engaging and effective. Regarding System Use, all educational processes should be integrated into the E-Learning system, including delivering materials, assigning tasks, and administering practice tests. Additionally, system features such as menus, interfaces, and attendance tracking must function smoothly to optimize usability. For User Satisfaction, the E-Learning system must improve students' overall satisfaction by addressing specific aspects like accurate and relevant information, benefits such as forums and subject-specific resources, and timely availability of materials and questions. Ensuring the system meets students' expectations will enhance their satisfaction and contribute to the success of the E-Learning system. In summary, improving Information Quality, Service Quality, System Quality, System Use, and User Satisfaction through targeted interventions and updates will significantly enhance the effectiveness and success of the E-Learning system.

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