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Integrating UTAUT2 and DeLone & McLean Models to Evaluate E-Learning Success: Evidence from Indonesian Higher Education

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Abstract: E-learning has become an essential component of higher education, yet studies integrating technology acceptance and information system success perspectives remain limited. This study proposes an integrated evaluation model combining the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) and the DeLone & McLean Information Systems Success Model to evaluate e-learning success in higher education. The novelty of this research lies in positioning system quality, information quality, and self-efficacy as mediating constructs linking behavioral acceptance factors to e-learning success through user satisfaction. Data were collected from 202 active users of a state university e-learning system using purposive sampling and analyzed using Partial Least Squares-Structural Equation Modeling (PLS-SEM), which was selected due to its suitability for predictive and exploratory model analysis involving multiple latent constructs. The results indicate that system quality (β=0.423, p=0.000), information quality (β=0.245, p=0.011), and self-efficacy (β=0.240, p=0.005) positively and significantly influence user satisfaction. User satisfaction emerged as the strongest predictor of e-learning success (β=0.776, p=0.000), confirming that positive user experiences play a central role in determining the effectiveness of e-learning systems. These findings provide both theoretical and practical contributions by demonstrating how behavioral acceptance factors are translated into e-learning success through perceived quality and satisfaction mechanisms in higher education contexts.

Keywords: DeLone & McLean; E-Learning success; Higher education; PLS-SEM; UTAUT2

Introduction

The rapid adoption of e-learning in higher education has transformed digital learning systems from supplementary tools into essential components of modern academic environments. Learning Management Systems (LMS) are increasingly used to support course delivery, assessments, communication, and student engagement. This transformation accelerated significantly after the COVID-19 pandemic and strengthened the demand for flexible and technology-supported learning environments (Adima et al., 2025; Chen et al., 2023; Murniati et al., 2022). However, despite widespread implementation, many higher education institutions still experience inconsistent e-learning effectiveness, including low user satisfaction, uneven system quality, and suboptimal learning experience (Al-Fraihat et al., 2020; Winarno & Legowo, 2024).

Previous studies have generally evaluated e-learning systems from either a technology acceptance perspective or an information system success perspective. The Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) explains users' behavioral acceptance through factors such as performance expectancy, effort expectancy, facilitating conditions, and habit (Du et al., 2025; Zheng et al., 2025). Meanwhile,

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the DeLone & McLean Information System Success Model emphasizes system quality, information quality, user satisfaction, and system success as determinants of information system effectiveness (Ouajdouni et al., 2021; Sutiyono et al., 2024; Zhao & Sun, 2024). Although both models are widely used, most studies apply them separately, resulting in a fragmented understanding of e-learning success (Prasetyo et al., 2021).

Several recent studies have attempted to integrate UTAUT-based models with the DeLone & McLean framework. However, these studies primarily focus on behavioral intention, continuance intention, or user satisfaction as final outcomes, rather than examining e-learning success as a comprehensive institutional outcome (Al-Fraihat et al., 2020; Bayastura et al., 2022; Gondomulio & Suroso, 2023).

Empirical research that explicitly places system quality and information quality as endogenous outcomes of UTAUT2 behavioural constructs is still limited, especially in the context of higher education institutions in Indonesia (Bayastura et al., 2022). So, limited studies explain how behavioral acceptance factors are translated into perceived system quality and information quality before ultimately influencing e-learning success. This limitation creates a theoretical gap regarding the mechanism through which technology acceptance contributes to successful e-learning implementation in higher education environments.

Another important limitation is related to self-efficacy. Many previous studies position self-efficacy only as an external or control variable, even though students' confidence in using digital learning systems plays an important role in independent learning environments (Sutamrin & Khadijah, 2023; Zulherman et al., 2025). In higher education contexts, where students are expected to learn autonomously, self-efficacy should be understood as part of the core mechanism influencing user satisfaction and e-learning success. Therefore, a more comprehensive analytical framework is needed to capture the interaction between behavioural acceptance, perceived system quality, and actual e-learning success (Ayubi & Retnowardhani, 2025; Zheng et al., 2025).

This study addresses these limitations by integrating the UTAUT2 model and the DeLone & McLean Information System Success Model into a single analytical framework for evaluating e-learning success in higher education. The novelty of this research lies in positioning system quality, information quality, and self-efficacy as mediating constructs that connect behavioral acceptance factors with e-learning success through user satisfaction (Bayastura et al., 2022). Unlike previous studies that mainly focused on intention to use or satisfaction, this study empirically examines e-learning success as the final outcome of an integrated behavioral–technical model.

This research is important because higher education institutions increasingly depend on e-learning systems to maintain effective learning processes and academic services. Understanding the factors that influence e-learning success can help universities improve system quality, strengthen user satisfaction, and design more effective digital learning strategies. In practical terms, the findings are expected to provide insights for state universities in South Jakarta in improving LMS usability, information quality, system responsiveness, and student learning experiences. In theoretical terms, this study contributes to the development of integrated e-learning evaluation models by clarifying the relationship between technology acceptance, perceived quality, user satisfaction, and e-learning success.

Method

This study employed a quantitative research approach to examine the relationships among variables within the integrated UTAUT2 and DeLone & McLean Information System Success Model in evaluating e-learning success in higher education. Quantitative methods were chosen because they are capable of producing measurable, objective, and statistically testable findings, making them suitable for evaluating the acceptance and success factors of information systems (Marta et al., 2024).

Data were collected using a structured questionnaire distributed to active users of the state university e-learning system, consisting primarily of students who had experience using the Learning Management System (LMS) in academic activities. The research instrument was developed based on validated indicators adapted from previous studies related to system quality, information quality, self-efficacy, behavioral acceptance, user satisfaction, and e-learning success. All questionnaire items were measured using a five-point Likert scale ranging from strongly disagree to strongly agree. This approach was chosen to ensure that the participants or students possessed relevant experience and sufficient exposure to the system being evaluated.

The research design or research procedure ensures that each stage, from problem analysis and data collection to analysis results and conclusions, is carried out systematically and follows applicable scientific methodological principles.

Based on Figure 1, the research flow shows a systematic series of processes starting from problem analysis to drawing conclusions. The research began with a preliminary study through literature review and case studies related to the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) and DeLone & McLean models to build a framework and formulate hypotheses. Next, the research instruments were developed and tested before being used in data collection through questionnaires. The collected data were then processed and analysed using statistical tests, including external and internal model tests. The results of the analysis formed the basis for the preparation of the report, recommendations, and final conclusions of the research.

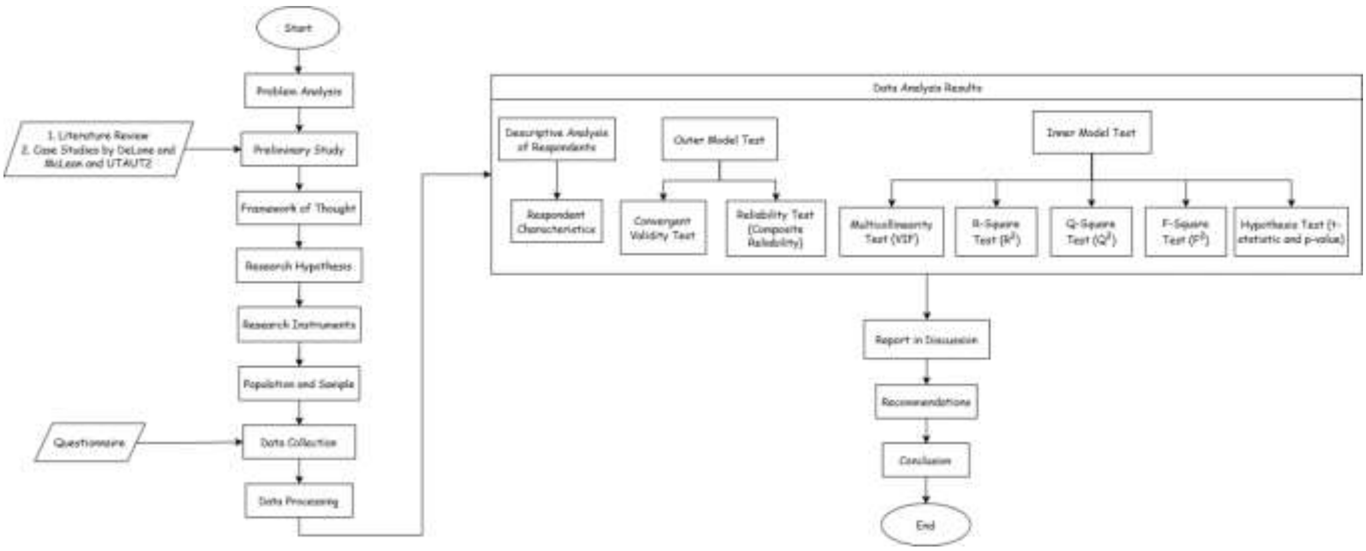

Figure 1. Research flow chart

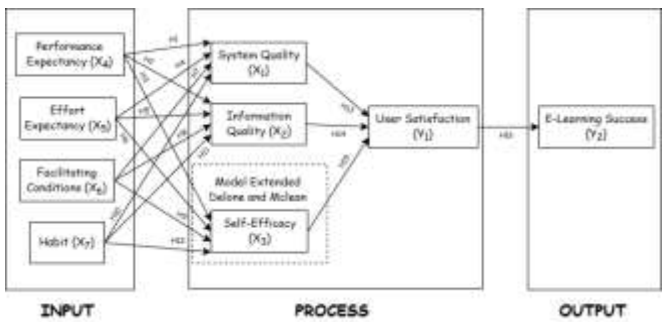

Figure 2. Proposed model

At the conceptual framework stage, it is necessary to systematically describe the relationships between research variables as a basis for developing testable hypotheses. Thus, this proposed thinking framework or model is a combination of the UTAUT2 technology acceptance model and DeLone & McLean's information system success model shown in Figure 2.

The integration of these two models is believed to provide a comprehensive understanding of user acceptance and the success of e-learning systems through the evaluation of technical and behavioural factors.

Research Instruments

Research instruments are used to systematically and validly collect data from respondents in order to measure research variables (Ardiansyah et al., 2023). The following is an overview of the instruments used in measuring research questionnaires.

Table 1. Measurement of the Research Questionnaire

Variable	Indicator	Reference
System Quality (X_1)	Reliability	(Efendi, 2020; Wirayuda, 2025)
	Ease of use	
	Response speed	
	Security	
	Flexibility	
Information Quality (X_2)	Accuracy	(Efendi, 2020; Wirayuda, 2025)
	Relevance	
	Timeliness	
	Completeness	
	Consistency	
Self-Efficacy (X_3)	Confidence in one's abilities	(Sutamrin & Khadijah, 2023)
	Problem solving in learning	

Variable	Indicator	Reference
Performance Expectancy (X_4)	Task execution Learning achievement targets Perceived usefulness Extrinsic motivation Outcome expectations Job-fit Relative advantage	(Wirayuda, 2025)
Effort Expectancy (X_5)	Perceived ease of use Complexity Ease of use	(Wirayuda, 2025)
Facilitating Conditions (X_6)	Perceived behavioral control Facilitating Conditions Compatibility	(Wirayuda, 2025)
Habit (X_7)	Prior use Addiction Behavior to be automatic	(Wirayuda, 2025)
User Satisfaction (Y_1)	Ease of information Efficiency Effectiveness Satisfaction Trust	(Achmadi & Oktrivina, 2021)
E-Learning Success (Y_2)	Organizational competitiveness System performance Knowledge improvement Positive impact on learning	(Ouajdouni et al., 2021)

Population and Sample

The population of this study consisted of 17.800 e-learning users at the university, including students, lecturers, and educational staff. The sample size was determined using the Slovin formula with a 7% margin of error, resulting in a minimum sample requirement that was fulfilled by 202 respondents. Purposive sampling was applied to ensure that respondents had sufficient experience and interaction with the e-learning system being evaluated. The Slovin formula is determined as follows:

$$s = \frac{N}{1+N(e)^2} \quad (1)$$

Explanation:
s = Number of samples
N = Population size
e = Known error tolerance level
After determining the Slovin formula, the number of samples used in this study is:

$$s = \frac{N}{1+N(e)^2} = \frac{17800}{1+17800(0.07)^2} = \frac{17800}{1+87{,}22} = \frac{17800}{88{,}22} = 202 \text{ people}$$

A 7% margin of error was selected to balance statistical adequacy and practical feasibility in collecting responses from active LMS users within the institutional setting. This level of precision is considered acceptable in exploratory and predictive studies employing PLS-SEM, particularly when the population characteristics are relatively homogeneous.

Data Analysis Results

The testing process for the results of this data analysis used the Partial Least Squares-Structural Equation Modelling (PLS-SEM) method with the assistance of SmartPLS 3 software, which consists of two main evaluations, namely the Outer Model and Inner Model evaluations (J. F. Hair et al., 2017). PLS-SEM was selected because it is suitable for predictive and exploratory research involving multiple latent constructs and complex structural relationships.

The basis for decision-making in the outer model test includes a convergent validity test, which is valid if the outer loading or loading factor value is ≥ 0.70 and the Average Variance Extracted (AVE) is ≥ 0.50, a discriminant validity test, which is valid if the indicator loading value for its own construct is higher than the loading for other constructs, and a reliability test, which is reliable if the Composite Reliability value is ≥ 0.70 and/or the Cronbach's Alpha value is ≥ 0.70 (Ghozali, 2021).

The basis for decision-making in the inner model test includes a multicollinearity test, which is valid or does not cause model problems if the Variance Inflation Factor (VIF) value is ≤ 5.00 (Sanjaya & Budiono, 2021), an r-square test, which is valid and classified as strongly predictive if the R^2 value is ≥ 0.75, the q-square test, which is valid and has predictive relevance if the Q^2 value is > 0 (Ghozali, 2021), the f-square test, which is valid and has a significant influence if the f^2 value is ≥ 0.35, and the hypothesis test, which is valid and accepted because of the influence between variables and is significant if the t-statistic value is ≥ 1.96 (5% significance level) or the p-value is ≤ 0.05 (Rahadi, 2023).

Furthermore, to assess the potential presence of Common Method Bias (CMB), this study employed Harman's Single-Factor Test, which is commonly used in survey-based research where data are collected from a single source at one point in time. The results indicated that the largest single factor accounted for less than 50% of the total variance, suggesting that no single factor dominated the covariance among the measures (Hasan & Elviana, 2023; Kock, 2021; Usmanova et al., 2020). Therefore, common method bias was not considered a serious concern in this study, and the findings were not significantly affected by common method variance.

Result and Discussion

Descriptive Analysis of Respondents

The respondents in this study were 202 e-learning users in South Jakarta, consisting of students and lecturers. Actually, the 202 respondents were intended to be students who were users of e-learning. The data was collected through questionnaires and demographic data such as gender, faculty, and cohort was obtained. Here are the results of the respondent data graph.

Table 2. Respondent Data Results

	Frequency	Percentage (%)
Gender		
Male	114	56.44
Female	88	43.56
Quantity	202	100
Faculty		
Economics and Business	23	11.39
Engineering	35	17.33
Computer Science	85	42.08
Law	17	8.42
Social Sciences and Political Science	25	12.38
Health Sciences	10	4.95
Medicine	7	3.47
Quantity	202	100
Cohort		
2021	4	1.98
2022	26	12.87
2023	41	20.30
2024	45	22.28
2025	86	42.57
Quantity	202	100

Of the 202 respondents, 56.44% were male and 43.56% were female, indicating a relatively proportional gender distribution, minimizing potential gender bias. However, institutionally, respondents were predominantly students from the Faculty of Computer Science (42.08%), followed by the Faculty of Engineering (17.33%) and Economics and Business (11.39%). This predominance of technology-based backgrounds indicates that perceptions of e-learning are likely influenced by higher levels of digital literacy compared to non-technology faculties.

Descriptive Analysis of Limitations

The use of a purposive sampling approach resulted in an overrepresentation of respondents from the Faculty of Computer Science (42.08%) and students from the most recent academic cohort (42.57% from the 2025 cohort). While these groups are among the most active users of the e-learning system, such concentration may introduce sampling bias and potentially limit the generalizability of the findings to other faculties and senior cohorts. Future studies are encouraged to employ more balanced sampling strategies, such as stratified purposive sampling or proportional sampling across faculties and academic cohorts, to enhance representativeness and strengthen the external validity of the results.

Common Method Bias (CMB) Test

The Common Method Bias test is a test used to detect measurement bias due to the use of the same data sources and collection methods. This Common Method Bias test was examined using Harman's single factor test by entering all measurement items into an unrotated exploratory factor analysis or displaying them with an Unrotated Factor Solution. The following are the results of the common method bias test in Figure 3.

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	28.358	38.322	38.322	28.358	38.322	38.322
2	2.470	3.337	41.659	2.470	3.337	41.659
3	2.314	3.127	44.786	2.314	3.127	44.786

Figure 3. Common method bias (CMB) test results

Based on the figure above, the test results using SPSS software, not SmartPLS, were able to determine the proportion of variance in respondent data collected in a credible study. The results showed that the first factor only explained 38.322% of the total variance, which is below the 50% threshold. Harman's Single-Factor Test showed that the first factor explained less than 50% of the total variance, indicating that common method bias was not a significant concern in this study.

Outer Model Test Results

The Outer Model test in SmartPLS is used to determine the validity and reliability of indicators in forming research constructs, thereby ensuring that measurement quality has been met (J. Hair et al., 2017).

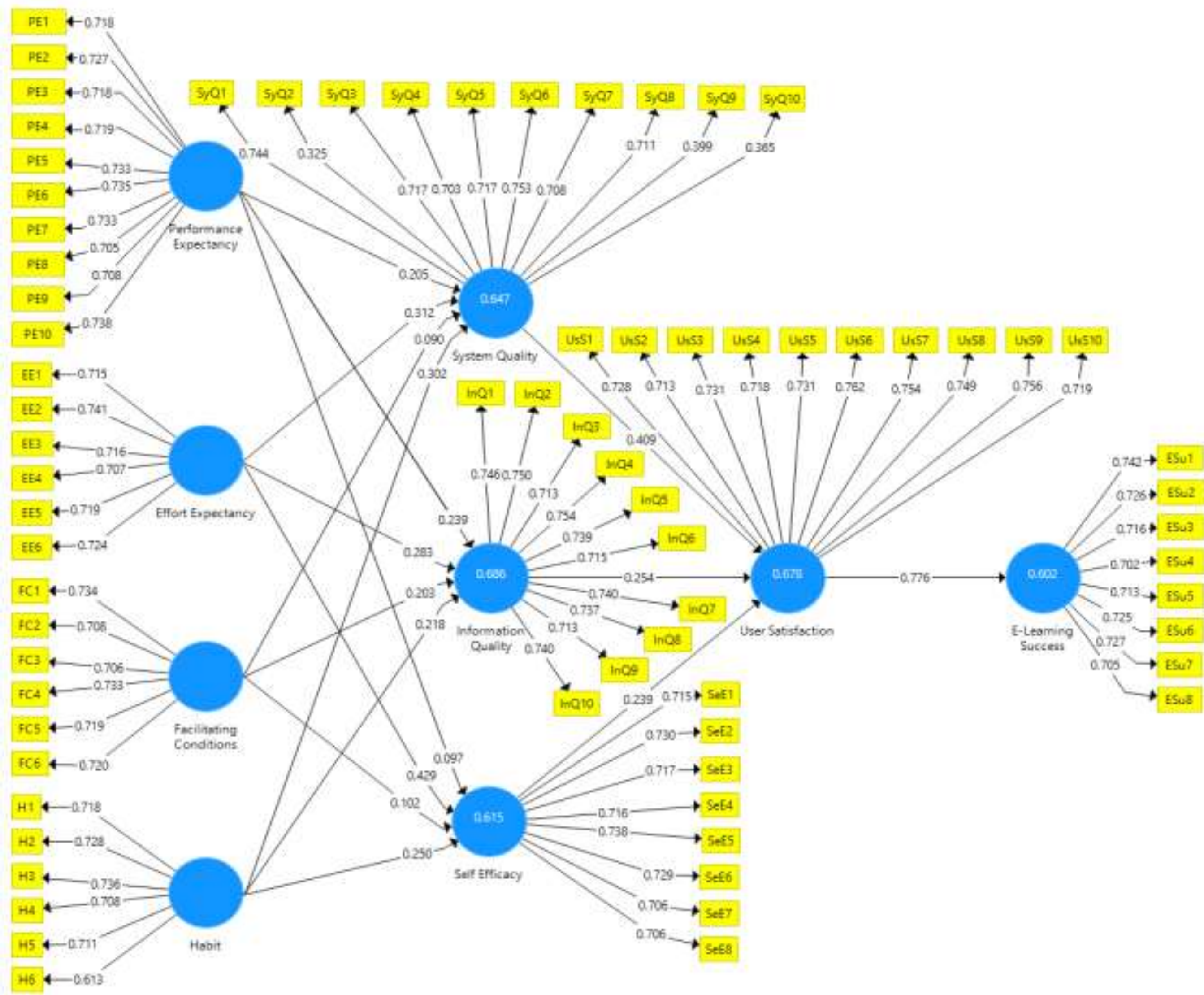

Figure 4. Outer model test results

Based on Figure 4, it shows that all constructs in the PLS-SEM or SmartPLS model have indicators with adequate loading values and clear structural relationships. The R-square values for System Quality, Information Quality, User Satisfaction, and E-Learning Success indicate that the model has strong predictive power, so that the integration of UTAUT2 and DeLone and McLean is considered feasible for measuring the effectiveness of e-learning.

However, there are several indicators that do not meet the test criteria, namely when the outer loading value is ≥ 0.70 and the Average Variance Extracted (AVE) is ≥ 0.50. These values are considered invalid as aspects of measuring the effectiveness of information systems. The following is the model design after the model indicators have been removed.

It turns out that there are four indicators that do not meet the outer loading value requirement of ≥ 0.70, namely H6, SyQ2, SyQ9, and SyQ10. These indicators show a weak contribution in representing the latent construct, thus potentially reducing convergent validity and measurement accuracy. Therefore, these indicators were eliminated to improve the quality of the overall measurement model. This process strengthens the Average Variance Extracted (AVE) value and internal reliability of the construct without changing its theoretical meaning. After that, the results of the convergent validity test and the reliability test are continued in the table 3.

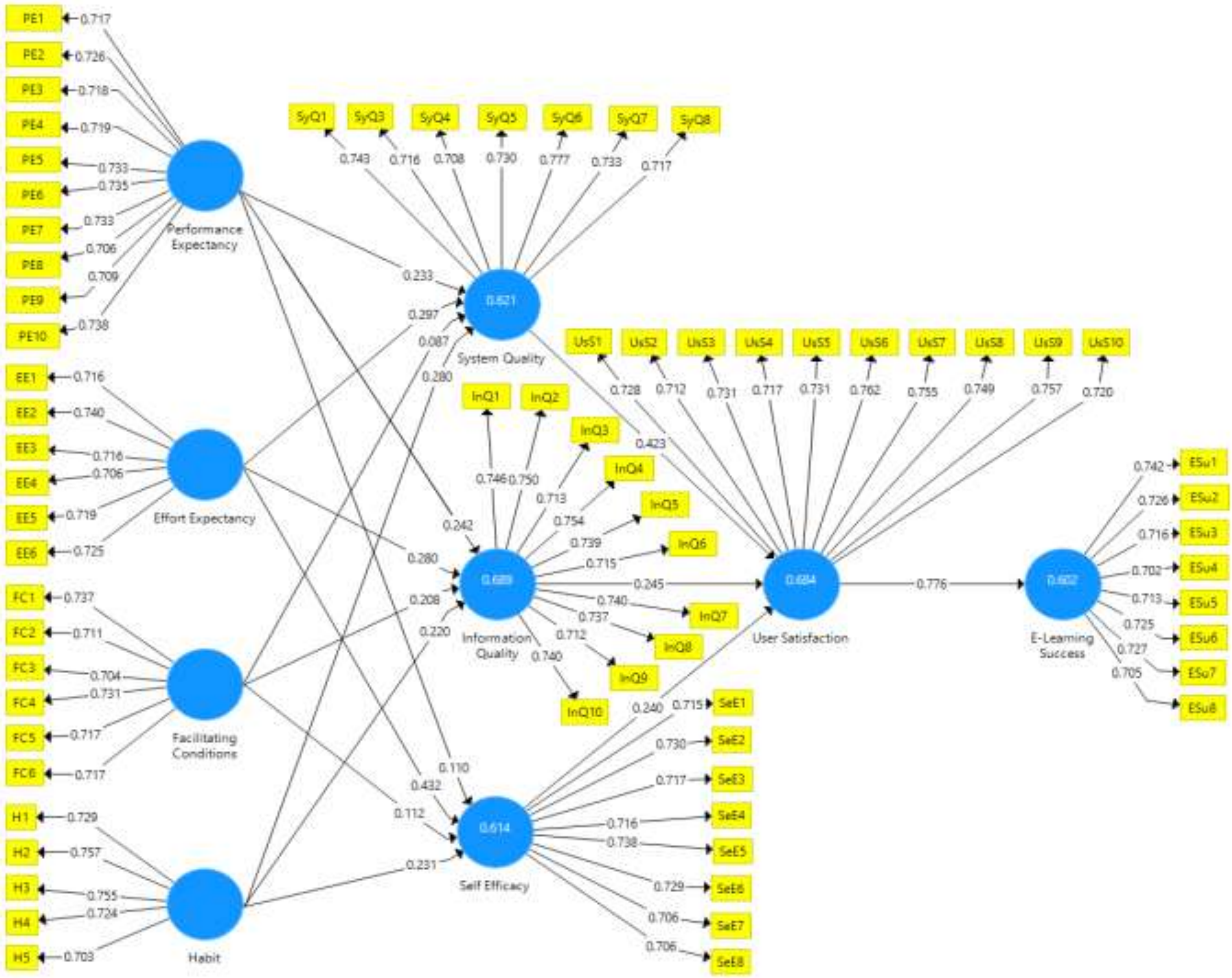

Figure 5. Latest outer model test results after model removal

Table 3. Results of Convergent Validity Test and Reliability Test with Outer Model Test

Indicator	Outer Loading Value	AVE Value	Cronbach's Alpha	Composite Reliability	Conclusion
PE1	0.717	0.523	0.899	0.917	Valid & Reliable
PE2	0.726				
PE3	0.718				
PE4	0.719				
PE5	0.733				
PE6	0.735				
PE7	0.733				
PE8	0.706				
PE9	0.709				
PE10	0.738				
EE1	0.716	0.519	0.816	0.866	Valid & Reliable
EE2	0.740				
EE3	0.716				
EE4	0.706				
EE5	0.719				
EE6	0.725				
FC1	0.737	0.518	0.815	0.866	Valid & Reliable
FC2	0.711				
FC3	0.704				

Indicator	Outer Loading Value	AVE Value	Cronbach's Alpha	Composite Reliability	Conclusion
FC4	0.731				
FC5	0.717				
FC6	0.717				
H1	0.729	0.539	0.786	0.854	Valid & Reliable
H2	0.757				
H3	0.755				
H4	0.724				
H5	0.703				
SyQ1	0.743	0.536	0.856	0.890	Valid & Reliable
SyQ3	0.716				
SyQ4	0.708				
SyQ5	0.730				
SyQ6	0.777				
SyQ7	0.733				
SyQ8	0.717				
InQ1	0.746	0.540	0.905	0.921	Valid & Reliable
InQ2	0.750				
InQ3	0.713				
InQ4	0.754				
InQ5	0.739				
InQ6	0.715				
InQ7	0.740				
InQ8	0.737				
InQ9	0.712				
InQ10	0.740				
SeE1	0.715	0.518	0.867	0.896	Valid & Reliable
SeE2	0.730				
SeE3	0.717				
SeE4	0.716				
SeE5	0.738				
SeE6	0.729				
SeE7	0.706				
SeE8	0.706				
UsS1	0.728	0.542	0.906	0.922	Valid & Reliable
UsS2	0.712				
UsS3	0.731				
UsS4	0.717				
UsS5	0.731				
UsS6	0.762				
UsS7	0.755				
UsS8	0.749				
UsS9	0.757				
UsS10	0.720				
ESu1	0.742	0.518	0.867	0.896	Valid & Reliable
ESu2	0.726				
ESu3	0.716				
ESu4	0.702				
ESu5	0.713				
ESu6	0.725				
ESu7	0.727				
ESu8	0.705				

Based on the visualization of the constructed model, all indicators achieved outer loading values above the recommended threshold of 0.70, indicating adequate convergent validity. In addition, all constructs obtained AVE values above 0.50 and Composite Reliability as well as Cronbach's Alpha values above 0.70, confirming good construct validity and internal consistency reliability.

Table 4. Discriminant Validity Test Results

Variable	ESu	EE	FC	H	InQ	PE	SeE	SyQ	UsS
E-Learning Success (ESu)	0.720								
Effort Expectancy (EE)	0.733	0.720							
Facilitating Conditions (FC)	0.697	0.708	0.720						
Habit (H)	0.739	0.648	0.636	0.734					
Information Quality (InQ)	0.745	0.741	0.712	0.705	0.735				
Performance Expectancy (PE)	0.793	0.705	0.686	0.705	0.738	0.723			
Self-Efficacy (SeE)	0.682	0.738	0.639	0.659	0.732	0.654	0.720		
System Quality (SyQ)	0.672	0.704	0.635	0.692	0.781	0.699	0.686	0.732	
User Satisfaction (UsS)	0.776	0.725	0.714	0.730	0.751	0.786	0.710	0.779	0.736

Based on the results of this test, each construct using the Fornell–Larcker Criterion showed a higher AVE square root value compared to the correlation values between other constructs. This indicates that all variables in the model have met the discriminant validity criteria, are considered valid, and are able to empirically distinguish constructs well.

Inner Model Test Results

The Inner Model test in SmartPLS is used to determine the strength of the relationship between latent variables, the value of determination, and the significance of influence so that the quality and suitability of the research structural model can be assessed comprehensively in supporting empirical analysis results (Setiabudhi et al., 2025).

Table 5. Multicollinearity Test Results

Hypothesis	Value	Description
H1 = PE → SyQ	2.711	No Multicollinearity
H2 = PE → InQ		
H3 = PE → SeE		
H4 = EE → SyQ	2.552	No Multicollinearity
H5 = EE → InQ		
H6 = EE → SeE		
H7 = FC → SyQ	2.415	No Multicollinearity
H8 = FC → InQ		
H9 = FC → SeE		
H10 = H → SyQ	2.270	No Multicollinearity
H11 = H → InQ		
H12 = H → SeE		
H13 = SyQ → UsS	2.767	No Multicollinearity
H14 = InQ → UsS	3.156	
H15 = SeE → UsS	2.323	
H16 = UsS → ESu	1.000	No Multicollinearity

Based on the results of this test, all Variance Inflation Factor (VIF) values in the relationship between constructs are below the threshold of 5, so that no multicollinearity is found in each predictor. Thus, all hypotheses in the inner model meet the eligibility criteria and can be further analysed in the structural model.

Table 6. F-Square Test Results

Hypothesis	Value	Description
H1 = PE → SyQ	0.053	Minor Influence
H2 = PE → InQ	0.070	Minor Influence
H3 = PE → SeE	0.012	Very Minor Influence
H4 = EE → SyQ	0.091	Minor Influence
H5 = EE → InQ	0.099	Minor Influence
H6 = EE → SeE	0.189	Moderate Influence
H7 = FC → SyQ	0.008	Very Minor Influence
H8 = FC → InQ	0.058	Minor Influence
H9 = FC → SeE	0.013	Very Minor Influence
H10 = H → SyQ	0.091	Minor Influence
H11 = H → InQ	0.069	Minor Influence
H12 = H → SeE	0.061	Minor Influence
H13 = SyQ → UsS	0.204	Moderate Influence
H14 = InQ → UsS	0.060	Minor Influence
H15 = SeE → UsS	0.078	Minor Influence
H16 = UsS → ESu	1.511	Significant Influence

Based on the results of this test, it appears that most of the relationships between variables show very small to moderate effects. The greatest effect was found in the relationship between User Satisfaction and E-Learning Success, which showed a significant effect. These findings confirm that user satisfaction is a key factor in determining the success of e-learning implementation in this research model.

Table 7. Inner Model Test Results and Effect Size Interpretation

Variable	R-Square	R-Square Adjusted	Description	Q-Square	Description	Key Predictors	f^2 Range	Interpretation
System Quality	0.621	0.613	Moderate	0.321	Relevant	PE, EE, FC, H	0.008 – 0.091	Small effects; quality perceptions are shaped incrementally by behavioral factors
Information Quality	0.689	0.683	Moderate	0.363	Relevant	PE, EE, FC, H	0.058 – 0.099	Small but meaningful effects indicating

Variable	R-Square	R-Square Adjusted	Description	Q-Square	Description	Key Predictors	f^2 Range	Interpretation
								cumulative influence of acceptance variables
Self-Efficacy	0.614	0.606	Moderate	0.309	Relevant	PE, EE, FC, H	0.012 – 0.189	Small to moderate effects; strongest contribution from effort expectancy
User Satisfaction	0.684	0.679	Moderate	0.362	Relevant	SyQ, InQ, SeE	0.060 – 0.204	Moderate effect of system quality; satisfaction driven primarily by perceived quality
E-Learning Success	0.602	0.600	Moderate	0.301	Relevant	UsS	1.511	Very large effect; user satisfaction is the dominant determinant of success

Based on the combined results of this test, the structural model shows adequate explanatory and predictive capabilities, indicated by moderate R^2 values and positive Q^2 for all endogenous constructs. Effect size (f^2) analysis clarifies the practical significance of the relationships between variables, where most behavioral constructs have small to moderate effects on system quality, information quality, and self-efficacy, indicating gradual but meaningful contributions. In contrast, the path from User Satisfaction to E-Learning Success shows a very large effect size (f^2 = 1.511), confirming that user satisfaction is a major determinant of e-learning success, not merely an intermediary variable.

Table 8. Results of Hypothesis Testing or Path Coefficient Testing on the UTAUT2 and DeLone & McLean Models

Hypothesis	Variable or Path Coefficient	Original Sample (O)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	Description
H1	PE → SyQ	0.233	0.085	2.754	0.006	Accepted
H2	PE → InQ	0.242	0.070	3.469	0.001	Accepted
H3	PE → SeE	0.110	0.081	1.356	0.175	Rejected
H4	EE → SyQ	0.297	0.087	3.398	0.001	Accepted
H5	EE → InQ	0.280	0.089	3.158	0.002	Accepted
H6	EE → SeE	0.432	0.079	5.429	0.000	Accepted
H7	FC → SyQ	0.087	0.109	0.797	0.425	Rejected
H8	FC → InQ	0.208	0.067	3.115	0.002	Accepted
H9	FC → SeE	0.112	0.094	1.195	0.232	Rejected
H10	H → SyQ	0.280	0.064	4.400	0.000	Accepted
H11	H → InQ	0.220	0.054	4.100	0.000	Accepted
H12	H → SeE	0.231	0.058	3.956	0.000	Accepted
H13	SyQ → UsS	0.423	0.078	5.416	0.000	Accepted
H14	InQ → UsS	0.245	0.097	2.542	0.011	Accepted
H15	SeE → UsS	0.240	0.086	2.783	0.005	Accepted
H16	UsS → ESu	0.776	0.033	23.863	0.000	Accepted

Discussion

The results of the research hypothesis are results that show whether or not there is a significant influence between the constructs in the model, based on the path coefficient value, t-statistic, and p-value, thereby validating the theoretical relationship tested in the study (Suryanto, 2022).

From the results of calculations conducted using the PLS-SEM or SmartPLS method with Bootstrapping, it was found that most hypothesized relationships were significant, except for H3, H7, and H9, which showed positive but insignificant effects within the integrated e-learning success model. The following is an overview of the results of each hypothesis test based on the interpretive analysis of the e-learning information system.

H1 (Performance Expectancy → System Quality)

Performance expectancy was found to improve students' perceptions of system quality, indicating that users who perceive the LMS as useful also tend to evaluate the system as more reliable, effective, and supportive of academic activities (Susanto, 2019).

H2 (Performance Expectancy → Information Quality)

Performance expectancy positively contributed to information quality, suggesting that students who recognize the benefits of the LMS are more likely to perceive the learning information as relevant, accurate, and useful for supporting their learning process.

H3 (Performance Expectancy → Self-Efficacy)

Performance expectancy did not substantially strengthen students' self-efficacy, indicating that confidence in using the LMS is influenced more by direct experience and familiarity with system interaction rather than perceived usefulness alone (Udin et al., 2022; Yani et al., 2024).

H4 (Effort Expectancy → System Quality)

Ease of use contributed positively to system quality perceptions, demonstrating that students tend to evaluate the LMS more favorably when the system is simple to operate and requires minimal effort during academic activities.

H5 (Effort Expectancy → Information Quality)

Effort expectancy positively influenced information quality, suggesting that accessible and user-friendly systems help students obtain and understand learning information more effectively.

H6 (Effort Expectancy → Self-Efficacy)

The ease of interacting with the LMS strengthened students' confidence in operating the system independently. This finding indicates that intuitive system design supports the development of user self-efficacy in digital learning environments (Udin et al., 2022).

H7 (Facilitating Conditions → System Quality)

Facilitating conditions did not significantly strengthen perceptions of system quality, suggesting that infrastructure availability alone is insufficient to improve users' evaluations of the LMS without consistent usability, interface quality, and positive interaction experiences.

H8 (Facilitating Conditions → Information Quality)

Technical support and infrastructure availability positively contributed to information quality, indicating that adequate facilities help students access learning information more efficiently and consistently.

H9 (Facilitating Conditions → Self-Efficacy)

Facilitating conditions showed limited influence on self-efficacy, implying that students' confidence in using the LMS is shaped more strongly by direct learning experiences and habitual interaction than by infrastructure support alone.

H10 (Habit → System Quality)

Habit positively strengthened system quality perceptions, demonstrating that repeated use of the LMS increases students' familiarity with system features and contributes to more positive evaluations of system performance.

H11 (Habit → Information Quality)

Frequent interaction with the LMS improved perceptions of information quality, indicating that students who routinely use the system are more likely to perceive learning information as understandable, useful, and accessible.

H12 (Habit → Self-Efficacy)

Habit significantly enhanced self-efficacy, suggesting that continuous LMS usage strengthens students' confidence and ability to independently operate digital learning systems.

H13 (System Quality → User Satisfaction)

System quality emerged as a strong determinant of user satisfaction, indicating that responsive features, reliable performance, and user-friendly interfaces play important roles in creating positive e-learning experiences (Anggraeni et al., 2026; Prantiastio et al., 2023; Prastio et al., 2024).

H14 (Information Quality → User Satisfaction)

Information quality positively influenced user satisfaction, suggesting that accurate, relevant, and well-structured learning information enhances students' overall satisfaction with the LMS (Bayastura et al., 2022; Prastio et al., 2024).

H15 (Self-Efficacy → User Satisfaction)

Students with stronger self-efficacy tended to experience higher levels of satisfaction, indicating that confidence in operating the LMS supports more positive perceptions of the overall e-learning experience (Widyaningrum et al., 2024).

H16 (User Satisfaction → E-Learning Success)

User satisfaction became the strongest predictor of e-learning success, demonstrating that successful LMS implementation depends heavily on positive learning experiences, perceived usefulness, and overall satisfaction with the digital learning environment (Al-Fraihat et al., 2020; Novianti, 2019; Rabih & Yammine, 2025).

This study provides a deeper understanding of e-learning system success by integrating behavioral acceptance factors with system success dimensions. Overall, the results indicate that behavioral constructs do not directly drive satisfaction or system success but instead operate indirectly through users' perceptions of system quality and information quality. This confirms that in institutional e-learning contexts, particularly in higher education, perceived quality functions as a key transmission mechanism between technology acceptance and achieved system success.

Discussion of Rejected Hypotheses

Several hypothesized relationships were found to be non-significant and therefore require critical discussion. First, the effect of Performance Expectancy on Self-Efficacy (H3) was positive but not significant. In terms of effectiveness of information systems, the perception of an e-learning system as useful does not necessarily enhance students' confidence in their ability to use it effectively. In mandatory or semi-mandatory learning environments, such as the use of LMS in higher education, students may acknowledge the benefits of the system while still feeling uncertain about their competencies, particularly when learning tasks demand higher levels of autonomy and self-regulation. These results contradict with Mensah et al. (2022) who stated that performance expectancy positively influences self-efficacy, as the perceived usefulness of technology can increase an individual's confidence in using it effectively. However, in the context of mandatory e-learning, perceived system usefulness does not automatically shape user confidence, as self-efficacy is more determined by direct experience, training, and adequate learning support.

The insignificant relationship between performance expectancy and self-efficacy suggests that students' confidence in using the e-learning system is not primarily shaped by perceived usefulness. Instead, self-efficacy appears to be more strongly influenced by direct experience, familiarity with system features, and repeated interaction with the LMS environment. This finding reflects the characteristics of higher education e-learning systems, where students may recognize the usefulness of the platform while still experiencing uncertainty in operating it independently.

Second, the effects of Facilitating Conditions on System Quality (H7) and Self-Efficacy (H9) were positive but not significant. In terms of effectiveness of information systems, this indicates that the availability of infrastructure and technical support does not automatically translate into better perceived system quality or increased user confidence. This may reflect a mismatch between institutional support and users' actual needs. Although infrastructure is available, its effectiveness depends largely on system design, usability, and the adequacy of user guidance. Without targeted training and intuitive interface design, facilitating conditions tend to function as background enablers rather than as primary determinants of perceived quality or user confidence. These findings emphasize that technical readiness alone is insufficient unless accompanied by pedagogical and design-oriented interventions.

These results align with Chu et al. (2025) who stated that facilitating conditions have a positive but insignificant effect on self-efficacy through blended learning-based technical support and resources. However, based on the research hypothesis, the availability of facilities does not directly increase student self-efficacy without adequate experience using and interacting with the system.

Meanwhile, these results align with Sari et al. (2025) who stated that facilitating conditions have a significant positive and indirect effect on system quality through infrastructure and technical support. In the context of e-learning, the availability of facilities alone is not enough to shape perceptions of system quality without the support of interface design, system stability, and a consistent user experience.

Therefore, the insignificant effect of facilitating conditions on system quality and self-efficacy indicates that infrastructure availability alone does not automatically improve users' perceptions or confidence in using the LMS. In the context of higher education, the LMS operates as a standardized institutional system that is already routinely accessible to students. As a result, technical facilities may be perceived as basic requirements rather than factors that directly enhance learning experiences or user confidence.

Theoretical Implications

From a theoretical perspective, this study extends UTAUT2 by demonstrating that, within educational contexts, behavioral factors primarily influence outcomes through quality perceptions rather than exerting direct effects on user satisfaction or system success. The findings support a two-stage mechanism in which behavioral acceptance shapes users' evaluations of system quality and information quality, which subsequently influence user satisfaction and ultimately e-learning success. This sequential process begins with acceptance → perceived quality → satisfaction → success. Such a process provides a more nuanced explanation of how e-learning technology acceptance can be translated into meaningful system success and highlights which aspects should be emphasized in terms of both system functionality and technical performance.

Furthermore, by positioning self-efficacy as an endogenous construct rather than merely as a control variable, this study enhances the explanatory power of integrated acceptance–success models. The results indicate that self-efficacy plays a selective role, being more strongly influenced by usage experiences and system design factors than by general perceptions of usefulness or infrastructure availability. This contributes to the refinement of e-learning evaluation frameworks by emphasizing the importance of users' psychological readiness alongside the technical quality of the system.

Practical Implications

The findings of this study provide several actionable practical implications for higher education institutions. Rather than broadly aiming to "improve system quality," institutions, including PQR University in South Jakarta, should prioritize specific system quality indicators, particularly response speed, interface consistency, and system reliability, which were found to significantly influence user satisfaction. Optimizing server performance to reduce loading times and ensuring consistent navigation across all LMS modules can substantially enhance students' quality perceptions.

In addition, institutions should invest in user-centered system design and targeted training programs to strengthen self-efficacy. Short, task-oriented tutorials and embedded guidance features within the system are considered more effective in building user confidence than general technical support. Therefore, facilitating conditions should be reconceptualized not merely as infrastructure provision but as a combination of technical, instructional, and system design support.

Finally, policymakers and academic administrators should recognize that improving e-learning success requires aligning strategies to enhance behavioral acceptance with concrete improvements in system quality. Efforts to promote technology adoption will be less effective if not accompanied by enhancements in system responsiveness, information clarity, and usability.

Limitations and Future Research

Several limitations should be acknowledged. First, the cross-sectional design restricts causal inference; future longitudinal studies could better capture changes in acceptance, quality perception, and satisfaction over time. Second, the reliance on self-reported data may introduce social desirability bias, potentially inflating perceived acceptance levels. Third, the sample was skewed toward IT-savvy students, which may overestimate overall acceptance and system evaluation. Fourth, data were collected from a single institution, limiting the generalizability of the findings across diverse Indonesian higher education contexts. Finally, context-specific factors such as pandemic-related learning conditions and institutional policies were not explicitly controlled. Future research should address these limitations by employing multi-institutional samples, mixed-method approaches, and longitudinal designs to further validate and extend the proposed model.

Conclusion

This study demonstrates that the integration of the UTAUT2 and DeLone & McLean Information System Success Model provides a comprehensive framework for explaining e-learning success in higher education. The findings confirm that Performance Expectancy positively and significantly influences System Quality and Information Quality. However, Performance Expectancy showed a positive but insignificant effect on Self-Efficacy. Then, Effort Expectancy positively and significantly influences System Quality, Information Quality, and Self-Efficacy. Facilitating Conditions positively and significantly influence Information Quality. However, Facilitating Conditions showed a positive but insignificant effect on System Quality and Self-Efficacy. And the last, Habit positively and significantly influences System Quality, Information Quality, and Self-Efficacy. Next, System Quality, Information Quality, and Self-Efficacy positively and significantly influence User Satisfaction, while User Satisfaction emerges as the strongest determinant of E-Learning Success. Theoretically, this study extends previous e-learning success research by integrating behavioral acceptance and information system success perspectives into a unified explanatory model. Unlike prior studies that primarily focused on behavioral intention or technology adoption, this research demonstrates how behavioral acceptance factors are translated into e-learning success through perceived quality and satisfaction mechanisms. But practically, the findings suggest that higher education institutions should not only focus on providing technical infrastructure but also prioritize system usability, interface consistency, information clarity, and user-centered learning support.

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Author Contributions

Conceptualization, data collection, formal analysis, methodology, software, writing – original draft preparation, visualization, T. I. A.; conceptualization, methodology, supervision, writing—review and editing, D. M. K. N.; supervision, writing—review and editing, C. E. W. All authors

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