Bulletin of Electrical Engineering and Informatics
Vol. 15, No. 4, August 2026, pp. 3532~3545
ISSN: 2302-9285, DOI: 10.11591/eei.v15i4.10160

Optimizing academic information systems: linking interface design with user satisfaction and loyalty

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Article Info

Article history:

Received Feb 26, 2025
Revised Jun 15, 2026
Accepted Jul 14, 2026

Keywords:

Academic information system
Interface design
Partial least squares structural equation modeling
User loyalty
User satisfaction

ABSTRACT

Academic information systems (AIS) play a crucial role in supporting academic and administrative processes in higher education institutions. Despite their widespread adoption, sustained user engagement remains a challenge, often linked to usability and system responsiveness issues. This study integrates the technology acceptance model (TAM) with experiential interface dimensions visual quality (VQ) and user interface responsiveness (UIR) to examine their influence on user satisfaction (US) and loyalty within AIS environments. Data were collected from 432 active AIS users across 12 Indonesian universities and analyzed using partial least squares structural equation modeling (PLS-SEM). The results indicate that perceived ease of use (PEOU) and perceived usefulness significantly enhance US, which in turn strongly predicts user loyalty (UL). System responsiveness demonstrates a substantial influence on perceived usability, while usability exerts both direct and indirect effects on long-term user commitment. Although VQ contributes positively to usability perceptions and satisfaction, its direct role in sustaining loyalty is comparatively limited. Importance-performance map analysis (IPMA) further identifies PEOU and UIR as the most strategic priorities for improving long-term engagement. By extending TAM with experiential interface factors, this study offers a more comprehensive framework for understanding AIS adoption and provides practical guidance for designing user-centered, performance-driven AIS.

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1. INTRODUCTION

The rapid advancement of digital technology has significantly transformed the educational sector, particularly through the implementation of academic information systems (AIS). These systems facilitate academic and administrative processes such as student registration, course management, academic performance evaluation, and institutional reporting, thereby enhancing institutional efficiency, and user convenience [1]. By functioning as an integrated platform that connects students, faculty, and administrative personnel, AIS supports improved decision-making, resource allocation, and internal communication [2]. Despite these benefits, higher education institutions particularly in developing countries such as Indonesia continue to encounter persistent challenges in AIS adoption. User dissatisfaction and low sustained engagement remain prevalent, suggesting that many AIS implementations fail to meet user expectations [3], [4]. Empirical evidence indicates that poor interface design, slow system responsiveness, and limited user engagement are among the primary barriers to successful AIS adoption [5], [6]. These limitations often undermine user trust

and reduce long-term system usage [7], [8]. Furthermore, misalignment between system features and user expectations may lead users to perceive AIS as complex, unintuitive, or insufficient for supporting academic workflows [9], [10].

Although enterprise resource planning (ERP) systems integrated with artificial intelligence (AI) have been widely adopted to optimize organizational processes such as finance, logistics, and human resource management, AIS operates in a distinct context. Unlike ERP systems that emphasize cross-functional business integration, AIS primarily supports student-facing academic services, course administration, and learning-related activities. Consequently, AIS requires higher levels of usability, personalization, and interface responsiveness to accommodate the dynamic and interaction-intensive nature of academic users. While AI-driven functionalities such as predictive analytics and academic advising represent future development directions, the present study focuses on usability dimensions within existing non-AI-driven AIS environments. Establishing this distinction clarifies why interface-related factors may exert a more pronounced influence in AIS compared to traditional ERP contexts. Research on information system adoption has predominantly relied on theoretical frameworks such as the technology acceptance model (TAM) and the information system success model (ISSM) [11], [12]. TAM, introduced by Davis and Davis [6], posits that perceived ease of use (PEOU) and perceived usefulness (PU) determine user acceptance and has been extensively validated across educational, healthcare, and business domains [13], [14]. Meanwhile, the ISSM by DeLone and McLean [7] evaluates system success through system quality, information quality, and service quality dimensions. Although these models provide strong theoretical foundations, they primarily emphasize cognitive and functional determinants of adoption. As noted in prior studies, aesthetic and performance-related attributes that shape user experience are often underrepresented within TAM-based frameworks [15].

A critical gap in AIS adoption research therefore lies in the limited integration of experiential factors particularly visual quality (VQ) and user interface responsiveness (UIR) into established acceptance models [1]. VQ encompasses interface aesthetics, color harmony, and layout structure that influence perceived usability and user trust [16], [17]. Well-designed interfaces enhance satisfaction by creating intuitive and engaging digital interactions [18], whereas poorly structured systems may trigger cognitive overload and frustration [19]. Similarly, UIR, including system speed, interactive efficiency, and real-time feedback, plays a pivotal role in sustaining user engagement [20], [21]. Systems characterized by latency and delayed responses frequently generate negative user perceptions and diminished trust. Despite their significance in human computer interaction research, VQ and UIR have rarely been systematically embedded within TAM-based AIS adoption models, limiting explanatory power regarding satisfaction and loyalty outcomes [22].

To address this limitation, this study extends the TAM framework by incorporating selected quality dimensions inspired by SERVQUAL, thereby providing a more comprehensive understanding of user satisfaction (US) and loyalty in AIS contexts [23]. While TAM captures cognitive evaluations through PEOU and PU, integrating VQ and UIR enables the model to account for experiential attributes influencing user perceptions. Empirical validation of these constructs is essential, as prior investigations have often relied on qualitative observations rather than rigorous quantitative modeling [24]. In addition, this research introduces user loyalty (UL) as a post-adoption outcome variable, encompassing continued use, advocacy, and recommendation behaviors [25]. Unlike satisfaction alone, loyalty reflects trust, emotional attachment, and sustained engagement with the system [26]. Understanding loyalty is increasingly important for ensuring long-term AIS sustainability in digitally transforming institutions [27]. Beyond its theoretical contribution, this study offers practical implications for AIS developers and institutional decision-makers seeking to design user-centered academic systems aligned with evolving expectations. Empirical evidence regarding the influence of interface aesthetics and responsiveness can inform strategic improvements that enhance engagement and trust. Furthermore, emerging technologies such as AI and blockchain present opportunities to complement usability improvements. AI-driven personalization may provide adaptive recommendations and automated support, while blockchain can enhance transparency and transactional security within academic processes [28]. By integrating cognitive and experiential perspectives, this study contributes to advancing AIS adoption research and supports the development of systems that promote sustainable user engagement.

2. METHOD

2.1. Research design

This study employs a quantitative approach using partial least squares structural equation modeling (PLS-SEM) with SmartPLS 4.0 to examine the structural relationships among the constructs in the proposed research framework. The model integrates the TAM with selected service quality dimensions derived from SERVQUAL to evaluate user perceptions and post-adoption behavior of AIS in higher education institutions.

To ensure accurate representation of user perceptions, purposive sampling was applied, targeting individuals who had actively used the AIS for at least one academic semester. This criterion ensured that respondents possessed sufficient experience to provide informed evaluations of the system. Data were collected

through a structured survey instrument adapted from validated prior studies. Preliminary statistical assessments indicated non-normal data distribution based on the Kolmogorov-Smirnov test. Accordingly, PLS-SEM was selected as the analytical method due to its robustness in handling complex models and non-normally distributed data. This approach enables the simultaneous assessment of measurement reliability and structural relationships while emphasizing predictive accuracy and variance explanation.

2.2. Sampling and research tools

The study population consists of active AIS users in higher education institutions in Indonesia, including students, faculty members, and administrative staff who regularly interact with the system. A purposive sampling technique was employed to ensure that respondents had used AIS for at least one academic semester and were actively engaged in academic or administrative activities within the platform [2]. This criterion ensured that participants possessed sufficient experience and familiarity with the system to provide informed evaluations regarding interface design, responsiveness, satisfaction, and loyalty. Data collection was conducted through an online survey distributed across 12 universities over a period of nearly three weeks. A total of valid responses was obtained, consisting of 60% students, 22% faculty members, and 18% administrative staff, thereby ensuring diverse representation of AIS stakeholders [29]. The Kolmogorov Smirnov test indicated that the dataset was not normally distributed. Accordingly, PLS-SEM was selected over covariance-based SEM (CB-SEM), as it is more appropriate for exploratory research models and non-normally distributed data [30]. The survey instrument consisted of validated scales adapted from prior studies to measure VQ, UIR, PEOU, PU, US, and UL. Each construct was operationalized through multiple indicators to ensure measurement reliability and validity. VQ was assessed through interface aesthetics, color harmony, and layout structure [31], UIR focused on system response time, ease of navigation, and feedback accuracy. PEOU measured system usability, learning ease, and intuitive accessibility. PU reflected productivity enhancement, time efficiency, and task completion support. US captured overall satisfaction with AIS usage, while UL included reuse intention, advocacy, trust, and emotional attachment to the system.

To ensure construct reliability and validity, several statistical criteria were applied. Convergent validity was evaluated through outer loadings exceeding 0.708 and average variance extracted (AVE) values above 0.50. Internal consistency reliability was assessed using composite reliability (CR) and Cronbach's Alpha, with values ranging from 0.791 to 0.970, indicating strong reliability. Discriminant validity was examined using the heterotrait-monotrait ratio (HTMT), with all values below the recommended threshold of 0.90 [32], [33]. These procedures ensured that the measurement model satisfied the required statistical standards before proceeding to structural model evaluation [26]. The adoption of AIS in higher education remains an evolving research domain, particularly regarding the influence of VQ and UIR on US and loyalty within the TAM framework. By integrating experiential interface dimensions with cognitive constructs such as PEOU and PU, this study provides a comprehensive understanding of AIS adoption behavior [34], [35]. The empirical validation of VQ and UIR within the SERVQUAL-TAM framework offers practical implications for designing user-centered AIS that support sustained engagement and long-term retention in academic institutions [36]. The measurement scales used for each construct are detailed in Table 1.

2.3. Conceptual framework

The conceptual framework, illustrated in Figure 1, combines constructs from the TAM and SERVQUAL to explore the interplay between system quality dimensions and user outcomes in AIS. TAM's constructs, including PEOU, PU, and US, serve as foundational elements for understanding technology adoption behaviors [37]. These are complemented by SERVQUAL dimensions, such as VQ and UIR, which emphasize experiential and service quality aspects [38].

This integrated model positions UL as the ultimate outcome variable, reflecting post-adoption behaviors such as continued usage, advocacy, and trust. Additionally, cognitive and emotional factors, including system reliability and user attachment, are hypothesized to significantly contribute to fostering loyalty [39], [40]. These dimensions are particularly relevant in hypothesis 12, which posits that UL is shaped not only by satisfaction and system performance but also by the emotional and cognitive bonds users form with the system [41], [42]. Figure 1 provides a visual representation of these relationships, highlighting both direct, and indirect effects among the constructs studied.

2.4. Research hypotheses

Building on the theoretical underpinnings of the TAM and SERVQUAL, as well as findings from prior research, this study proposes the following hypotheses to explore the complex relationships among key constructs in AIS:

H1. VQ positively influences PEOU. The aesthetic and organizational aspects of a system interface improve usability, aligning with TAM's emphasis on ease of use [6].

Table 1. Measurement scale for constructs

Latent variables		Indicators	Source
PEOU	PEOU1	Ease of understanding features	[40], [43]
	PEOU2	Ease of learning the system	
	PEOU3	Ease of accessing features	
	PEOU4	Ease of interface navigation	
PU	PU1	Efficiency in task completion	[8], [43]
	PU2	Improvement in productivity	
	PU3	Time-saving	
	PU4	Positive impact on work outcomes	
UIR	UIR1	System response time	[6], [43]
	UIR2	Ease of navigation	
	UIR3	Accuracy of system response	
UL	UL1	Intention to reuse	[8], [44]
	UL2	Recommendation to others	
	UL3	Trust in the system	
	UL4	Commitment to continued use	
US	US1	Overall satisfaction	[44], [45]
	US2	Satisfaction with usage experience	
VQ	VQ1	Interface aesthetics	[45], [46]
	VQ2	Color alignment	
	VQ3	Layout alignment	

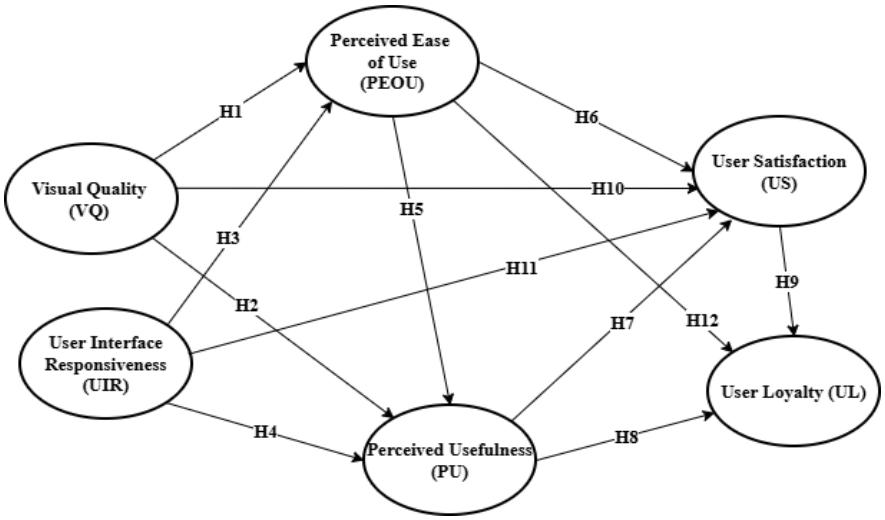

Figure 1. Research framework source(s): figure created by authors

H2. VQ positively influences PU. Interface design and visual coherence enhance user perceptions of system effectiveness in achieving goals [47].
H3. UIR positively influences PEOU. Systems that respond promptly and accurately reduce user frustration, facilitating ease of use [46].
H4. UIR positively influences PU. Accurate and timely system feedback enhances the perception of system utility [14].
H5. PEOU positively influences PU. Systems that are easier to use are perceived as more useful, reinforcing TAM's central premise [37].
H6. PEOU positively influences US. Simplicity in navigating and understanding the system contributes to higher satisfaction levels [48].
H7. PU positively influences US. When users perceive the system as effective, their satisfaction increases [49], [50].
H8. PU positively influences UL. Users who find a system useful are more likely to continue using it and recommend it to others [2].
H9. US positively influences UL. High levels of satisfaction foster trust and emotional attachment, leading to loyalty [45].
H10. VQ positively influences US. Positive visual experiences foster satisfaction by meeting or exceeding user expectations [45].

H11. UIR positively influences US. Responsiveness in addressing user actions improves overall satisfaction by ensuring smooth interaction [40].
H12. PEOU positively influences UL. Ease of use promotes sustained engagement and loyalty through positive user experiences [44].

These hypotheses are designed to capture the multidimensional relationships between system attributes, user perceptions, and behavioral outcomes. By incorporating constructs from TAM and SERVQUAL, this study aims to provide a nuanced understanding of factors driving AIS adoption and loyalty.

2.5. Data analysis

The data analysis followed a structured three-step procedure using PLS-SEM, conducted in SmartPLS version 4.0. This method was selected due to its suitability for analyzing complex structural models and prediction-oriented research. The model evaluation process consisted of: i) measurement model assessment to verify reliability and validity, ii) structural model assessment using bootstrapping (10,000 samples) to assess path significance, R^2, Q^2, and collinearity diagnostics; and iii) importance-performance map analysis (IPMA) to identify critical predictors that combine statistical importance with practical relevance. These procedures ensure that the analytical process is transparent and replicable.

- Step 1: measurement model assessment

The measurement model was evaluated prior to hypothesis testing. Reliability was assessed through Cronbach's alpha and CR to ensure internal consistency among the measured constructs [17], [29]. Convergent validity was established using AVE, where values exceeding 0.50 were considered acceptable [26]. Discriminant validity was examined using both the fornell-larcker criterion and the HTMT ratio, ensuring that each construct was distinct from the others in the model [51].

- Step 2: structural model assessment

Once reliability and validity were confirmed, the structural model was evaluated. Path coefficients were analyzed using bootstrapping techniques to determine the strength and significance of relationships among constructs. The R-squared (R^2) values were calculated to assess the model's explanatory power [30], while predictive relevance was examined using Stone-Geisser's Q^2 statistic [36]. Additionally, collinearity among predictor constructs was assessed using variance inflation factor (VIF), with values below the recommended threshold indicating the absence of multicollinearity.

- Step 3: IPMA

Beyond the standard PLS-SEM analysis, IPMA was performed to provide managerial insights into practical implications [12], [14]. IPMA extends traditional PLS-SEM by not only assessing the impact of independent variables on the dependent variable but also evaluating the performance of each predictor [31]. This analysis enables researchers and practitioners to identify key areas for improvement by prioritizing constructs with high importance but lower performance levels [4]. The IPMA results assist in identifying which factors contribute most significantly to US and loyalty within AIS while highlighting potential weaknesses in system implementation [22].

3. RESULTS AND DISCUSSION

3.1. Measurement model

The measurement model evaluation confirmed both convergent and discriminant validity of the constructs. Convergent validity was demonstrated through indicator loadings exceeding 0.708 and AVE values above 0.50 for all constructs, meeting the thresholds recommended by Hair *et al*. [52] and Sarstedt *et al*. [53]. CR and Cronbach's Alpha values ranged from 0.791 to 0.970, indicating strong internal consistency across all constructs. For instance, VQ achieved a CR of 0.903 and Cronbach's Alpha of 0.838, while US demonstrated the highest reliability with a CR of 0.970 and Alpha of 0.939. Although the loadings for US were relatively high, they remained within acceptable limits and did not indicate construct redundancy, as supported by subsequent discriminant validity assessments. These results align with recent studies, such as Sarstedt *et al*. [53] which emphasize the importance of robust validity metrics in developing reliable structural models. Overall, the findings confirm that the constructs are measured accurately and consistently represent the intended latent variables. The convergent validity and reliability metrics of the constructs are summarized in Table 2.

Discriminant validity was assessed using the HTMT, which is widely recommended for evaluating construct distinctiveness in variance-based structural equation modeling [32], [54]. The HTMT results for all latent variables are presented in Table 3. As shown in the table, all HTMT values remain below the recommended threshold of 0.90, indicating that each construct is empirically distinct from the others. These results confirm that the measurement items represent unique conceptual dimensions and do not exhibit problematic overlap among constructs. Consequently, the discriminant validity of the measurement model is considered satisfactory, allowing the analysis to proceed to the structural model evaluation stage [55].

Table 2. Convergent validity and reliability metrics

Latent variables	Indicators	Loadings	Cronbach's alpha	CR	AVE
PEOU	PEOU1	0.886	0.89	0.923	0.751
	PEOU2	0.848			
	PEOU3	0.860			
	PEOU4	0.871			
PU	PU1	0.877	0.862	0.906	0.708
	PU2	0.872			
	PU3	0.853			
	PU4	0.758			
UIR	UIR1	0.816	0.791	0.878	0.705
	UIR2	0.856			
	UIR3	0.847			
UL	UL1	0.818	0.901	0.932	0.774
	UL2	0.826			
	UL3	0.945			
	UL4	0.922			
US	US1	0.971	0.939	0.97	0.943
	US2	0.971			
VQ	VQ1	0.892	0.838	0.903	0.758
	VQ2	0.916			
	VQ3	0.799			

Note(s): CR=composite reliability; and AVE=average variance extracted

Table 3. Discriminant validity assessment using HTMT

Latent variables	PEOU	PU	UIR	UL	US	VQ
PEOU						
PU	0.705					
UIR	0.850	0.705				
UL	0.843	0.785	0.895			
US	0.700	0.634	0.739	0.781		
VQ	0.691	0.627	0.827	0.735	0.685	

3.2. Structural model

The structural model assessment began with examining multicollinearity issues among predictor constructs. VIF values ranged from 1.812 to 2.610, remaining below the recommended threshold of 3.0, indicating the absence of multicollinearity concerns. The model's explanatory power was evaluated using R^2 values. The results indicate moderate explanatory power, with R^2 values of 0.42 for PU, 0.53 for US, and 0.39 for UL. According to established guidelines in PLS-SEM, these values suggest that the model demonstrates satisfactory predictive capability in explaining US and loyalty behaviors. Predictive relevance was assessed using the Stone-Geisser Q^2 statistic. The Q^2 values ranged from 0.004 to 0.53, confirming that the model possesses predictive relevance for the endogenous constructs. Furthermore, effect size (f^2) analysis revealed that UIR had a substantial effect on PEOU (f^2=0.357), while VQ exerted a moderate effect on US (f^2=0.219). These findings indicate that system responsiveness plays a dominant role in shaping perceived usability, whereas visual elements contribute moderately to US. The overall structural relationships among the constructs, including the estimated path coefficients and hypothesized connections between variables, are illustrated in Figure 2.

3.3. Hypotheses testing

Bootstrapping with 10,000 subsamples at a 95% confidence level was employed to test the proposed hypotheses, with statistical significance determined by t-values exceeding 1.96. The results demonstrate that all twelve hypotheses were supported. VQ positively influenced PEOU (H1: β=0.219, T=3.699, p<0.001) and PU (H2: β=0.184, T=3.276, p=0.001). These findings suggest that aesthetically structured interfaces enhance users' perceptions of both usability and functional benefit. UIR showed a strong positive effect on PEOU (H3: β=0.570, T=9.830, p<0.001) and a significant effect on PU (H4: β=0.211, T=3.276, p=0.001). This indicates that system speed, feedback accuracy, and navigational fluidity significantly shape users' cognitive evaluations of AIS. PEOU significantly influenced PU (H5: β=0.373, T=5.790, p<0.001) and US (H6: β=0.209, T=3.556, p<0.001), reinforcing the foundational propositions of the TAM. PU positively affected US (H7: β=0.381, T=8.318, p<0.001) and UL (H8: β=0.200, T=3.825, p<0.001), highlighting the importance of perceived performance enhancement in fostering sustained engagement. US emerged as a strong predictor of UL (H9: β=0.394, T=7.315, p<0.001), confirming its central mediating role in post-adoption behavior. Additionally, VQ (H10: β=0.173, T=3.396, p=0.001) and UIR (H11: β=0.201, T=3.246, p=0.001) significantly influenced US. Finally, PEU directly affected UL (H12: β=0.363, T=7.034, p<0.001), indicating that intuitive

systems promote long-term commitment beyond cognitive evaluations of usefulness. The detailed hypothesis testing results are presented in Table 4.

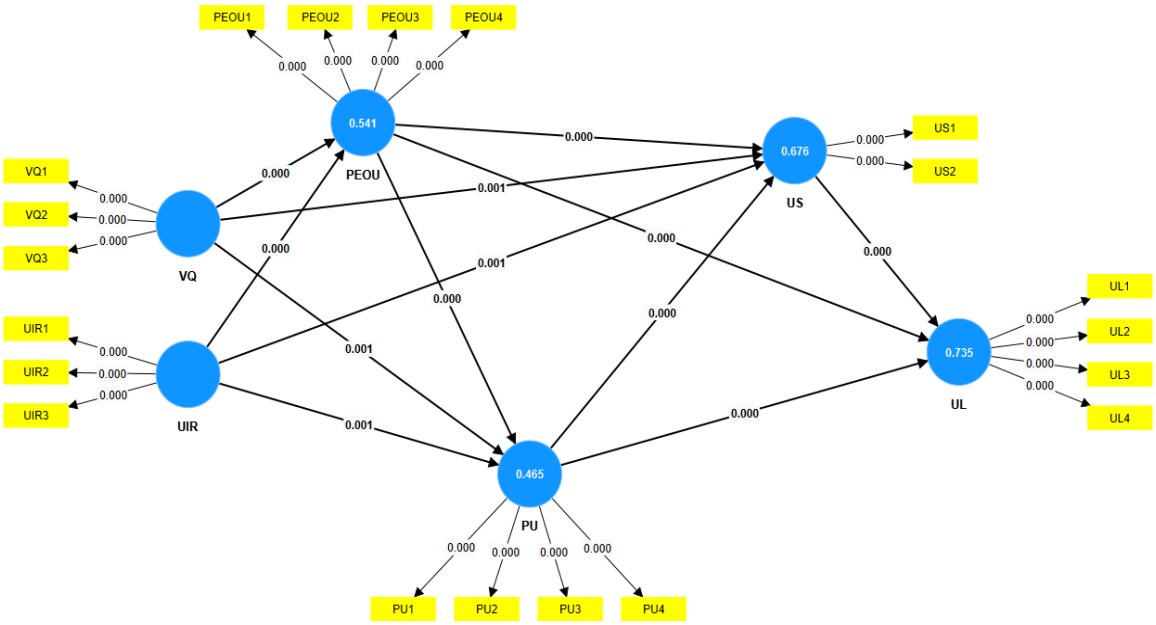

Figure 2. Structural model

Table 4. Hypotheses testing results

Hypotheses	β	T-statistics	p-value	VIF	Supported
H1. VQ→PEU	0.219	3.699	0.000	1.827	Yes
H2. VQ→PU	0.184	3.276	0.001	1.931	Yes
H3. UIR→PEU	0.570	9.830	0.000	2.532	Yes
H4. UIR→PU	0.211	3.276	0.001	2.610	Yes
H5. PEU→PU	0.373	5.790	0.000	2.172	Yes
H6. PEU→US	0.209	3.556	0.000	2.428	Yes
H7. PU→US	0.381	8.318	0.000	1.845	Yes
H8. PU→UL	0.200	3.825	0.000	1.812	Yes
H9. US→UL	0.394	7.315	0.000	1.886	Yes
H10. VQ→US	0.173	3.396	0.001	1.994	Yes
H11. UIR→US	0.201	3.246	0.001	1.827	Yes
H12. PEU→UL	0.363	7.034	0.000	2.058	Yes

3.4. Importance-performance map analysis

The IPMA extends the standard PLS-SEM results by simultaneously evaluating the total effect (importance) of each construct on UL and its average performance score. This dual assessment enables the identification of priority areas for managerial intervention within the AIS. The results indicate that PEOU demonstrates the highest importance value (0.576) with a performance score of 74.97%. This finding suggests that usability remains the most critical driver of UL. In other words, even when other system attributes perform adequately, the overall intuitive structure and ease of navigation of AIS play a decisive role in sustaining long-term engagement. This is consistent with prior research emphasizing that intuitive interface design and ease of learning significantly influence continuance intention. UIR follows with an importance value of 0.481 and a comparatively lower performance level of 70.03%. Although responsiveness is highly influential in shaping loyalty, its performance score indicates potential room for improvement. This gap between high importance and relatively lower performance highlights system responsiveness as a priority improvement area. Previous studies on digital platform adoption similarly demonstrate that delayed feedback, system lag, and navigational inefficiencies negatively affect user trust and satisfaction, thereby discouraging prolonged system use. Figure 3 and Table 5 illustrate these contrasts clearly: constructs such as UIR and PEOU exhibit high strategic importance, yet UIR's performance lags behind other constructs, signaling a critical area for enhancement.

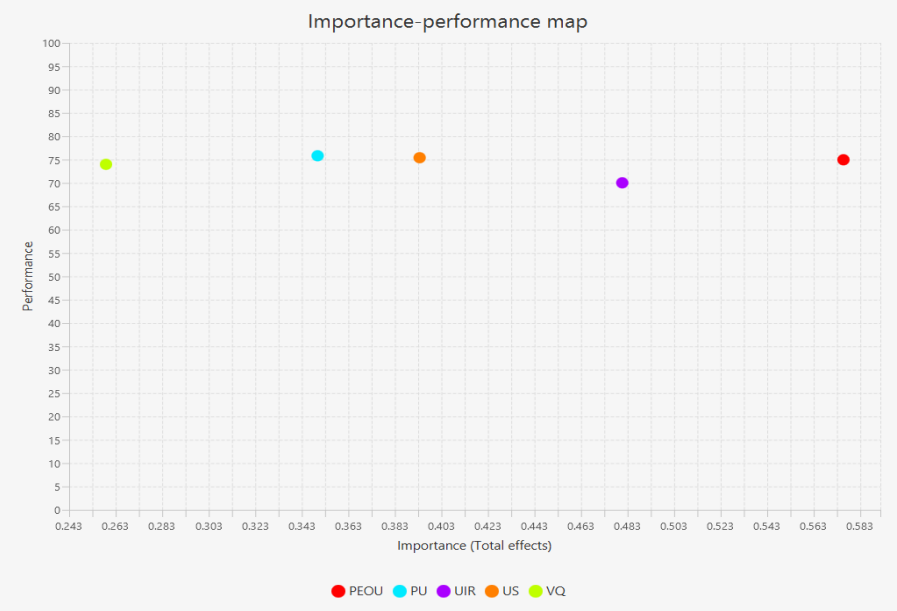

Figure 3. IPMA

Table 5. Comparison of importance and performance values for key constructs

Construct	Total effect (importance)	Performance (%)
PEOU	0.576	74.97
UIR	0.481	70.03
PU	0.350	75.82
US	0.394	75.41
VQ	0.259	73.99

PU (importance=0.350; performance=75.82%) and US (importance=0.394; performance=75.41%) also contribute meaningfully to UL. These findings suggest that users remain engaged when AIS enhances productivity and supports academic or administrative efficiency. While their performance scores are relatively high, their importance values indicate that continuous optimization of functional benefits remains essential. In contrast, VQ shows the lowest importance value (0.259) despite maintaining a relatively high-performance score (73.99%). This indicates that although interface aesthetics are well perceived, their direct contribution to loyalty is comparatively weaker. This supports prior findings suggesting that visual appeal influences initial perceptions but does not independently sustain long-term commitment without functional effectiveness.

3.5. Discussion

The findings of this study provide robust empirical support for the integration of SERVQUAL dimensions into the TAM framework within the context of AIS. Specifically, the results demonstrate that both VQ and UIR significantly shape users' cognitive evaluations of the system, particularly PEU and PU. The strong effect of UIR on PEU (β=0.570) indicates that system speed, feedback accuracy, and navigational fluidity are central determinants of perceived usability. This finding reinforces prior research suggesting that responsive digital environments reduce cognitive effort and enhance user confidence [45]. From a human computer interaction perspective, system responsiveness directly influences the efficiency of task execution and minimizes users' cognitive load during interaction. When users receive immediate feedback and experience smooth navigation, they perceive the system as easier to operate and more reliable. In contrast, although VQ also positively influenced PEU (β=0.219), its effect size was comparatively smaller, suggesting that functional performance outweighs purely aesthetic attributes in shaping usability perceptions. Visual aesthetics primarily enhance the visual appeal and initial impressions of the interface, but they do not substantially improve task efficiency or interaction performance. Consequently, in performance-oriented systems such as AIS, responsiveness tends to exert a stronger influence on usability perceptions than purely visual design attributes.

Consistent with TAM theory, PEU significantly influenced PU and US, confirming its foundational mediating role [53]. These results suggest that when users perceive the AIS as intuitive and effortless, they are more likely to recognize its practical benefits and report higher satisfaction levels. Furthermore, PU significantly predicted both US and UL, supporting prior findings that perceived performance enhancement is

a critical driver of post-adoption behavior [14]. US emerged as a strong predictor of UL (β=0.394), highlighting its central role in fostering continued system usage and advocacy behaviors [44]. This confirms that satisfaction functions as a key mechanism translating cognitive evaluations into behavioral commitment within institutional digital systems. Importantly, the results also demonstrate that PEU directly influenced UL (β=0.363). This indicates that intuitive system design not only enhances PU and satisfaction but also exerts an independent influence on long-term commitment. Such findings suggest that usability should be treated as a strategic priority in AIS development rather than merely a supporting attribute. The model explained 53% of the variance in US and 39% of the variance in UL, indicating moderate predictive power. These values suggest that while system quality and cognitive evaluations play substantial roles, UL in academic systems may also be influenced by contextual or organizational factors beyond interface and usability dimensions. One notable finding concerns the relatively lower direct importance of VQ in driving UL. Although VQ positively influenced PEU and US, its overall impact on loyalty was weaker compared to usability and responsiveness factors. This finding diverges from studies that position visual design as a primary determinant of engagement. A plausible explanation is that in academic environments, users prioritize efficiency, reliability, and task completion over aesthetic appeal. While visual elements may enhance initial impressions, sustained loyalty appears to depend more strongly on functional responsiveness and PU.

The results validate the extended TAM framework by demonstrating that experiential system quality dimensions (VQ and UIR) indirectly and directly influence post-adoption outcomes through cognitive and affective mechanisms. This integrated perspective provides a more comprehensive understanding of AIS engagement, particularly in higher education contexts where system usage is mandatory and performance-driven.

4. PRACTICAL IMPLICATIONS

From a practical standpoint, the findings offer clear strategic priorities for AIS developers, institutional leaders, and policymakers. The structural and IPMA results consistently identify PEOU and UIR as the most influential drivers of UL. Therefore, system usability and responsiveness should be treated as primary design imperatives rather than secondary interface attributes. First, given the strong effect of PEOU on both US and UL, AIS developers should prioritize intuitive workflow design, simplified navigation structures, and reduced cognitive load. Features such as guided task flows, contextual tooltips, and dashboard personalization can enhance perceived usability and minimize user resistance. Since usability directly influences loyalty, investments in user-centered design are likely to yield long-term engagement benefits. Second, the high importance yet comparatively lower performance of UIR (as indicated by IPMA results) highlights system responsiveness as a critical improvement area. Institutions should focus on backend optimization, server scalability, and real-time feedback mechanisms to reduce latency and improve interaction fluidity. Even minor delays in system response can negatively affect trust and satisfaction, ultimately influencing continued usage intentions. Thus, technical performance optimization should be integrated into institutional digital transformation strategies. Third, although VQ demonstrated a comparatively lower direct impact on loyalty, its influence on PEU and US indicates that visual consistency and aesthetic clarity remain important supporting factors. Maintaining coherent layouts, readable typography, and structured interface hierarchies can reinforce cognitive ease and indirectly contribute to sustained engagement.

Beyond interface-level improvements, the findings suggest that institutions should adopt continuous system evaluation mechanisms. Regular usability audits, structured feedback collection, and iterative development cycles can ensure alignment between system functionalities and evolving user expectations. By embedding user analytics into system management processes, institutions can make data-driven decisions that enhance both satisfaction and long-term loyalty. While emerging technologies such as AI present opportunities for enhancing AIS functionality through adaptive dashboards, predictive academic recommendations, or intelligent support systems such integrations should prioritize usability and responsiveness rather than technological novelty. The empirical findings of this study indicate that functional performance and intuitive interaction remain more influential than purely technological sophistication.

5. COMPARISON WITH PRIOR STUDIES

The findings of this study both confirm and extend prior research within the TAM and service quality literature. Consistent with Davis [6], PEU and PU remain foundational determinants of US and post-adoption behavior. Similarly, the service quality dimensions introduced by Parasuraman *et al*. [38], continue to demonstrate relevance in digital system environments, particularly in shaping user evaluations of system performance.

However, this study advances the literature in several important ways. First, while prior TAM-based studies primarily emphasize cognitive evaluations (PEOU and PU) as predictors of satisfaction and continuance

intention, the present findings demonstrate that experiential interface-related dimensions specifically VQ and UIR significantly influence these cognitive constructs. This suggests that user perceptions in AIS environments are not formed solely through functional evaluation but are also shaped by interaction quality and system responsiveness. Second, unlike traditional SERVQUAL applications that focus on general service environments, this study operationalizes selected service quality dimensions within a mandatory academic system context. The results indicate that UIR exerts a particularly strong influence on perceived usability, highlighting that responsiveness may play a more critical role in institutional digital systems compared to voluntary consumer platforms. This nuance contributes to the ongoing discussion regarding how TAM and service quality constructs operate differently across mandatory versus voluntary usage settings. Third, while prior studies often position visual aesthetics as a primary driver of engagement, the current findings reveal that VQ plays a complementary rather than dominant role in sustaining long-term loyalty. In the AIS context, users appear to prioritize usability efficiency and responsiveness over purely aesthetic attributes. This contextual distinction enriches the theoretical understanding of interface design effects within performance-driven institutional systems. By integrating SERVQUAL dimensions with TAM in a higher education AIS environment, this study provides a more comprehensive framework for explaining post-adoption behavior. The results suggest that loyalty is shaped through a layered mechanism: experiential system qualities influence cognitive evaluations, which in turn drive affective satisfaction and behavioral commitment. This multi-layered explanation extends existing TAM-based adoption models by incorporating interaction-level experiential factors into the structural pathway toward UL.

6. CONCLUSION

This study contributes to the AIS literature by integrating the TAM with selected experiential quality dimensions from SERVQUAL specifically VQ and UIR to explain US and loyalty in higher education contexts. The findings confirm that usability and responsiveness play central roles in shaping user perceptions and post-adoption behavior. PEU emerged as a significant determinant of both US and UL, while UIR strongly influenced perceived usability and usefulness. These results highlight that functional performance and interaction quality are more influential than aesthetic appeal in sustaining long-term engagement with institutional digital systems. Although VQ positively affected usability perceptions and satisfaction, its direct contribution to loyalty was comparatively limited. This suggests that in performance-driven academic environments, users prioritize efficiency, reliability, and system responsiveness over purely aesthetic attributes. The extended model explains 53% of the variance in US and 39% in UL, indicating moderate predictive strength and confirming the relevance of integrating experiential system dimensions into TAM-based adoption frameworks. By demonstrating that experiential interface qualities indirectly and directly influence cognitive and affective mechanisms, this study provides a more comprehensive framework for evaluating digital system engagement in higher education. From a practical perspective, institutions should prioritize usability optimization, system responsiveness, and continuous user-centered evaluation to sustain long-term AIS engagement. Rather than focusing solely on visual enhancement or technological novelty, AIS development strategies should emphasize intuitive interaction, performance reliability, and alignment with academic workflows. This study advances understanding of AIS adoption by showing that sustained UL depends on a layered mechanism combining cognitive evaluation, experiential interaction quality, and affective satisfaction within institutional digital ecosystems.

Despite its contributions, this study has several limitations. First, the sample was limited to higher education institutions in Indonesia, which may restrict the generalizability of the findings. Future research could explore AIS adoption in different cultural or organizational contexts. Second, the cross-sectional design may not fully capture the dynamic nature of US and loyalty. Longitudinal studies could provide deeper insights into how these relationships evolve over time. Lastly, while this study focused on VQ and UIR, future research could examine additional SERVQUAL dimensions, such as reliability and assurance, to further expand the framework. Investigating the integration of emerging technologies, such as predictive analytics and adaptive interfaces, could also enrich the understanding of AIS effectiveness.

FUNDING INFORMATION

This research was conducted independently and did not receive any external research grant or contract funding from any institution, organization, or third party. All costs associated with the research activities, data analysis, and manuscript preparation were fully supported by the authors.

AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest.

ETHICAL APPROVAL

This study adhered to ethical standards for research involving human participants. Participation was voluntary, informed consent was obtained digitally, and all responses were collected anonymously to ensure confidentiality.

DATA AVAILABILITY

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

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