Divergent Success Mechanisms in LMS Adoption: A Multi-Group Analysis of Teachers and Students Perspectives

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***Abstract*—The Learning Management System (LMS) is becoming a standard in the educational sector, and the success is frequently evaluated through a generalized perspective that may overlook the distinct needs of different user groups. Therefore, this study aimed to evaluate LMS success by applying the DeLone and McLean information system success model and examining the moderating role of user groups. The objective was to determine how the structural relationships in the model differed between students and teachers. A quantitative cross-sectional survey was conducted with 248 active users at a single public senior high school in Bali, Indonesia. The study instrument was developed based on validated indicators from established literature to ensure content validity. During the process, data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) combined with Multi-group Analysis. The results showed that the proposed model signified strong explanatory power for user satisfaction and perceived net benefits. The analysis showed meaningful differences in several structural paths, specifically, information quality exerted a stronger influence on intention to use and satisfaction among students. On the other hand, the system quality signified a stronger effect for teachers. The outcomes showed that LMS success was shaped by functional user roles, reflecting differences in how system features and content were used. Although this study was limited to a specific institutional context, the process provided empirical evidence that incorporating user roles improved the assessment of system success. In a practical context, the results recommended that development should prioritize content quality for students and system reliability for teachers.**

***Keywords*—learning management system, information system success model, multi-group analysis, user role, Partial Least Squares Structural Equation Modeling (PLS-SEM)**

I. Introduction

The rapid global adoption of Learning Management System (LMS) was significantly accelerated by the COVID-19 pandemic, establishing these platforms as fundamental infrastructure in modern educational institutions [1–7]. However, assessing the actual effectiveness of LMS implementation in the post-pandemic era remains a critical challenge [8], requiring a shift in focus from initial acceptance to sustained use and long-term impact, conceptualized as Net Benefits (NB) [9–11]. Much of the existing literature relies on model oriented toward pre-adoption factors, such as the Technology Acceptance Model (TAM) and related frameworks. These methods often provide limited perception into post-adoption success and are less capable of capturing the tangible benefits as well as outcomes generated through continued system use [12].

The Information System Success Model (ISSM) proposed by DeLone and McLean (D&M) [9] offers a robust framework for evaluating system success across multiple dimensions, including System, Information, and Service Quality, Intention to Use (ITU), User Satisfaction (US), as well as NB to address the limitation [6, 13–15]. Despite the widespread application, a critical gap remains, as most studies implicitly treat user as homogeneous [16]. This perspective neglects the educational reality that teachers and students possess fundamentally distinct functional priorities in the interaction with the LMS [17, 18]. Teachers typically function as content producers, administrators, and system managers, while students primarily act as content consumers and students [19].

The functional divergence mentioned earlier proposes that the success path (causal relationships in the ISSM) is unlikely to be uniform across user groups. For instance, teachers may prioritize System Quality (SQ), including stability and administrative features, to facilitate effective class management. Meanwhile, students may focus more on Information Quality (IQ), particularly the accuracy, relevance, and organization of content, to support individual learning [20, 21]. Understanding these distinct success mechanisms is essential for formulating targeted and role-sensitive intervention strategies [22–26]. This study proposes that User Role (Teachers vs. Students) serves as a crucial moderating variable that influences the strength and direction of the relationships in the ISSM.

This study is guided by two primary objectives, which include the following. First, to contextually validate the DeLone and McLean ISSM in the Indonesian educational setting. Second, to critically examine the moderating effect of User Role (Teachers vs. Students) on the ISSM path coefficients through Multi-Group Analysis (MGA) [27]. By using this advanced analytical method, the analysis aims to make a significant theoretical contribution by segmenting the ISSM and challenging the prevailing assumption of user homogeneity in LMS studies [28, 29]. From a practical perspective, the results are expected to assist educational

institutions and LMS developers in designing as well as prioritizing system features that more effectively address the distinct functional needs of each user group [30, 31].

II. Materials and Methods

The theoretical foundation of this study was grounded in a well-established framework in the information system discipline. The method was selected due to its proven relevance in analyzing multiple aspects of LMS use, including implementation transition, continued usage behavior, and the comprehensive evaluation of system performance.

A. LMS

An LMS is a web-based platform that serves as a central medium for processing, storing, and distributing digital learning resources, including audio, video, and text, to support flexible blended learning methods [27, 32–38]. In the post-pandemic era, LMS adoption in educational institutions has reached a high level of saturation. However, widespread adoption does not necessarily ensure system success. Recent developments show that the primary challenge has shifted from initial technology acceptance to ensuring the implemented system delivers tangible NB. This inconsistency may heighten the risk of information system failure, particularly as modern LMS platforms incorporate advanced features, including Virtual Classrooms and Course Tools, that further complicate the assessment of System, Information, and Service Quality [39].

The platform investigated in this study, melajah.id, is a customized Moodle-based LMS specifically developed to support digital learning in the institutional context. Support services for the platform are centrally managed by a dedicated Information Technology (IT) Support Unit, which is responsible for server maintenance, user account administration, and provision of technical assistance. Additionally, support is delivered through two primary channels, namely an incorporated help desk in the platform and real-time coordination via a social media-based communication group. The channels ensure that both teachers and students receive timely solutions to technical issues.

B. Limitations of TAM & UTAUT

The model presents fundamental limitations even though TAM and its extensions, such as the Unified Theory of Acceptance and Use of Technology (UTAUT), have dominated e-learning studies. Most studies [20] have focused primarily on behavioral intention or initial acceptance, rather than on long-term system effectiveness. A major criticism of this method is that intention does not necessarily translate into actual impact. Findings from comparative studies of TAM and ISSM show that TAM outcomes, namely intention and attitudes, inadequately capture a real system's success in the post-adoption phase [40]. This limitation obscures a comprehensive understanding of LMS effectiveness, and the Return on Investment (ROI) derived from system implementation.

C. ISSM

This study adopts the D&M ISSM [9] to address the limitations. The ISSM provides a comprehensive framework by systematically linking SQ, Information, and Service dimensions as input dimensions that influence ITU and US, mediating the realization of NB as the final measure of system success. The structural relationships of these dimensions are illustrated in Fig. 1. Moreover, empirical studies applying the ISSM in the LMS context have validated that the model effectively explains the impact of LMS on US as well as academic outcomes in a more holistic and integrative way [41].

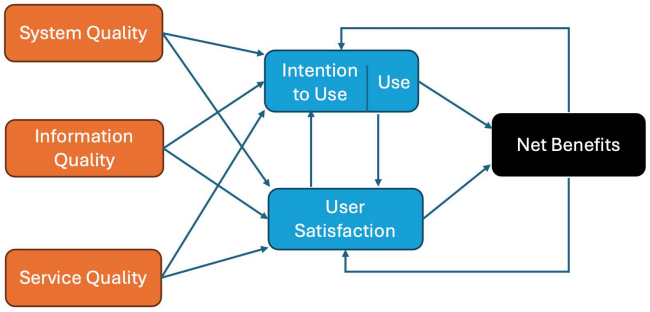

Fig. 1. ISSM DeLone and McLean model.

D. Proposed Model and Hypotheses

The study model was developed based on the DeLone and McLean ISSM [9] framework, with a major modification by incorporating the User Role as a moderating variable. The model retained US and NB as the primary indicators of system success, in line with the post-adoption success literature [42]. During the analysis, baseline hypotheses (H1−H9) were formulated to validate the overall causal relationships in the ISSM. In addition, the MGA Hypotheses (HMGA) were developed to test the central contribution of this study on how the User Role significantly moderated the strength of the relationships among ISSM paths.

The previously discussed differentiation shows the functional roles of teachers as content producers/administrators with system efficiency and support, while students are positioned mainly as consumers of instructional content. These divergent objectives propose that the mechanisms driving LMS success were expected to vary in strength across user groups. Partial Least Squares Structural Equation Modeling (PLS-SEM) with MGA was used to empirically test these differences, leading to moderation hypotheses that specifically examine how core quality dimensions influenced major user variables across teachers and students. The conceptual framework and the proposed hypotheses are visually represented in Fig. 2.

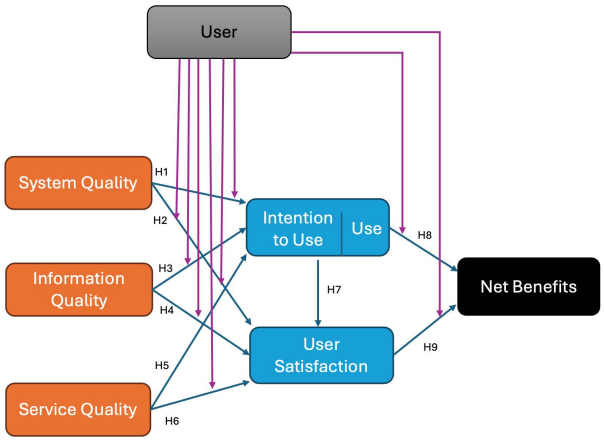

Fig. 2. Conceptual model.

The hypotheses tested in this study were as follows:

H1: System Quality significantly influenced the ITU LMS.

H2: System Quality significantly influenced the US with the LMS.

H3: Information Quality significantly influenced the ITU LMS.

H4: Information Quality significantly influenced the US with the LMS.

H5: Service Quality significantly influenced the ITU LMS.

H6: Service Quality significantly influenced the US with the LMS.

H7: ITU significantly influenced the US with the LMS.

H8: ITU significantly influenced the NB of the LMS.

H9: US significantly influenced the NB of the LMS.

HMGA1 Significant difference between students and teachers in the effect of System Quality on ITU.

HMGA2 Significant difference between students and teachers in the effect of Information Quality on ITU.

HMGA3 Significant difference between students and teachers in the effect of Service Quality on ITU.

HMGA4 Significant difference between students and teachers in the effect of System Quality on the US.

HMGA5 Significant difference between students and teachers in the effect of Information Quality on the US.

HMGA6 Significant difference between students and teachers in the effect of Service Quality on the US.

HMGA7 Significant difference between students and teachers in the effect of ITU on Actual Usage.

HMGA8 Significant difference between students and teachers in the effect of US on NB.

HMGA9 Significant difference between students and teachers in the effect of ITU on the US.

E. Study Design, Population, and Data Analysis

This study used a quantitative analytical method using a cross-sectional survey design to evaluate a modified D&M ISSM [43–45]. The method was selected to enable the application of Partial Least Squares Structural Equation Modeling (PLS-SEM), with a particular focus on MGA. The study population consisted of active user of melajah.id, a specialized LMS implemented for blended learning at Senior High School No. 1 Ubud, Bali. Purposive sampling was used to segment respondents into two functional groups, with students positioned as content consumers and teachers as system administrators and content producers. This functional differentiation was essential for MGA, as the system facilitated a rigorous empirical comparison of how LMS success mechanisms operated differently across user roles.

A total of 248 valid responses were collected and analyzed, comprising 218 students (87.9%) and 30 teachers (12.1%). Strict inclusion criteria were applied to ensure data robustness and validity. This required all participants to be active users during the study period, guaranteeing sufficient hands-on experience to assess the system, information, and Service Quality (SerQ) dimensions of the LMS. Although the subgroup of the teachers was smaller, the sample size satisfied the structural requirements for comparative modeling in the PLS-SEM framework [11, 45]. Table 1 shows the detailed demographic characteristics, including gender distribution and grade levels.

Table 1. Demographic profile of respondent

Demographic Variable	Category	Frequency (*N*)	Percentage (%)
User Role	Students	218	87.9%
	Teachers	30	12.1%
Gender	Male	118	47.6%
	Female	130	52.4%
LMS Platform	melajah.id (Moodle-based)	248	100%
Grade Level (Students)	Class XI	108	49.5%
	Class XII	110	50.5%
Teaching Experience (Teachers)	<5 Years	2	6.7%
	5–10 Years	23	76.7%
	>10 Years	5	16.7%
Duration Using LMS	1–2 Years	108	43.5%
	2–3 Years	110	44.4%
	>3 Years	30	12.1%
Response Rate	Total Distributed	397	
	Valid Responses	248	62.5%

[1]All respondents had used the melajah.id platform for a minimum of one full year, ensuring a comprehensive understanding of the system's features, information quality, and support services. Furthermore, the group of teachers (n = 30) represented the total active teaching staff using the LMS for the selected subjects, fulfilling the analytical requirements for PLS-SEM MGA in this focused institutional context.

Table 2. Constructs and measurement items

No	Construct	Items	Source
1	(System Quality - SQ)	The LMS was easy to use and operate without requiring extensive training or experience.	[12, 27, 39, 46]
		LMS features such as menu navigation were well organized and easy to locate.	
		The LMS showed high stability, rarely experiencing system failures, errors, or unexpected downtime.	
		The access speed and loading time of the LMS were fast and responsive.	
		Advanced features such as virtual classrooms and file sharing could be accessed and used reliably.	
2	Information Quality (IQ)	The learning materials and resources presented on the LMS were accurate and error-free.	[27, 39, 46, 47]
		Information, content, and announcements shown were often relevant to the subjects/assignments of the course.	
		The learning content presented was often up-to-date and current.	
		The information presentation format, namely text, audio, and video, in the LMS was clear and easy to understand.	
		Information regarding my schedule, assignments, and grades was shown in full.	
3	Service Quality (SerQ)	Technical support or the Help Desk was highly responsive and quick to address my questions/issues.	[27, 39, 40, 48]
		Teachers/facilitators provided adequate guidance on how to use LMS features.	
		The support services provided, including FAQ guides, were professional and empathetic.	

		The system provided effective communication channels, e.g., email or chat, to resolve technical issues.	
		Support staff and administrators possessed adequate knowledge to resolve LMS technical issues.	
4	Intention to Use (ITU)	I plan to continue using this LMS for my academic activities in the future.	[12, 27, 39, 46, 48]
		I would recommend this LMS to my friends/colleagues.	
		When given a choice, I would prefer using this LMS over other conventional methods.	
		I would use this LMS frequently in teaching/learning activities.	
		I am confident that the use of this LMS would be sustainable in the future.	
5	User Satisfaction (US)	I was very satisfied with my overall experience of using the LMS.	[12, 27, 39, 46, 48]
		The LMS had met my expectations as an effective learning/teaching tool.	
		I enjoyed using this LMS for my daily academic activities.	
		When given the choice, I would continue to use this LMS in the future.	
		I was satisfied with all the features and services provided by the LMS.	
6	Net Benefits (NB) - Students Group	Using the LMS helped me achieve better learning outcomes.	[12, 27, 39, 46, 48]
		The LMS improved my understanding and depth of knowledge of the subject matter.	
		The LMS improved my efficiency in managing study time and submitting assignments.	
		The LMS facilitates more effective communication with classmates regarding assignments and materials than the email system.	
		The LMS supported me in achieving the established learning objectives.	
7	Net Benefits (NB) - Teachers Group	The LMS significantly reduced the time I spend on administrative tasks	[12, 27, 39, 46, 48]
		The LMS improved the efficiency and effectiveness of the assessment management process.	
		The LMS helped me manage classes and interact with students in an organized and productive way.	
		Using the LMS helped me achieve the pedagogical and curriculum targets set by the institution.	
		Using the LMS helped me achieve the pedagogical and curriculum targets set by the institution. The LMS facilitated the delivery of higher-quality lecture/lesson materials.	

[1]The detailed measurement instrument, including the adapted items for each construct and the respective sources, is provided in Table A1.

All latent constructs, namely SQ, IQ, SerQ, ITU, US, and NB, were assessed on a 5-point Likert scale, with 1 indicating Strongly Disagree and 5 signifying Strongly Agree. This scale facilitated the structured collection of user-perception data. Questionnaire items were developed by adapting validated instruments from the ISSM literature and other relevant contemporary studies [5, 49–51]. The comprehensive list of constructs, their respective measurement items, and the literature sources are detailed in Table 2.

A crucial methodological requirement of this MGA was the measurement invariance for the NB construct. To ensure strong content validity, the indicators for NB were carefully adapted to reflect the distinct functional responsibilities of students as content consumers and teachers as content producers. This contextual adaptation was essential to accurately capture the perceived value and impact of the system in the divergent user group.

Recent studies supported applying MGA when the measurement model was adjusted for a specific group, even though MICOM procedures typically assume identical indicators, provided that the underlying latent construct remained theoretically consistent [52]. In technology studies, imposing identical benefit indicators on both groups led to measurement bias, as the concept of 'benefits' for teachers (e.g., grading efficiency) fundamentally differed from that for students (e.g., learning flexibility) [53]. This study ensured that the MGA results captured the actual success mechanisms of the Melajah.id platform by adopting a functional-equivalence method, reflecting the perspective of its distinct stakeholders, and following user-centered evaluation principles [54].

The data applied in the analysis were examined using the PLS-SEM method with SmartPLS software. PLS-SEM was selected due to its superior capability in testing complex predictive model, adaptability to non-normal samples, and high efficiency in performing moderation analysis and MGA.

The data analysis procedure started with the validation of the Measurement Model (Outer Model) to ensure the psychometric quality of the instrument. Reliability was assessed using Cronbach's Alpha and Composite Reliability (CR) ($\geq$ 0.7), while validity was established using Convergent Validity (AVE $\geq$ 0.5) and Discriminant Validity (HTMT < 0.90). After the validity of the instrument was confirmed, the evaluation proceeded to the Structural Model (Inner Model). The model fit was assessed using the Standardized Root Mean Square Residual (SRMR $\leq$ 0.10), and the predictive power of the model was evaluated using the coefficient of determination (R^2). Moreover, baseline hypothesis testing (pooled data) was performed using the bootstrapping procedure (5000 subsamples), with hypotheses considered supported when the resulting T-value was $\geq$ 1.96 and the p-value was $\leq$ 0.05.

The most crucial stage of the analysis was the testing of the moderation effect through MGA. However, the MGA was preceded by the Measurement Invariance of Composite Models (MICOM) procedure [52]. MICOM ensured the comparative validity of the model, particularly through Compositional Invariance, guaranteeing that the observed differences in results were structural rather than stemming from variations in construct interpretation across groups. After comparative invariance was established, the MGA proceeded using the Permutation Test to compare the structural path coefficients (β) between the Students and Teachers groups. Moderation hypotheses were declared supported when the p-value from the Permutation Test showed statistical significance ($\leq$ 0.05), empirically proving that the User Role significantly moderated the LMS success mechanisms.

III. Result and Discussion

Quantitative data analysis was performed using PLS-SEM via SmartPLS 4 software. This method was selected because PLS-SEM efficiently accommodated a complex multidimensional model and facilitated MGA, especially with non-normally distributed data. Statistical significance testing for the path coefficients was conducted using the bootstrapping procedure with 5000 subsamples.

A. Measurement Model Evaluation

Reliability and convergent validity tests showed the

excellent psychometric quality of the study instrument. The detailed results of these tests, including indicator loadings, Cronbach's Alpha, Composite Reliability (CR), and Average Variance Extracted (AVE), are presented in Table 3. All indicators signified Outer Loading values more than the threshold of 0.708, with the lowest value at 0.709 and the highest at 0.932. Furthermore, all constructs showed CR higher than 0.70 (ranging from 0.877 to 0.931), confirming strong internal consistency. The Average Variance Extracted (AVE) criterion for convergent validity was met, with all constructs showing values >0.50, and the highest being 0.729 for SerQ, proving that each construct successfully captured more explained variance than measurement error.

Table 3. Validity and reliability

Indicator	Construct	Indicator Loadings (λ)	Cronbach's Alpha	Cronbach's Alpha	Cronbach's Alpha
SQ1	System Quality	0.845	0.863	0.901	0.645
SQ2		0.827			
SQ3		0.751			
SQ4		0.817			
SQ5		0.773			
IQ1	Information Quality	0.772	0.825	0.877	0.589
IQ2		0.753			
IQ3		0.801			
IQ4		0.71			
IQ5		0.797			
SerQ1	Service Quality	0.895	0.906	0.931	0.729
SerQ2		0.9			
SerQ3		0.823			
SerQ4		0.824			
SerQ5		0.823			
ITU1	Intention to Use	0.755	0.846	0.891	0.622
ITU2		0.709			
ITU3		0.781			
ITU4		0.899			
ITU5		0.786			
US1	User Satisfaction	0.822	0.868	0.905	0.656
US2		0.759			
US3		0.783			
US4		0.839			
US5		0.842			
NB1	Net Benefits	0.823	0.877	0.91	0.67
NB2		0.843			
NB3		0.801			
NB4		0.797			
NB5		0.827			

Discriminant validity was evaluated using the Heterotrait-Monotrait Ratio of Correlations (HTMT) criterion, which was a strict standard recommended for PLS-SEM. The results in Table 4 showed that all HTMT values were lower than the conservative threshold of 0.90. The highest value recorded was only 0.866 (between SerQ and NB), remaining significantly lower than the 0.90 limit. This result confirmed that each latent construct in the study model was empirically distinct from the others, implying no significant conceptual overlap.

Table 4. HTMT

Construct	*IQ*	*ITU*	*NB*	*SerQ*	*SQ*	*US*
IQ						
ITU	0.777					
NB	0.481	0.632				
SerQ	0.446	0.549	0.866			
SQ	0.448	0.564	0.852	0.857		
US	0.718	0.823	0.798	0.81	0.77	

The evaluation continued with the Structural Model Assessment in the analysis (Inner Model). The overall model fit was assessed using the SRMR, which showed a value of 0.094 for the Estimated Model. Although this figure was slightly higher than the strict threshold of 0.08, the value was considered adequate for a complex PLS-SEM model. The predictive power of the model was assessed using the R^2. The US variable showed a very strong R^2 (0.724), while ITU (0.495) and NB (0.501) signified strong predictive power. These results implied that the LMS quality dimensions were effective in explaining the overall success of the system.

Initial hypothesis testing on the pooled data showed that eight of the nine structural paths had a statistically significant influence ($p < 0.05$). Only the SerQ→ITU path was not significantly supported ($\beta = 0.151$, $p = 0.057$). However, the outcome should be interpreted cautiously because the primary objective of this study was the MGA. The MICOM procedure was subsequently performed, which showed comparative invariability. This validated that the differences in the path coefficients were behavioral differences and not measurement variability.

B. Structural Model Evaluation and Hypotheses Testing

The evaluation proceeded to the structural model after the validity of the measurement model was confirmed. The overall model fit was assessed using the SRMR, which showed values of 0.074 and 0.091 for the Saturated and Estimated Models, respectively. Although this value slightly exceeded the strict threshold of 0.08 often proposed, the variable remained in the acceptable range (<0.10) for exploratory studies using the PLS-SEM [55, 56]. The predictive power of the model was assessed using the R^2. The results showed that this ISSM model possessed substantial predictive power, specifically for the US variable (R^2 = 0.724). This signified that 72.4% of the variance in the US could be explained by the exogenous constructs of the model. The complete path coefficients and R^2 values for the structural model are visually presented in Fig. 3.

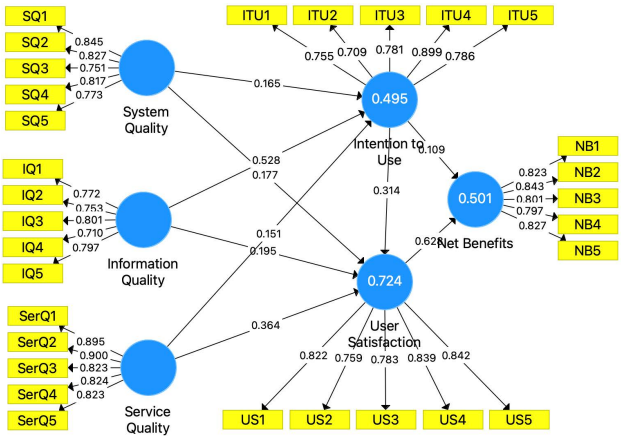

Fig. 3. Structural Equation Model (SEM) result.

The NB variable ($R^2 = 0.501$) and ITU ($R^2 = 0.495$) showed strong predictive levels, surpassing the 0.25 threshold for classification as medium-to-strong predictive power. An analysis of the effect size (F^2) was conducted to assess the contribution of individual predictors. Generally, IQ had a large effect on ITU ($F^2 = 0.458$), and the effect of US on NB was great ($F^2 = 0.401$). The results consistently confirmed that the LMS quality dimensions were highly effective predictors of system success.

Initial hypothesis testing was conducted on the pooled data using the bootstrapping procedure to determine the significance of the structural paths, and the results strongly supported the ISSM framework. A total of eight paths out of the nine proposed hypotheses were found to be statistically significant at $p < 0.05$. The strongest supported path was from IQ→ITU (β =0.528, t = 13.880), followed by US→NB (β = 0.628, t = 12.397), signifying the crucial role of IQ as a driver of adoption intention and US as a determinant of NB. The detailed results of the structural path analysis, including β-values, T-statistics, and p-values, are summarized in Table 5.

Table 5. Path structure

Path	β	Mean	STDEV	T Stat	PVal	Res
Information Quality → Intention to Use	0.528	0.527	0.038	13.88	0	Supported
Information Quality → User Satisfaction	0.195	0.195	0.042	4.633	0	Supported
Intention to Use → Net Benefits	0.109	0.107	0.054	2.007	0.045	Supported
Intention to Use → User Satisfaction	0.314	0.309	0.057	5.522	0	Supported
Service Quality → Intention to Use	0.151	0.148	0.079	1.909	0.057	Not Supported
Service Quality → User Satisfaction	0.364	0.366	0.069	5.266	0	Supported
System Quality → Intention to Use	0.165	0.17	0.078	2.106	0.036	Supported
System Quality → User Satisfaction	0.177	0.18	0.076	2.321	0.021	Supported
User Satisfaction → Net Benefits	0.628	0.633	0.051	12.39	0	Supported

The only hypothesis not significantly supported at the pooled data level was SerQ→ITU (β = 0.151, p = 0.057). Although the path coefficient was positive, its p-value was slightly higher than the 0.05 boundary. The pooled data hypothesis test results served as an initial step in validating the overall model. However, the high R^2 values in the general model potentially masked significant heterogeneity between the subgroups. The subsequent and next step included assessing MICOM and performing MGA to examine how the user roles (Teachers vs. Students) moderated the path strengths.

C. MGA

The MGA became the next crucial step to address the main objective of this study in uncovering the divergent success mechanisms between Students and Teachers. Before comparing the path coefficients, the MICOM procedure was performed to ensure that the constructs used had equivalent meaning and composition across groups. The results showed that Configural Invariance was satisfied, and Compositional Invariance was generally proven, with most constructs having permutation p-values higher than 0.05.

The result of the Equality of Composite Mean/Variance (Step 3) identified a significant mean difference only in the SerQ construct, even though Compositional Invariance was successfully achieved (p = 0.028<0.05). This outcome signified the presence of a partial invariance during the process. Based on the rigorous PLS-SEM method [52], the fulfillment of Compositional Invariance (Step 2) was considered adequate to validate the comparability of the structural model and proceed with testing path coefficient differences using the Permutation Test.

The Permutation Test results in Table 6 showed significant heterogeneity in the ISSM model, confirming the existence of Divergent Success Mechanisms. A total of five structural paths were significantly different (p < 0.05) between the Students and Teachers groups. The paths including IQ towards ITU ($\Delta\beta$ = +0.624, p = 0.004) and US ($\Delta\beta$ = +0.269, p = 0.009) were significantly stronger for the group of students. Consequently, the paths comprising SQ towards ITU ($\Delta\beta$ = −0.433, p = 0.031) and US ($\Delta\beta$ = −0.430, p = 0.032) were significantly stronger for the Teachers group.

Table 6. Permutation test result

Path	Path Coefficients-diff (x - y)	p-Value original 1-tailed (x vs y)	p-Value new (x vs y)
Information Quality → Intention to Use	0.624	0.002	0.004
Information Quality → User Satisfaction	0.269	0.008	0.016
Intention to Use → Net Benefits	−0.198	0.923	0.154
Intention to Use → User Satisfaction	0.544	0.006	0.013
Service Quality → Intention to Use	−0.184	0.826	0.348
Service Quality → User Satisfaction	−0.243	0.955	0.090
System Quality → Intention to Use	−0.433	0.984	0.032
System Quality → User Satisfaction	−0.430	0.991	0.019
User Satisfaction → Net Benefits	−0.038	0.624	0.752

The pattern of divergence signified the fundamental differences in functional priorities. The analysis indicated that students, as content consumers, based individual ITU and US mainly on the quality of information. Meanwhile, teachers, acting as content producers and system administrators, responded more strongly to the functional quality and reliability of the system. The relationship between ITU→US was also found to be stronger for Students ($\Delta\beta = -0.544$, $p = 0.013$). These statistical results empirically rejected the assumption of LMS user homogeneity and formed the basis for the in-depth theoretical interpretation in the Discussion section.

D. Discussion

This study aimed to evaluate the LMS at Senior High School No. 1 Ubud by validating the D&M ISSM and investigating the moderating effect of User Role to uncover divergent success mechanisms. The empirical results from the pooled data analysis confirmed that the D&M model was valid, with the predictor variables collectively explaining 72.4% of the variance in the US and 50.1% in NB. This high explanatory power was associated with the previous literature, affirming that the quality dimensions of an LMS were the primary antecedents of e-learning system success in an educational context [18, 42].

A distinguished result in the pooled results was that SerQ did not significantly influence ITU. This result could be contextualized by the mandatory nature of the melajah.id platform in the institution. Since the platform served as the primary and official channel for accessing curriculum materials, engaging in forums, and conducting online examinations, left users with limited alternatives. In this mandatory environment, the intention to use the system was driven more by institutional requirements and academic necessity than by the perceived quality of IT support services. This observation was consistent with the technology acceptance theory by Venkatesh [57], who explained that in mandatory contexts, perceived support had a diminishing effect on usage intention because system adoption was required irrespective of individual evaluation of the SerQ.

The main contribution of this study was in the MGA results, proving that the LMS success mechanisms were heterogeneous. The outcomes supported the premise of Divergent Success Mechanisms, where the strength of the structural relationships among variables differed significantly between Teachers and Students. This showed that the functional priority of the user strongly moderated the ISSM model. Statistically, a total of five path relationships were found to be significantly different, rejecting the common assumption of homogeneity in previous studies.

The most significant difference was found in the influence of IQ. The MGA results showed that the IQ→ITU and IQ→US paths were significantly stronger in the group of students. This finding was associated with the Task-Technology Fit Theory, explaining that students whose primary task was knowledge acquisition naturally assumed the role of main content consumers. Therefore, the accuracy, relevance, and timeliness of the learning materials accessed were the most critical. Poor IQ directly hindered ITU and the satisfaction of students, reaffirming the principle of digital learning [58].

The SQ dimension was found to have a significant and stronger influence on the group of teachers. The SQ→ITU and SQ→US paths were significantly stronger for teachers. This disparity arose because teachers acted as system administrators and content producers, performing more complex and administrative tasks than the predecessors, respectively. For Teachers, technical stability, loading speed, and the convenience of administrative features (SQ) were essential work tools. Additionally, technical failure disrupted professional workflow and created administrative inefficiency, lowering the tolerance and satisfaction more deeply than for students [59].

This study theoretically contributed critically by challenging the assumption of LMS user homogeneity in the ISSM literature. The MGA results empirically showed that aggregating the Teachers and Students samples activated Simpson's Paradox, where trends in the pooled data hid contradictory dynamics in the subgroups. By contextually validating the D&M model and testing the user role as a moderating variable, the analysis enriched information system success theory. This was performed by showing that the strength of causal paths was dependent on the functional role and job requirements of the user.

The divergent success mechanisms managerially proposed a segmented, dual-focus strategy for LMS managers and school administration. Resources should be focused on the Quality Assurance of content and learning materials (IQ) to improve the adoption as well as the satisfaction of students. Furthermore, allocating resources to strengthen technical infrastructure, ensure server stability, and simplify back-end navigation (SQ) could improve performance as well as the satisfaction of teachers, facilitating more efficient administrative operations. Relating to the discussion, technology investment produced a maximal and targeted ROI.

IV. Conclusion

In conclusion, this study successfully validated the D&M ISSM in the context of an LMS in the secondary educational sector. The main theoretical contribution was the strong rejection of the user homogeneity assumption through the MGA, which empirically uncovered divergent success mechanisms between Teachers and Students. This study found that IQ was the primary driver for Students, influencing ITU and satisfaction. Meanwhile, SQ was the crucial prerequisite for Teachers, impacting work efficiency. The analysis affirmed that LMS success was dependent on the functional role of the user. This provided the basis for adopting a managerial dual-focus strategy, prioritizing content quality for students and system stability for teachers.

The practical implications demanded that LMS administrators allocated resources in a segmented way, focusing on content curation to improve adoption of students and technical infrastructure to increase the performance of teachers. Despite providing significant results, the cross-sectional design and single-institution scope limited the generalizability of long-term causality assumptions. Future studies are recommended to use a longitudinal design to test the impact of these divergent mechanisms on actual learning outcomes (NB) over time. In addition, subsequent studies are inspired to examine other contextual moderating variables,

including Digital Literacy, to offer a more complete perspective on the factors that determine LMS success.

APPENDIX

Table A1. Measurement instrument and item sources

Construct	Code	Measurement Items (Indicators)	Source
System Quality (SQ)	SQ1	The LMS is easy to use and operate without requiring extensive training.	[12, 27, 39, 46]
	SQ2	LMS features (e.g., menu navigation) are well-organized and easy to find.	
	SQ3	The LMS has high stability (rarely encounters system failures or unexpected crashes).	
	SQ4	The access speed and loading time of the LMS are fast and responsive.	
	SQ5	Advanced features, such as file sharing, can be used reliably.	
Information Quality (IQ)	IQ1	The learning materials and resources presented on the LMS are accurate and reliable.	[27, 39, 46, 47]
	IQ2	The information and announcements displayed are always relevant to the subject matter.	
	IQ3	The learning content presented is always up-to-date and current.	
	IQ4	The format of information presentation (text, audio, video) is clear and understandable.	
	IQ5	Information regarding schedules, assignments, and grades is displayed comprehensively.	
Service Quality (SerQ)	SerQ1	Technical support/Help Desk is highly responsive in addressing questions/problems.	[12, 27, 39, 48]
	SerQ2	Facilitators provide adequate guidance on how to use the LMS features.	
	SerQ3	The support services provided (including FAQ guides) are professional and empathetic.	
	SerQ4	The system provides effective communication channels to resolve technical issues.	
	SerQ5	Support staff have sufficient knowledge to resolve LMS technical problems.	
User Satisfaction (US)	US1	Overall, I am very satisfied with my experience using the LMS.	[12, 27, 39, 46, 48]
	US2	The LMS has met my expectations as an effective learning/teaching platform.	
	US3	I enjoy using this LMS in my daily academic activities.	
	US4	If given a choice, I would continue to use this LMS in the future.	
	US5	I am satisfied with all the features and services provided by the LMS.	
Intention to Use (ITU)	ITU1	I plan to continue using this LMS to support my future learning activities.	[12, 27, 39, 46, 48]
	ITU2	I will access this LMS often to monitor materials, assignments, or interactions.	
	ITU3	I would recommend the use of this LMS to my peers or friends.	
	ITU4	Using this LMS has become part of my daily academic routine.	
	ITU5	I prefer using this LMS for accessing/managing materials over manual methods.	
Net Benefit -Student (NBS)	NBS1	Using the LMS helps me achieve better learning outcomes (e.g., improved academic grades).	[12, 27, 39, 46, 48]
	NBS2	The LMS enhances my understanding and depth of knowledge regarding the subject matter.	
	NBS3	The LMS improves my efficiency in managing study time and submitting assignments.	
	NBS4	The LMS facilitates more effective communication with classmates regarding assignments and materials.	
	NBS5	The LMS supports me in achieving the established learning objectives.	
Net Benefit -Teacher (NBT)	NBT1	The LMS significantly reduces the time I spend on administrative tasks (e.g., attendance, collecting assignments).	[12, 27, 39, 46, 48]
	NBT2	The LMS enhances my efficiency and effectiveness in the assessment management process.	
	NBT3	The LMS helps me manage classes and interact with students in a more organized and productive manner.	
	NBT4	Using the LMS helps me achieve the pedagogical and curriculum targets set by the institution.	
	NBT5	The LMS facilitates a higher quality delivery of teaching materials/lessons.	

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

The authors contributed to this study with distinct roles and responsibilities as follows: I Made Dharma Putra conceived and designed the research framework, coordinated the study implementation, managed data collection, and drafted the initial version of the manuscript as the corresponding author. Ni Nyoman Parwati provided guidance on the research methodology and ensured the integration of educational perspectives in the study. Ketut Agustini contributed to the refinement of research instruments and provided strategic instructions to ensure the effective execution of field activities. I Wayan Sukra Warpala provided critical theoretical insights and revised the manuscript to enhance its intellectual depth. I Kadek Suartama provided expert guidance on conducting the statistical analysis using PLS-SEM, assisted in the interpretation of quantitative findings, and supported the technical representation of tables and figures. Dewa Gede Hendra Divayana provided expert guidance on scholarly writing standards and directed the comprehensive refinement of the manuscript to ensure its completeness. All authors had approved the final version.

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