

Optimizing Learning Experiences: A Study of Student Satisfaction with LMS in Higher Education

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ABSTRACT

This research delves into the examination of student satisfaction regarding the use of Learning Management Systems (LMS) through a comprehensive questionnaire distributed among 326 participants. The study adopts a modified **DeLone and McLean is Model** as its methodology to assess various dimensions of LMS satisfaction. Utilizing SmartPLS for hypothesis testing, the study rigorously analyzes the data collected. **The findings** indicate the acceptance of all proposed hypotheses, revealing significant correlations among the variables under scrutiny. A notable outcome is the identification of service quality as the most prominent influencer of student satisfaction within LMS environments. **This underscores the critical** imperative for higher education institutions to prioritize and address service quality concerns proactively. Practical solutions may encompass optimizing technical support structures, refining user interfaces for enhanced accessibility, ensuring system stability, and facilitating ongoing training and support initiatives. By addressing these pivotal areas, institutions can elevate the overall student learning experience and enhance the efficacy of LMS platforms in facilitating robust educational outcomes.

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1. INTRODUCTION

LMS have undergone a remarkable transformation since their inception, adapting to the changing technological landscape and the evolving needs of the education and training sectors. Tracing the history of LMS, we can find their origins in the early 1900s, as various forms of distance and correspondence education emerged. In recent years, LMS have become critical components in advancing educational technology, supporting personalized learning experiences, remote learning, and the integration of open educational resources (OER). This aligns with global efforts to enhance digital education and make learning more accessible and flexible. However, the true development of LMS as we know them today can be attributed to the introduction of personal computer networking in the early 1990s [1]. The first LMS software, FirstClass, was developed by SoftArc in 1990 marking a significant milestone in the history of these systems.

LMS or learning management system, refers to software that automates the administration of training events [2]. It is important to note that the evolution of LMS has been shaped not only by technological advancements but also by pedagogical and instructional design theories. The shift towards more learner-centered approaches and the incorporation of multimedia and interactive elements have significantly influenced the development of modern LMS.

LMS offer numerous advantages within educational contexts. One of the primary benefits is the elimination of geographical barriers. LMS serve as an effective platform for students from the same institution but located in various campuses [3]. Universities with multiple campuses across different time zones can use LMS to bring together diverse student populations in a virtual environment. This integration enhances interaction, facilitates discussions, and encourages feedback. LMS are particularly beneficial for students in remote areas, different countries, or those with health issues, ensuring accessible and continuous learning. This is because LMS provide a continuous educational process irrespective of physical location and time constraints [4].

An initial survey of 25 students at a University in Indonesia using the LMS identified positive overall experiences but also revealed issues like slow response times, poor navigation, and limited storage. These problems suggested unmet quality assurance targets. The research aimed to analyze how these factors impact student satisfaction and LMS usage, providing a basis for improvements, especially in the context of adapting to online learning during the Covid-19 pandemic.

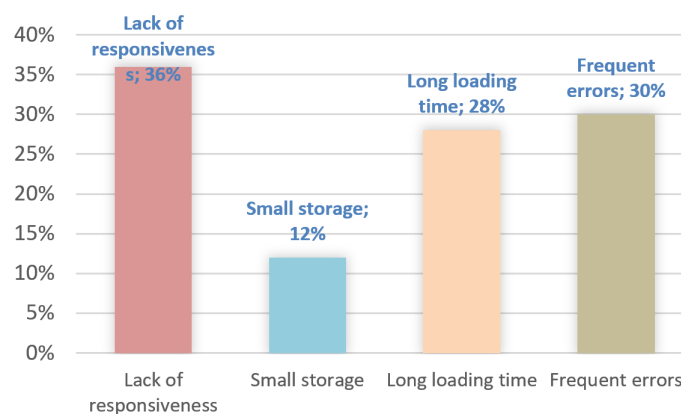


Figure 1. initial survey

The Figure 1, bar chart highlights key issues identified in the initial survey regarding user dissatisfaction with the Learning Management System (LMS). The most significant problem was a lack of responsiveness, reported by 36% of respondents, followed by frequent errors (30%), long loading times (28%), and limited storage capacity (12%). These findings emphasize the importance of addressing system quality issues, such as improving responsiveness and reducing errors, as well as enhancing service quality by optimizing loading times and increasing storage capacity. These challenges align with the study focus on using the DeLone and McLean is Success Model to analyze factors impacting student satisfaction and underline the need for targeted improvements to enhance the LMS user experience [5].

2. LITERATURE REVIEW

Several studies have used the DeLone and McLean model to evaluate the success of academic information systems. For example, [6] evaluated the quality of academic information systems and analyzed the factors influencing use, user satisfaction, and net benefits at Sultan Ageng Tirtayasa University. Similarly, [7] examined the benefits of the Academic Information System for students at Bontang Technological College, while [8] reviewed adaptations of the DeLone and McLean model commonly applied in university information systems.

This research builds on these prior works by uniquely adapting the DeLone and McLean model to specifically assess LMS user satisfaction within Indonesian higher education institutions. Unlike earlier studies, which primarily focused on general academic information systems, this study explores the role of system quality, service quality, and information quality in influencing user satisfaction in the LMS context, providing insights into improving e-learning effectiveness during and after the COVID-19 pandemic.

2.1. E-Learning

E-Learning, as defined by [9], leverages digital technology to deliver content and facilitate interaction between learners and materials online. Similarly, [10] describes it as a learning process enabled by internet technology, eliminating the need for physical classrooms. In summary, E-Learning utilizes the internet to facilitate learning, whether face-to-face or fully online, enabling students to quickly and comprehensively access materials for more optimal learning outcomes.

E-learning for web-based and mobile online learning has the same capabilities and functions to connect to the internet network. Therefore, [11] states that the possibility of learning through e-learning can be done anywhere, anytime in any way and rhythm. E-Learning is also defined as an online learning experience in a synchronous or asynchronous environment using devices such as cell phones, laptops, and others on internet access [12].

According to [13] E-learning offers three main benefits: for students, it provides flexible learning schedules, cost savings, and easier communication with teachers through various technologies. For lecturers, it eliminates the need for physical presence, saves time, and enhances communication via digital tools. For colleges or universities, e-learning reduces operational costs like electricity and supplies, and lowers infrastructure expenses by minimizing the need for physical classroom spaces.

2.2. Learning Management System

A Learning Management System (LMS) supports E-Learning by managing teaching, learning, and communication online. It provides tools for content delivery, activity tracking, performance monitoring, and assessment while enhancing communication through forums and messaging. LMS platforms offer structured materials, allowing students to learn flexibly while meeting assignment deadlines.

LMS platforms enhance learning with features like automated grading, interactive tools, and analytics for data-driven improvements. They provide user-friendly, flexible environments that support modern learners in a technology-driven education system.

According to [14], there are many benefits felt by users if the LMS can be implemented properly and correctly, including: Practical, because LMS can be accessed anywhere, anytime, and without any additional costs other than internet quota. With the LMS device, it increases student understanding, related to lecture material and coursework. Improve student academic abilities and learning outcomes. Attracting students to learn compared to traditional methods.

2.3. Research Model

DeLone & McLean original is Research Model included six interrelated dimensions: system quality, information quality, system usage, user satisfaction, individual impact, and organizational impact. Over time, the model was refined to address feedback from other researchers, resulting in an updated version that includes information quality, system quality, service quality, intention to use, and net benefits. These dimensions form the basis of the research model in this study, where system quality, service quality, and information quality are hypothesized to influence user satisfaction with LMS. The following methodology section details how these constructs were operationalized and tested in this study [15].

In research conducted by [16], it is explained that to measure user satisfaction, only 3 dimensions are used, namely system quality, information quality, and service quality, because newly implemented e-learning needs to be reviewed in terms of user satisfaction first. When users are satisfied, users will intend to use the e-learning and will automatically see the net benefits. Therefore, the researcher adopted the method used in this study.

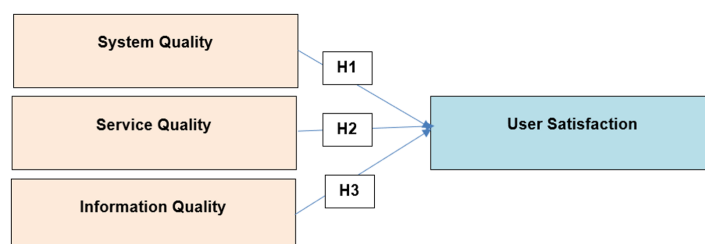


Figure 2. Research model

Figure 2, The research model, based on the DeLone and McLean is Success Model, examines the impact of three independent variables System Quality, Service Quality, and information Quality on the dependent variable, User Satisfaction. Hypotheses H1, H2, and H3 propose that system quality (ease of use, reliability), service quality (responsiveness, support), and information quality (accuracy, relevance, timeliness) significantly influence user satisfaction. This model underpins the study's analysis of factors contributing to student satisfaction with LMS platforms.

2.4. Variable Measurement

The study includes dependent and independent variables to analyze their relationships. The dependent variable is user satisfaction, while the independent variables are system quality, service quality, and information quality. These variables are used to measure and analyze the impact of system quality, service quality, and information quality on user satisfaction.

- System quality is the technical part of the is Success Model from DeLone & McLean. system quality is defined as: "desirable characteristics of the information system itself, which produces information". Variables that can be seen from System Quality include ease of use, system flexibility, system reliability, and ease of use, as well as intuition, sophistication, flexibility, response time [17].
- Service quality refers to the support and assistance provided by an is provider or IT support team to address user issues with an information system. It can be measured by factors such as response accuracy, reliability, technical competence, and the empathy of the support staff.
- Information quality Or the quality of information can be defined as a desired output from a created system. The desired characteristics of information Quality include relevance, ease of understanding, conciseness, completeness, timeliness and usefulness [18].
- User satisfaction is a student general perception of the entire system. User satisfaction is also used to assess student mindset. The user satisfaction component is used to evaluate the interaction between students and the LMS.

The interplay of system quality, service quality, information quality, and user satisfaction provides a comprehensive framework for evaluating the effectiveness of information systems. By understanding and measuring these variables, the study aims to highlight how each aspect contributes to the overall user experience, thereby offering insights into improving system performance and user interaction.

3. RESEARCH METHOD

The study measures user satisfaction using three dimensions: system quality, information quality, and service quality. This focus is essential for evaluating satisfaction with newly implemented e-learning systems, which influences user intention to use the platform and perceive its benefits. Data was collected through a Google Forms questionnaire using a Likert scale from 1 to 5 and tested on a sample from the existing population.

Table 1. indicators of Satisfaction Level of Research Model

Variable	indicator	Code	Statement
System Quality	Easy to Navigate	SQ1	LMS Has a Navigation System That is Easy to Understand
	Provision of information	SQ2	LMS Has Complete information
	Structure	SQ3	LMS Has a Good System Structure And is Easy to Learn
	Feasibility	SQ4	LMS Has a System That is Suitable For Use in Learning [19]
	Functionality	SQ5	LMS is Easy to Use (User Friendly)

Variable	indicator	Code	Statement
Service Quality	Readiness	SVQ1	LMS Can Be Accessed Anytime And Anywhere
	Reliability	SVQ2	LMS Can Be Relied On in Learning
	Feature Availability	SVQ3	The information And Features Required From The LMS Are Always Available [20]
	Evaluation	SVQ4	LMS Has An Evaluation Feature
	interaction	SVQ5	LMS Provides interaction Features Between Students And Lecturers
	Responsive	SVQ6	LMS Has a Fast Response Time
Information Quality	Accuracy	IQ1	The information On The LMS is Accurate
	Understandability	IQ2	The information On The LMS is Easy to Understand
	Relevance	IQ3	LMS Provides All Complete information Relevant to Learning
	Timeliness	IQ4	LMS Provides The Most Up to Date (Latest) information [21]
	Security	IQ5	LMS Has a Good Security System
	Accessibility	IQ6	information On The LMS is Easy to Access
	Usefulness	IQ7	The information in The LMS is Ready to Use
User Satisfaction	<i>Satisfaction</i>	US1	LMS Can Meet My Learning Needs
	<i>Joyfulness</i>	US2	Enjoy Using LMS
	<i>Happiness</i>	US3	The Joy of Using An LMS
	<i>Experience</i>	US4	Get New Experiences in Learning By Using LMS

Table 1 the research model assesses user satisfaction with the LMS through four variables: System Quality, Service Quality, information Quality, and User Satisfaction. System Quality focuses on usability, such as navigation (SQ1) and functionality (SQ5). Service Quality evaluates support reliability and responsiveness (e.g., SVQ2, SVQ5). information Quality ensures accurate, timely, and accessible content (e.g., IQ1, IQ4, IQ6). User Satisfaction includes enjoyment (US2) and overall learning experience (US4). These indicators collectively measure how well the LMS meets user needs and identify areas for improvement [22].

3.1. Research Hypothesis

in achieving the research objectives, the hypothesis that will be used in showing the influence between one variable and another is as follows:

- *Effect of system quality on user satisfaction*

System quality is the level of information inherent in the system itself which is seen from how well the hardware, software, and procedural policies in the information system provide information for user needs.

H1: System quality has a significant effect on the level of user satisfaction.

- *Effect of service quality on user satisfaction*

Service quality is a service provided to users from information system developers, and services in the form of information system updates and responses (if systems and information experience problems).

H2: Service quality has a significant effect on the level of user satisfaction.

- *Effect of information quality on user satisfaction*

Information quality is an information system that has characteristics of content, form, and time that will provide benefits or value to LMS users.

H3: information quality has a significant effect on the level of user satisfaction.

Each hypothesis is designed to evaluate the crucial factors affecting user satisfaction within an information system. The quality of the system, the services it provides, and the quality of the information it delivers all play pivotal roles in determining overall user satisfaction. By assessing these dimensions, this study aims to provide comprehensive insights into how each aspect influences the user experience, which can help guide improvements in the development and management of information systems. The findings from testing these hypotheses are expected to contribute valuable data for optimizing system quality, service delivery, and information accuracy to enhance user satisfaction.

3.2. Data Collection Method

Data collection methods are carried out by researchers to obtain the information needed to obtain the information. Data collection is an important thing in research, which is useful in collecting data. There are several data collection methods used, among others.

- Literature study is a data collection method carried out by literature, reading books, reference journals and previous research related to this research [23].
- Observation is an observation made directly by the researcher.
- Surveys and Questionnaires are a list of written questions that have been previously compiled by researchers. The questions in the questionnaire relate to the object under study. Research on these variables using a Likert scale consists of 5 choices, namely SA = strongly agree (5 points), A = agree (4 points), N = Neutral (3 points), D = disagree (2 points), SD = strongly disagree (1 point).

After the survey and questionnaire method, it is important to ensure that the data collection instruments have been tested for validity and reliability. Validity testing ensures that the questions asked truly measure what they are intended to measure, while reliability testing ensures the consistency of results obtained from the same instrument at different times. Additionally, determining an appropriate sample size plays a crucial role in ensuring that the data collected is generalizable and provides representative results for the larger population.

3.3. Population and Sample

The study targeted 954 undergraduate students who had completed at least two semesters. Using random sampling, 326 out of the 954 students were surveyed, exceeding the minimum sample size of 282 calculated using Slovin formula with a 5% significance level. This approach ensured that the sample was representative of the larger population [24].

3.4. Validity Test

The validity test assesses the reliability and validity of the measuring instrument used in a study. Its purpose is to ensure that each statement or question in the instrument accurately measures what it is intended to. The validity of the questionnaire can be evaluated using the Average Variance Extracted (AVE) value, with a value below 0.5 indicating that the statements are considered invalid.

3.5. Reliability Test

The testing stage assesses the stability of questionnaire results in measuring symptoms or events. High reliability indicates that the measuring instrument is stable, while low reliability suggests instability. Composite reliability and Cronbach Alpha are used to evaluate this stability, with values above 0.5 considered reliable.

3.6. Hypothesis Test

The test is carried out with a p-value approach, if a p-value 0.05 (alpha 5%) is obtained, it is concluded that the independent variable has a significant effect on the dependent variable (H_0 is rejected). Conversely, if the p-value > 0.05 , it is concluded that the independent variable has no significant effect on the dependent variable (H_0 is accepted).

4. RESULT AND DISCUSSION

Before completing the user satisfaction questionnaire, which uses a Likert scale to measure agreement or satisfaction, respondents first answer general demographic and personal questions. This preliminary section provides essential background information, enabling the study to analyze satisfaction levels from a broader perspective and identify patterns across different user groups. This approach ensures more robust findings and helps pinpoint areas for LMS improvement to better accommodate diverse user needs.

4.1. General Description of Respondents

Before the respondent fills out or answers the user satisfaction level questionnaire with a Likert scale, the respondent must first fill out the questionnaire in general and according to the respondent's characteristics. The shape of the research object is the characteristics of the respondents, based on gender, age, major, and device used to access the LMS.

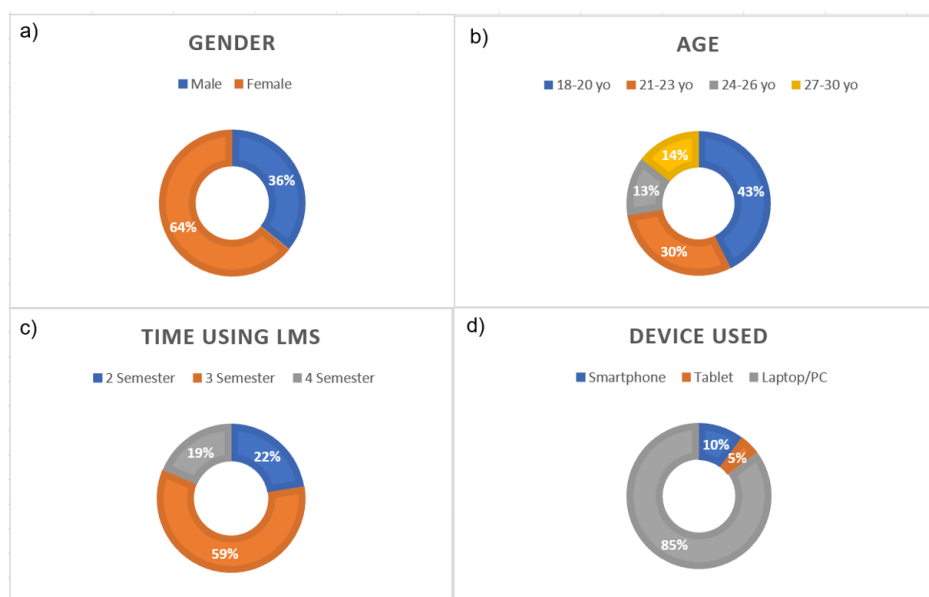


Figure 3. Respondents Profile

Figure 3 the respondent profile reveals that 64% of the participants are female (209 students) and 36% are male (117 students). The age distribution is dominated by students aged 18–20 years (43%, 139 students), followed by those aged 21–23 years (30%, 97 students), 27–30 years (14%, 47 students), and 24–26 years (13%, 43 students). Most respondents have used the LMS for 3 semesters (59%, 192 students), while 22% (73 students) have used it for 2 semesters, and 19% (61 students) for 4 semesters. Regarding devices, laptops/PCs are the most used (85%, 201 students), followed by smartphones (10%, 24 students), and tablets (5%, 11 students).

4.2. Model Evaluation

This research utilizes structural equation modeling-partial least squares (SEM-PLS) with SmartPLS software due to its suitability for small sample sizes, complex models, and exploratory studies, offering advantages over AMOS and LisREL. SEM-PLS evaluates the measurement model (outer model) for convergent validity, requiring loadings above 0.7 and a significant p-value (<0.05). However, loadings between 0.40–0.70 may be retained, particularly in newly developed questionnaires.

in SEM-PLS analysis, discriminant validity ensures constructs are distinct and is assessed using the Fornell-Larcker criterion, where the square root of a construct's Average Variance Extracted (AVE) must exceed its correlations with other constructs. The Heterotrait-Monotrait Ratio (HTMT), with acceptable values below 0.85, serves as an alternative measure. These methods highlight SmartPLS's robustness in evaluating models, especially in studies with novel frameworks or complex variables, enhancing the credibility of exploratory research findings.

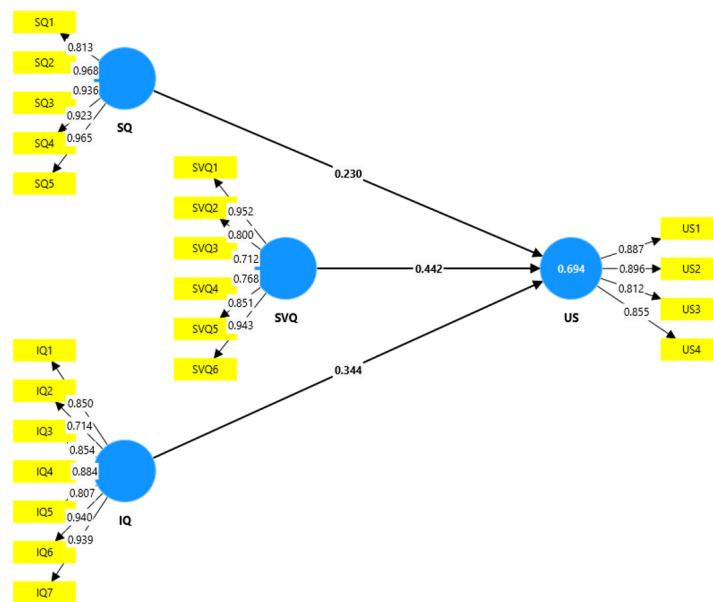


Figure 4. SmartPLS model results

The model in Figure 4 shows that System Quality (0.344), Service Quality (0.230), and information Quality (0.442) significantly impact User Satisfaction (US), with information Quality as the strongest predictor. An R-square value of 0.694 indicates these factors explain 69.4% of the variance in US, emphasizing the importance of system reliability, service responsiveness, and information accuracy in improving LMS satisfaction.

Table 2. Validity testing based on cross loading

Variable	IQ	SQ	SVQ	US
IQ1	0,850	0,361	0,379	0,524
IQ2	0,714	0,296	0,263	0,332
IQ3	0,854	0,402	0,374	0,488
IQ4	0,884	0,398	0,421	0,545
IQ5	0,807	0,359	0,338	0,416
IQ6	0,940	0,479	0,574	0,773
IQ7	0,939	0,480	0,569	0,769
SQ1	0,229	0,813	0,255	0,341
SQ2	0,494	0,968	0,500	0,641
SQ3	0,451	0,936	0,450	0,553
SQ4	0,435	0,923	0,420	0,518
SQ5	0,494	0,965	0,507	0,646
SVQ1	0,527	0,478	0,952	0,734
SVQ2	0,375	0,363	0,800	0,579
SVQ3	0,336	0,309	0,712	0,435
SVQ4	0,378	0,378	0,768	0,561
SVQ5	0,405	0,377	0,851	0,602
SVQ6	0,521	0,476	0,943	0,710
US1	0,632	0,543	0,638	0,887
US2	0,631	0,546	0,672	0,896
US3	0,485	0,488	0,577	0,812
sUS4	0,582	0,505	0,620	0,855

Based on cross loading validity testing in Figure 4 and Table 2, it is known that all outer loading values are > 0.7 , which means they have met the validity requirements based on the outer loading values. Next, validity testing is carried out based on the average variance extracted (AVE) value.

Table 3. Validity testing based on cross loading

Average Variance Extracted (AVE)	
IQ	0,737
SQ	0,851
SVQ	0,710
US	0,745

The Table 3 presents the results of validity testing based on Average Variance Extracted (AVE) for four constructs: Information Quality (IQ), Service Quality (SQ), System Quality (SVQ), and User Satisfaction (US). AVE values reflect the extent to which a latent variable explains the variance of its indicators, with a threshold of 0.5 indicating acceptable convergent validity. The results demonstrate that all constructs meet this criterion, with AVE values of 0.737 for IQ, 0.851 for SQ, 0.710 for SVQ, and 0.745 for US. These findings confirm that the measurement model has strong convergent validity, as each construct effectively explains a significant portion of the variance in its indicators.

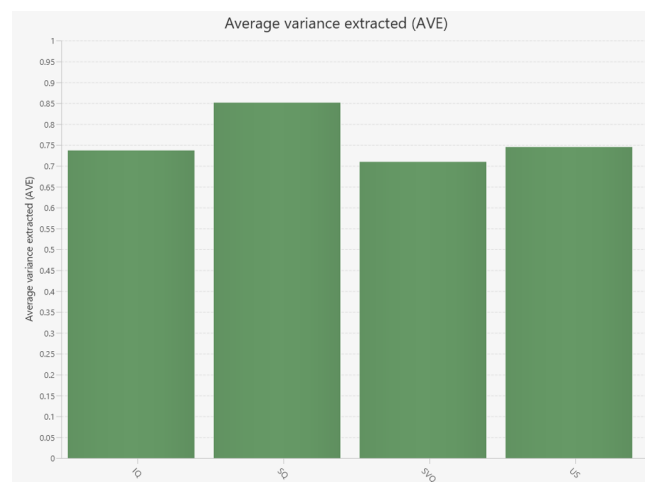


Figure 5. Validity testing based on Average Variance Extracted (AVE)

The bar chart in Figure 5 shows that all constructs information Quality (IQ), System Quality (SQ), Service Quality (SVQ), and User Satisfaction (US) have Average Variance Extracted (AVE) values above 0.5, confirming acceptable convergent validity. IQ has the highest AVE, indicating its indicators explain a significant proportion of the variance, while SQ, SVQ, and US also demonstrate strong AVE values. These findings validate the reliability of the measurements and support the study's framework for assessing factors influencing LMS user satisfaction.

Table 4. Reliability testing based on Composite Reliability (CR)

Composite Reliability	
IQ	0,951
SQ	0,966
SVQ	0,935
US	0,921

The Table 4 presents the results of reliability testing based on Composite Reliability (CR) for four constructs: information Quality (IQ), Service Quality (SQ), System Quality (SVQ), and User Satisfaction (US). Composite Reliability assesses the internal consistency of the constructs, with values above 0.7 considered acceptable and values above 0.9 indicating excellent reliability. The results demonstrate strong reliability for all constructs, with IQ = 0.951, SQ = 0.966, SVQ = 0.935, and US = 0.921. These high CR values indicate that the items used to measure each construct are consistent and reliable, confirming the robustness of the measurement model [25].

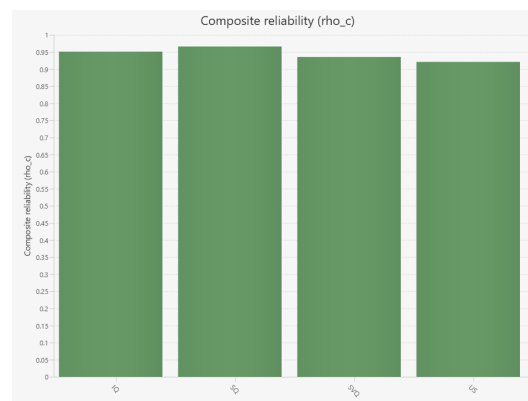


Figure 6. Reliability testing based on Composite Reliability (CR)

Figure 6, the bar chart displays the Composite Reliability (ρ_c) values for the constructs, Information Quality (IQ), System Quality (SQ), Service Quality (SVQ), and User Satisfaction (US). All constructs have reliability values above the recommended threshold of 0.7, indicating high internal consistency among their respective indicators. This suggests that the measured variables reliably represent their underlying constructs. Notably, all constructs approach or exceed 0.9, further reinforcing the robustness of the measurement model. These results align with the study methodological standards, confirmin

Table 5. Reliability testing based on Cronbach Alpha (CA)

Cronbach Alpha	
IQ	0.941
SQ	0.956
SVQ	0.916
US	0.886

Table 5, the table shows Cronbach Alpha (CA) reliability results for four constructs, information Quality (IQ = 0.941), Service Quality (SQ = 0.956), System Quality (SVQ = 0.916), and User Satisfaction (US = 0.886). With values above 0.7 indicating strong internal consistency, the results confirm excellent reliability across all constructs, ensuring the measurement items are consistent and reliable. These findings validate the constructs for further analysis, minimize measurement errors, and strengthen confidence in the research model, providing a robust foundation for hypothesis testing and structural model evaluation [26].

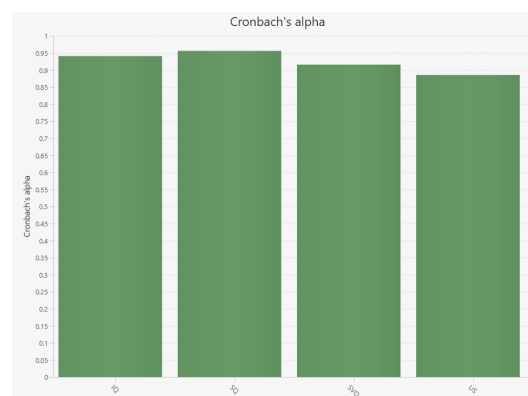


Figure 7. Reliability Testing based on Cronbach Alpha (CA)

In figure 7, the bar chart shows Cronbach Alpha values for Information Quality (IQ), System Quality (SQ), Service Quality (SVQ), and User Satisfaction (US), all exceeding 0.7, indicating strong internal consistency and reliability. Values near or above 0.9 confirm that the indicators reliably measure their constructs, validating the study's data collection and effectively capturing factors influencing LMS user satisfaction [27].

4.3. Hypothesis Testing

Hypothesis testing in the study was conducted using SmartPLS 4 with bootstrapping techniques to analyze data from the measurement stage. The bootstrapping process assessed the direction and significance of relationships between latent variables. Hypotheses were evaluated based on p-values, with a threshold of $p \leq 0.05$ for significance. Results from SmartPLS 4 provided p-values and information on indirect effects to determine which hypotheses were accepted or rejected.

Table 6. Hypothesis test results

	Hypothesis	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values
H1	System Quality influences The Level of User Satisfaction	0,344	0,342	0,060	5,715	0,000
H2	Service Quality influences The Level of User Satisfaction	0,230	0,224	0,046	4,992	0,000
H3	The quality of information influences the level of User Satisfaction	0,442	0,448	0,065	6,847	0,000

The analysis from Table 6 The analysis of the hypothesized structural and measurement models revealed significant factors influencing LMS user satisfaction. System Quality (regression coefficient 0.344, p-value 0.000), Service Quality (regression coefficient 0.230, p-value 0.000), and information Quality (regression coefficient 0.442, p-value 0.000) all positively and significantly impacted user satisfaction. These findings support all hypotheses (H1, H2, H3), confirming that improvements in system, service, and information quality enhance LMS user satisfaction [28].

4.4. R-Square

R-Square is used to measure the extent to which independent variables can explain the dependent variable. R-Square value categorized into strong if the value is more than 0.67, moderate if the value is more than 0.33 but less than 0.67, and weak if the value is more than 0.19 but less than 0.33. To find out how much the independent variable can explain the dependent variable. With the help of the SmartPLS 4.0 program, the R – Square output is found as follows:

Table 7. R-Square

	R Square
US	0,694

Table 7 It is known that the R-Square value of User Satisfaction (US) is 0.694, which means that SQ, SVQ, IQ are able to explain or influence US by 69.4%, the remaining 30.6% is influenced by other factors not explained in the research.

4.5. F-Square

The F-Square test is used to see the partial influence of each variable, both independent and dependent, respectively. The F-Square test has the following 3 criteria :

- If the F-Square value is between 0.02 - 0.15, it is categorized as a weak influence.
- If the F-Square value is between 0.15 - 0.35, it is categorized as moderate influence.
- If the F-Square value is between > 0.35 , it is categorized as a strong influence.

The results of the F-Square test in this research can be seen as follows:

Table 8. F-Square

Variable	F-Square	Criteria
System Quality → User Satisfaction	0.121	Weak
Service Quality → User Satisfaction	0.425	Strong
information Quality → User Satisfaction	0.259	Average

Based on Tabel 8, it can be interpreted that the relationship that has strong criteria is the influence of Service Quality on User Satisfaction because the F-Square obtained is in the range > 0.35 . The relationship that has moderate criteria is the influence of information Quality on User Satisfaction because it falls in the range of 0.15-0.35. Meanwhile, those with weak criteria are the influence of System Quality on User Satisfaction.

5. DISCUSSION

LMS are pivotal in driving innovation in the EdTech sector by enabling continuous education through advancements like AI-driven adaptive learning, cloud-based solutions, and modular content delivery. These features enhance inclusivity, accessibility, and align with global trends such as OER integration and microlearning modules [29, 30]. LMS also boost learning outcomes, support subscription-based revenue models, and provide affordable resources for learners [31]. Customizable solutions for industries like medical and vocational training create niche market opportunities, while microlearning and modular courses offer flexible pay-per-module or pay-per-course options [32].

Adaptive learning in LMS personalizes content to enhance learning outcomes [33], while the LMS-as-a-Service (LaaS) model provides scalable, cost-effective, cloud-based solutions. Integrating Open Educational Resources (OER) increases accessibility and affordability [34, 35]. Ensuring high system, service, and information quality is crucial for reliability, user satisfaction, and a better learning experience, enabling entrepreneurs to develop advanced LMS platforms with adaptive learning and real-time support [36].

Real-world examples like Coursera and Udemy demonstrate successful LMS-based business models [37]. Coursera offers diverse courses with interactive assignments and certifications, while Udemy operates a marketplace where instructors sell courses on a user-friendly LMS platform [38]. Both emphasize system reliability, information relevance, and service quality, contributing to their success [39].

LMS foster entrepreneurship in universities by supporting specialized courses, collaboration, and mentorship. Platforms like Y Combinator and Khan Academy demonstrate how LMS effectively scale educational solutions [40]. In Indonesia, Universitas Indonesia and Kampus Merdeka integrate LMS into entrepreneurship programs, offering courses, mentorship, and industry connections, while Ruangguru uses LMS to expand educational content and promote skill development [41].

6. MANAGERIAL IMPLICATIONS

To enhance service quality, institutions should ensure their technical support teams are well-trained, consistently available, and responsive to user needs. Continuous training programs can further improve user experience and satisfaction with the LMS. Furthermore, investing in technological infrastructure is crucial for improving system reliability, ease of use, and stability. Maintaining accurate, up-to-date, and relevant information through automated updates or integration with external resources is essential for user satisfaction. Additionally, adopting a data-driven approach through regular monitoring and evaluation using tools like the SmartPLS model can guide improvements. Promoting LMS platforms with user training and feature awareness, while integrating Open Educational Resources (OER) and adaptive technologies, ensures LMS platforms remain innovative, effective, and appealing to diverse learning needs.

7. CONCLUSION

This study has demonstrated the critical role of system quality, service quality, and information quality in influencing user satisfaction with LMS in higher education. Using the DeLone and McLean's Success Model as a framework and employing SmartPLS for data analysis, the findings reveal that all three factors significantly and positively impact user satisfaction. Among these, service quality was identified as the most

influential, underscoring the importance of responsive and competent technical support in ensuring a satisfying user experience. institutions must prioritize improvements in these areas to enhance the effectiveness and acceptance of LMS platforms.

The research findings also highlight the importance of integrating data-driven approaches in LMS management. With 69.4% of the variance in user satisfaction explained by the examined factors, managers can leverage these insights to strategically allocate resources and implement targeted improvements. Continuous monitoring and assessment of system performance, coupled with regular updates and user feedback mechanisms, can help institutions maintain high standards of LMS quality. Such efforts not only enhance the user experience but also encourage continued use and engagement, ultimately contributing to better educational outcomes.

Finally, this study emphasizes the need for innovation in LMS integration and application. institutions should explore advanced functionalities, such as adaptive learning technologies and seamless integration with Open Educational Resources (OER), to cater to diverse learner needs. Customizable learning models, including microlearning and subscription-based services, can further expand access and flexibility for students. By addressing these aspects, educational institutions can position their LMS platforms as robust tools for modern learning, fostering both user satisfaction and long-term educational success.

8. DECLARATIONS

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8.2. Author Contributions

Conceptualization: MN; Methodology: MN; Software: AR; Validation: MN and AR; Formal Analysis: MN and AR; investigation: MN; Resources: MN; Data Curation: AR; Writing Original Draft Preparation: AR and MN; Writing Review and Editing: MN and AR; Visualization: MN; All authors, MN, and AR, have read and agreed to the published version of the manuscript.

8.3. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

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8.5. Declaration of Conflicting interest

The authors declare that they have no conflicts of interest, known competing financial interests, or personal relationships that could have influenced the work reported in this paper

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