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Optimizing Learning Management Systems for Student Success in Ghana: A Management Framework

Stella A. Yamoah [a], Emmanuel E. Yamoah [b, *]

[a] School of Technology, Ghana Institute of Management and Public Administration, Accra, Ghana
[b] Department of Management Sciences, University of Education, Winneba, Ghana

Abstract

The widespread adoption of Learning Management Systems (LMS) in higher education necessitates understanding their impact on student performance, particularly in understudied contexts like Ghana. This study examines the factors influencing LMS use and their subsequent impact on academic performance among Ghanaian undergraduates. A quantitative survey design involved 232 undergraduate students from diverse disciplines at a Ghanaian public university. Data were collected using a validated questionnaire measuring LMS utilization, system/information quality, service quality, user self-efficacy, student satisfaction, and academic performance. Partial Least Squares Structural Equation Modeling (PLS-SEM) was employed to analyze the relationships between these constructs. The results indicate that system quality, information quality, and user self-efficacy significantly influence LMS utilization, while service quality has a minimal direct effect. Furthermore, user self-efficacy and IT service quality are key determinants of student satisfaction. Both student satisfaction and LMS utilization strongly influence academic performance. These findings suggest that LMS effectiveness in the Ghanaian context relies not only on technology but also on user empowerment and support. Managerial implications include the need for Ghanaian universities to adopt a multi-pronged approach that prioritizes user empowerment, robust IT support, and faculty training to maximize LMS impact on student performance and satisfaction.

Keywords: learning management system, LMS, academic performance, student satisfaction, higher education management.

1. Introduction

Learning Management Systems (LMS) have proliferated in higher education, propelled by the growth of electronic learning (e-learning) and exacerbated by the COVID-19 epidemic. These digital

* Corresponding author
E-mail addresses: stellaayamoah@gmail.com (S.A. Yamoah), eeyamoah@uew.edu.gh (E.E. Yamoah)

platforms offer a virtual environment for academic pursuits, prompting questions about their impact on student outcomes. Although research validates the efficacy of LMS in supporting traditional learning (Emelyanova, Voronina, 2014; Kim, et al., 2019; Broadbent et al., 2023), its influence on academic performance, particularly in contexts like Ghana, remains less understood.

While defining 'academic performance' presents challenges (Burns, Darling, 2002; Habibah et al., 2011), this study focuses on its multifaceted nature, encompassing competence, productivity, efficiency, and knowledge acquisition (Aldholay et al., 2018). Building on existing research (Kuh et al., 2006; Ampofo, Osei-Owusu, 2015), we go beyond mere system usage (Isaac et al., 2017) to investigate the actual relationship between LMS engagement and performance at the University of Education, Winneba (UEW) in Ghana.

This study addresses a critical gap by investigating the impact of LMS on academic performance within the specific context of Ghanaian higher education. While concerns exist regarding adaptability and support for students (Ssekakubo et al., 2011; Park, Robinson, 2021), understanding the true potential of LMS is crucial for informing effective educational practices and policies in the e-learning era. Our findings will not only contribute to the broader LMS discourse but also provide valuable insights for Ghanaian universities navigating the transformative landscape of digital education.

2. Theoretical Review

Organizations implementing information systems (IS) often fall short of realizing their full potential in enhancing service quality, revenue, and consumer reach. To assess IS effectiveness, various models and tools have emerged, with the DeLone and McLean IS Success Models standing out as prominent contributors (DeLone, McLean, 2002; DeLone, McLean, 2003). The original D&M model (1992) identifies six constructs: system quality, information quality, system use, user satisfaction, individual impact, and organizational impact.

System quality evaluates overall performance, while information quality assesses system output, directly impacting both system use and user satisfaction. These, in turn, influence individual users and the overall organizational impact. Responding to the need for ongoing refinement, scholars have expanded or modified the original model. Ten years after its inception, DeLone and McLean proposed a revised IS performance model, introducing information, system, and service quality, (intention to) use, user satisfaction, and net benefits as the six interconnected dimensions of IS success.

In the updated model, the quality of information, system, and service influences future usage and user satisfaction, ultimately leading to net benefits. The model suggests that the evaluation of a system rests on the quality of provided information, system, and service, influencing user intentions to use and satisfaction. The ensuing benefits, positive or negative, further impact user satisfaction and continued system use (DeLone, McLean, 2003). This framework offers a comprehensive understanding of IS success, guiding organizations in optimizing their information systems for enhanced performance and user satisfaction.

Study model and justification

In this study, the Technology Acceptance Model (TAM) serves to elucidate the independent variable, LMS Use, by explaining the factors contributing to its extensive adoption. Meanwhile, the DeLone and McLean Information Systems (D & M IS) Success Model, a comprehensive and heterogeneous framework, offers deeper insights into the elements defining a system's success.

Focusing on LMS utilization and its impact on academic performance, the D & M IS success model emerges as an apt framework due to its ability to assess the diverse characteristics of IS success. This model aligns seamlessly with both the independent variable (LMS Use) and the dependent variable (students' academic performance), encapsulated by the net benefit construct.

The versatility of the D & M IS success model is underscored by its application across various platforms, including mobile and internet banking (Koo et al., 2013), Learning Management Systems (Nawaz, 2019), and healthcare information systems (Ojo, 2017). Nawaz (2019) specifically employed the model to evaluate the effectiveness of the Moodle LMS, revealing a significant and positive correlation between system use, user satisfaction, and effective learning. Similarly, Mohammed (2015) explored e-learning usage in higher education institutions, finding that information quality, system quality, and service quality positively influence system use and user satisfaction.

Given the increasing demand for LMS in Ghanaian universities, this research adopts the D & M IS model to investigate the nexus between LMS usage and students' academic performance at a major public university, aligning with the model's proven efficacy in diverse educational contexts.

Review of related studies and hypotheses

System Quality

System quality directly impacts LMS usage and user satisfaction (Trentin, 2009; Abrego-Almazán et al., 2017). A user-friendly, reliable, and easy-to-navigate system encourages engagement and fosters positive user experiences (Petter, McLean, 2009; DeLone, McLean, 2003). While open-source and cloud-based LMS dominate the market (Dobre, 2015; Davis et al., 2009), customization by universities often raises usability concerns (Nawaz, 2019). Therefore, this study assesses the post-customization usability of widely used LMS and its influence on student perception and usage. Therefore, we hypothesize that;

H1: The System Quality of an LMS will positively relate to LMS usage.

H2: The System Quality of an LMS will positively relate to students' satisfaction.

Information Quality

Extensive research has explored information quality in e-learning platforms, highlighting its crucial role in learning outcomes and user satisfaction (Lee, Lee, 2008; Aldholay et al., 2018; Al-Azawei, 2019). Well-organized and engaging content, delivered through diverse channels (instructor-led, internet-based, quizzes, and assignments), fosters effective information delivery and learning (Gudigantala et al., 2011). Established criteria for information quality include proper content format, accuracy, relevancy, and clear presentation (Mtebe, Raisamo, 2014; Aldholay et al., 2018). Notably, studies suggest information quality surpasses both system and service quality as the strongest predictor of e-learning course effectiveness (Nawaz, 2019). Accurate, appropriate, up-to-date, and readily understandable information, as emphasized by Wang et al. (2007), is deemed essential for student success. Hence, we put forth the following propositions:

H3: Information Quality will positively influence LMS usage.

H4: Information Quality will positively influence students' satisfaction.

LMS Service Quality

Service quality can help an institution gain a competitive edge by adding value to its product that will delight customers (Santos, 2003). Service quality fortifies an organization's client base and separates it from its competitors (Ramya et al., 2019). Wang et al., (2007) evaluated service quality based on service delivery, providing adequate explanations and helpful assistance through an online medium. According to DeLone and Mclean (2003), the quality of service is described by the following characteristics: tangibles, dependability, responsiveness, assurance, accessibility, interactivity, and empathy. Regular consultation and discussions with existing customers and providing sufficient support for the system's end-users will help enhance service quality. The user's view of the system's service quality can also be affected by partial user involvement or problems during the actual use (Koohang, Du Plessis, 2004). Many students in Ghana or Africa, in general, are not used to many information technology systems (Ssekakubo et al., 2011). The fact that students are not used to IS systems is disturbing because it will affect students' interest in LMS. Almost all institutions have an information technology directorate or units that provide support services to online students to use an LMS more effectively. As a result, this construct is used to evaluate the quality of services provided by IT departments. Students who receive strong support from the IT department are expected to continue to use the LMS and have a positive attitude toward it. Recent research has shown that service quality has a strong association with actual usage and satisfaction (Chiu et al., 2016; Nawaz, 2019). Following from this, the study hypothesizes that;

H5: IT Service Quality of an LMS will positively influence LMS usage.

H6: IT Service Quality of an LMS will positively influence students' satisfaction.

LMS Users' Self-Efficacy

Students have the freedom to choose what they want to study, when they want to learn, and how long they want to learn when it comes to online learning. These self-directed learning attributes of e-learning are vital to a user's learning effort and progress (Alvarez-Risco et al., 2020). Self-efficacy is a crucial variable in technology use since human characteristics differ significantly

(Mahdavian et al., 2016). The self-efficacy concept can be applied to several circumstances. In general, self-efficacy refers to one's evaluation of their ability to succeed (Alvarez-Risco et al., 2020). According to the self-efficacy theory, individuals establish their understanding of their self-efficacy based on previous interactions with comparable tasks, watching others complete similar tasks, social persuasion, and emotional state, according to the self-efficacy theory (Staples et al. 1998). On the other hand, Shen et al. (2013) described it as a student's belief in studying effectively from an online course. According to a large body of studies, academic self-efficacy is positively linked to system use and satisfaction (Lee, Lee, 2008; Aldholay et al., 2018; Alvarez-Risco et al., 2020). LMS usage is in its infancy in Ghana. As a result, it will be critical to look into the link between student self-efficacy and LMS usage. The study hypothesizes that;

H7: LMS users' self-efficacy will significantly predict LMS usage.

H8: LMS users' self-efficacy will significantly predict students' satisfaction.

LMS Use

The learning management system has to be used to benefit from it (Lai et al., 2012; Abdullah, Ward, 2016). This construct measures the degree to which students use the LMS. Delone & Mclean (2003) posited that increased system use is a crucial predictor of LMS performance. Actual use in online learning often represents the regularity and length of use (Kim et al., 2017).) One of the most critical directions in technology utilization is assessing the influence of system use on IS success factors such as performance and satisfaction (DeLone, McLean, 2016). Some studies have looked into the impact of actual use on performance and satisfaction (Aldholay et al., 2018; Oguguo, 2021). Despite the mixed results, it was discovered that there is a positive relationship between system use, satisfaction, and performance (Kim, 2017; Aldholay et al., 2018). On the other hand, other research found that this relationship is insignificant (Wu, Wang, 2006; Ojo, 2017). In DeLone and McLean's (2003) model, "intention to use" was proposed as an alternative measure in some contexts based on the system's usage level. For the early stages of device implementation, "intention to use" has been suggested as a helpful metric (Nawaz, 2019). The Moodle LMS of the University is already in use; as a result, assessing the system usage would be more appropriate. Therefore, this study will use LMS usage to determine the system's benefits and students' academic performance. Hence,

H9: LMS use will significantly influence students' satisfaction.

H11: LMS use will significantly influence students' academic performance.

User Satisfaction

User satisfaction with Learning Management Systems (LMS) has been linked to both system utilization and academic performance. Several studies suggest a positive relationship between satisfaction and use, with fulfilled needs and positive assessments driving increased system engagement (Bokhari, 2001; Delone, McLean, 2003). This aligns with the notion that a system's perceived value motivates continued use (Zviran et al., 2005). User satisfaction also appears to influence performance, although findings are mixed. Mtebe & Raisamo (2014) and Isaac et al. (2017) observed significant positive effects, while Norzaidi et al. (2011) and Ojo (2017) found no significant correlation. Given this inconclusive evidence, this study hypothesizes that;

H10: Students' satisfaction will positively influence academic performance.

Students' Academic Performance

Students have the freedom to choose what they want to study when they want to learn, and how long they want to learn when it comes to online learning.

As an educational institution, a university plays a pivotal role in cultivating high-caliber graduates for the national workforce (Garkaz et al., 2011). Education, a cornerstone of individual, communal, and national development, imparts crucial skills, talents, and awareness (Kapur, 2018). Academic accomplishment enhances theoretical knowledge, skills, and competency, enabling individuals to contribute meaningfully to community well-being (Kapur, 2018).

Students' academic performance holds sway over their long-term aspirations, influencing the trajectory of their further studies and career prospects (Valli Jayanthi et al., 2014). Various factors, including class attendance, assignments, exams, and participation in extracurricular activities, impact academic performance. Schools respond to external pressures by implementing progressive techniques to enhance student performance (Kapur, 2018). Academic success profoundly affects

students' confidence, motivation, and persistence in their educational journey. Suboptimal performance correlates with attrition, reduced graduate throughput, and escalated educational costs (Waggoner, Goldman, 2005).

The repercussions extend to limited opportunities for tertiary education and advanced degrees, prompting educators' enduring interest in students' academic performance (Ali et al., 2009). Students, relying on universities as conduits to future success, seek the best programs to acquire optimal skills and knowledge (Waggoner, Goldman, 2005). In the contemporary job market, companies prioritize adaptable graduates with diverse skills and experiences, intensifying the demand for well-rounded individuals (Andon et al., 2010).

The concept of academic success involves multidimensional constructs encompassing students' abilities, attitudes, and actions, all contributing to excellence in the classroom (Hijazi, Naqvi, 2006). In the context of this study, the use of Learning Management Systems (LMS) and student satisfaction emerge as crucial factors influencing academic performance, warranting consideration as important variables in the research framework. The study's framework is shown in Figure 1 below.

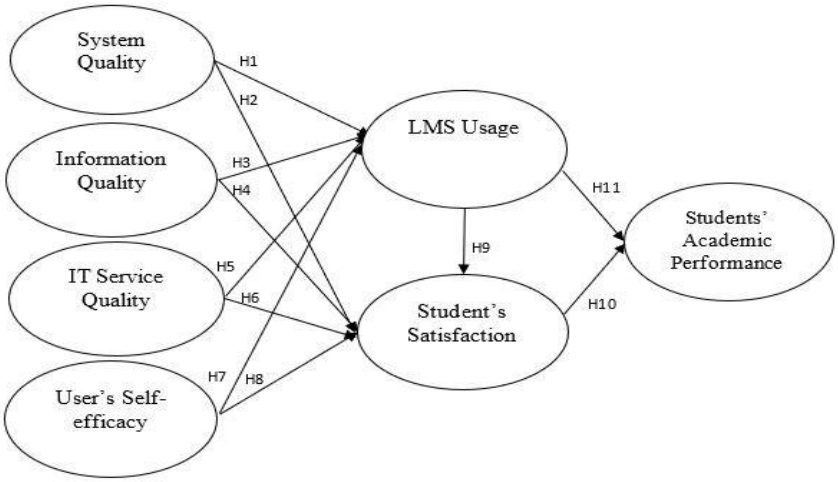

Fig.1. Conceptual framework

Methodology

This study adheres to a positivist philosophy, employing quantitative methods to systematically investigate the intricate dynamics between Learning Management System (LMS) usage and students' academic performance at a major public university in Ghana. An explanatory research design was adopted to elucidate causal relationships among various variables.

Data Collection

Data collection was done during the second semester of the 2022/2023 academic year. The principal instrument was a meticulously constructed questionnaire. The questionnaire was subdivided into four parts. The first part collected respondents' demographic data, including age, gender, and academic level. The second part gathered data on factors influencing students' LMS usage, with factors adopted from DeLone and McLean (2003), except for self-efficacy, which was adopted from Lee and Lee (2007). The third part assessed user satisfaction, while the fourth part evaluated students' academic performance, both using measures adopted from Aldholay et al. (2018).

Population and Sampling Technique

The study targeted a population of 1,892 regular undergraduate students at one of the university campuses. A simple random sampling technique was employed to ensure generalizability, allowing each student an equal probability of selection and thereby enhancing the sample's representativeness. Although a sample size of 320 subjects would be ideal for a 95 % confidence level and a 5 % margin of error, the final sample size consisted of 232 respondents. This adjusted sample size was determined based on practical considerations, including available resources, time constraints, and the need to maintain a balance between precision and feasibility.

Despite the reduced sample size, 232 respondents provided a sufficiently robust dataset, enabling meaningful insights into the research questions while preserving statistical significance. Additionally, the simple random sampling approach ensured the diversity of the student body was accurately reflected in the sample. Consequently, the study's findings are still generalizable within the context of the study, although the reduced sample size is acknowledged as a limitation.

Data Analysis

Data analysis was conducted using a two-phased approach. First, descriptive statistics were applied to characterize the sample demographics and other relevant factors, providing a clear overview of respondent profiles and establishing a basis for deeper analysis. Following this, Partial Least Squares Structural Equation Modeling (PLS-SEM) was utilized to rigorously test hypotheses and examine relationships between the constructs. The analysis was performed using SmartPLS version 4.0, chosen for its advanced capabilities in managing complex models and suitability for smaller sample sizes, aligning well with the study's objectives. This use of PLS-SEM allowed for an in-depth examination of the relationships between LMS usage, student satisfaction, and academic performance, ensuring a theoretically grounded and comprehensive exploration of the research questions.

3. Results

Demographic Characteristics of Respondents

Table 1 shows the demographic background of the respondents. The study comprises 232 university students, with a gender distribution of 53.4 % males and 46.6 % females, reflecting the gender composition of the total student population. In terms of age, the predominant age group among respondents is 18 to 30 years, encompassing 95.3 % of participants. Students aged 31 to 40 constitute 4.3 %, while only 0.4 % fall within the 41 to 50 age range. This age distribution reflects the evolving demographic landscape of undergraduate students, indicating a shift from an older demographic to an influx of younger students entering directly from secondary school.

Regarding academic levels, the distribution is as follows: 11.2 % in level 100, 39.2 % in level 200, 15.1 % in level 300, and 34.5 % in level 400. This inclusive representation ensures diverse perspectives from all academic levels at the public university, contributing to a comprehensive understanding of students' experiences with LMS usage and its impact on academic performance.

Table 1. Demographic variables description

Demographic Variables	Frequency	Percentage
Gender		
Male	124	53.4
Female	108	46.6
Age		
18 – 30 years	221	95.3
31 – 40 years	10	4.3
41 – 50 years	1	.4
Academic Level		
Level 100	26	11.2
Level 200	91	39.2
Level 300	35	15.1
Level 400	80	34.5

Data Normality and Multicollinearity

In preparation for statistical analysis, the dataset underwent thorough screening, encompassing checks for missing data, outliers, and adherence to normality assumptions (Coakes, 2006). This process involved verifying the accuracy of data entry, identifying and handling missing values, and evaluating outliers within the research instrument items.

Missing data, and intentional or inadvertent non-responses in survey instruments, were meticulously addressed, and questionnaires with missing data were excluded from the analysis (Hair et al., 2014). To ascertain the normality of the dataset, a skewness-kurtosis test was conducted, assessing the irregularity and peakness of the distribution, respectively (Byrne, 2013;

Kim, 2019). All skewness and kurtosis values fell within the expected ranges, supporting the dataset's normality (Byrne, 2013).

Additionally, to mitigate multicollinearity, a Variance Inflation Factor (VIF) test was performed, with all VIF values found to be below the threshold of 5 (VIF < 5), indicating no significant issues of multicollinearity (Kim, 2019). This rigorous screening ensures the dataset's reliability and appropriateness for subsequent statistical analyses. Table 2 below presents the results of these tests.

Table 2. Loadings and normality of measurement

Items		Factor Loadings	VIF	Skewness		Kurtosis	
				Statistic	Std. Error	Statistic	Std. Error
SQ1	The LMS is easy to use	0.885	1.872	-0.858	0.16	0.274	0.318
SQ2	The LMS is user friendly	0.856	1.798	-0.981	0.16	0.131	0.318
SQ3	The LMS is easy to learn	0.795	1.584	-0.747	0.16	-0.127	0.318
IQ1	The course content in the LMS is accurate	0.73	1.41	-0.66	0.16	0.188	0.318
IQ2	The course content in the LMS is up-to-date	0.836	1.641	-0.836	0.16	0.081	0.318
IQ3	The courses have sufficient content required for me to complete learning process	0.822	1.348	-0.751	0.16	0.022	0.318
SEQ1	The staff in charge of LMS is committed	0.823	1.926	-0.382	0.16	-0.528	0.318
SEQ2	The staff in charge of LMS responds to my request quickly	0.892	2.507	-0.03	0.16	-0.943	0.318
SEQ3	The staff in charge of LMS has the technical ability to solve my problems	0.784	1.704	-0.254	0.16	-0.333	0.318
SEQ4	The staff in charge of LMS shows concern and empathy	0.845	2.079	-0.37	0.16	-0.563	0.318
SE1	I feel confident finding information on the LMS	0.812	1.658	-0.85	0.16	0.18	0.318
SE2	I feel confident downloading and	0.886	2.136	-1.061	0.16	0.417	0.318
SE3	uploading files on the LMS	0.879	1.963	-1.012	0.16	0.58	0.318
LU2	I use LMS to access leaning resources	0.82	1.29	-1.49	0.16	3.373	0.318
LU4	I use LMS to accomplish and submit my assignments	0.893	1.29	-1.834	0.16	5.037	0.318
SAT1	The LMS is better when compared with off-line lectures	0.845	1.953	-0.202	0.16	-1.29	0.318
SAT2	The LMS has met my	0.913	2.761	-0.143	0.16	-1.121	0.318

Items		Factor Loadings	VIF	Skewness		Kurtosis	
				Statistic	Std. Error	Statistic	Std. Error
	expectations						
SAT3	Overall, I am satisfied with the LMS learning	0.907	2.467	-0.373	0.16	-0.716	0.318
AP1	LMS helps me to learn more quickly	0.87	2.322	-0.45	0.16	-0.581	0.318
AP2	LMS makes it easier for me to complete my assignments	0.856	2.171	-0.799	0.16	0.011	0.318
AP3	LMS helps me acquire new knowledge	0.797	1.795	-0.705	0.16	-0.187	0.318
AP4	LMS helps to improve my overall academic performance	0.859	2.15	-0.895	0.16	0.007	0.318

Measurement Model Evaluation

Following the assessment of fit and construction of the measurement model, the next phase involved testing the structural model, and exploring the hypothesized relationships between latent constructs (Weston, Gore, 2006). This critical aspect of Structural Equation Modeling (SEM) emphasizes the interconnections and magnitudes of links between constructs, delving into the structural theory's specified relationships through a set of structural equations (Hair et al., 2012).

The theoretical model was subjected to scrutiny to ensure the validity and reliability of the measurement model, as emphasized by Bagozzi and Yi (2012). Confirmatory Factor Analysis (CFA) was employed to evaluate the measurement model, encompassing factor loading, Cronbach's Alpha, composite reliability (CR), average variance extracted (AVE), and discriminant validity utilizing Fornell-Larcker and Heterotrait-Monotrait Ratio (HTMT) (Henseler et al., 2015). To enhance the model's robustness, two items with low factor loadings were removed from the LMS usage constructs (LU1 = 0.439 and LU3 = 0.521), aligning with recommended thresholds (Gefen, Straub, 2005). The re-tested model demonstrated improved parameter evaluation (Figure 2).

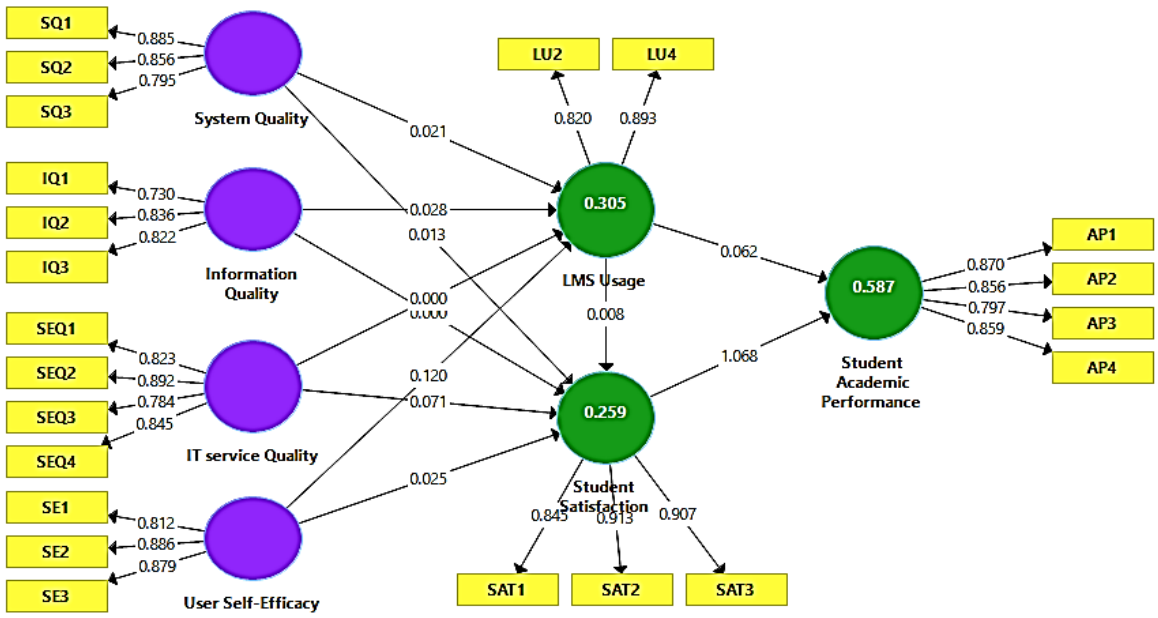

Fig. 2. Path analysis diagram

Internal consistency, assessed through Cronbach's alpha, and construct reliability, measured by composite reliability, surpassed the recommended thresholds, affirming strong construct reliability (Hair et al., 2010; Hu, Bentler, 1998; Hasan, Boa, 2020). Convergent validity, evaluated via Average Variance Extracted (AVE), met the requisite threshold of 0.50, indicating minor measuring errors compared to observed variance. Conclusively, all AVE values exceeded 0.50 (Henseler et al., 2015; Hair et al., 2012), attesting to the acceptable convergent validity of the research output (Table 3).

Table 3. Convergent, composite and internal consistency analysis

Constructs	Cronbach's Alpha (α)	Composite Reliability	Average Variance Extracted (AVE)
System Quality (SQ)	0.802	0.883	0.715
Information Quality (IQ)	0.718	0.840	0.636
Service Quality (SEQ)	0.857	0.903	0.700
Self-Efficacy (SE)	0.823	0.894	0.739
LMS Use (LU)	0.643	0.847	0.735
Students' Satisfaction (SAT)	0.867	0.919	0.790
Students' Academic Performance (AP)	0.868	0.910	0.716

Discriminant validity which explains how each construct is different (distinct) from each other, was also evaluated. This was done using Fornell-Larcker Criterion (Henseler et al., 2015). Discriminant validity is achieved if the Square root of AVE is greater than the inner correlation of the constructs (Table 4). From Table 4, the square root of the AVE value (bold) is seen to be greater than its inner correlation values, suggesting acceptance of discriminant validity among constructs.

Table 4. Fornell-larcker criterion (discriminant validity)

Construct	SEQ	IQ	LU	AP	SAT	SQ	SE
SEQ	**0.837**						
IQ	0.365	**0.798**					
LU	0.296	0.419	**0.857**				
AP	0.493	0.360	0.382	**0.846**			
SAT	0.434	0.285	0.307	0.749	**0.889**		
SQ	0.470	0.559	0.395	0.431	0.362	**0.846**	
SE	0.429	0.446	0.487	0.439	0.384	0.398	**0.860**

Another measure to support discriminant validity is the Heterotrait-Monotrait ratio (HTMT) criteria. For HTMT to be achieved, all correlation values should be values below the threshold of 0.900. Table 5 confirmed a perfect discriminant validity.

Table 5. Heterotrait-monotrait ratio (htmt)

	SEQ	IQ	LU	AP	SAT	SQ	SE
SEQ							
IQ	0.431						
LU	0.397	0.612					
AP	0.568	0.430	0.507				
SAT	0.497	0.329	0.407	0.857			
SQ	0.572	0.723	0.536	0.511	0.422		
SE	0.517	0.578	0.653	0.515	0.449	0.492	

Structural Model Evaluation

The research proved that the measuring model was accurate and trustworthy. The structural model has to be evaluated next. This involved analyzing the coefficient of determination and the model prediction accuracy and observing the link between the constructs. The coefficient of determination (R^2) usually measures the model predictive power of the structural model. It explains how the independent variable predicts the variance in the dependent variable. Three values of the coefficient of determination were evaluated (Table 6). One describes the variance in LMS usage (R^2_{LU}), the other explains the variance in Student Academic Performance (R^2_{AP}), and the last explains the variance in Student Satisfaction (R^2_{SAT}). The value of R^2_{LU} = 0. 305 indicates that system quality, information quality, IT service quality, and user self-efficacy explain 30.5 % of the variance in student LMS usage. It was also found R^2_{SAT} = 0.259 indicates system quality, information quality, IT service quality, and user self-efficacy, which explains 25.9 % of the variance in student satisfaction. Lastly, R^2_{AP} = 0.587 indicates that student LMS usage and student satisfaction explain the 58.7 % variance in student academic performance. The model's predictive accuracy was also estimated using Stone-Geisser Indicator (Q^2) (Henseler et al., 2015). The Stone-Geisser Indicator (Q^2) measures the model prediction relevance or model significance. A good prediction quality should have an indicator value greater than zero (Henseler et al., 2015). The standards of (Q^2) in Table 6 suggest that the model is correct and that the constructs are necessary for the model's general adjustment.

Table 6. Model predictive power and relevance

Construct	(R^2)	(Q^2)
LMS Usage (LU)	0.305	0.201
Student Academic Performance (AP)	0.587	0.407
Student Satisfaction	0.259	0.189

Hypotheses Testing

The model's fitness was evaluated using the Standardized Root-Mean-Square Residual (SRMR) and the Normed Fit Index (NFI). The SRMR assesses the mean of the differences between observed and predicted correlations, with values below 0.08 indicating a good fit (Henseler et al., 2015). The NFI compares the Chi-square value of the model to a null model, with values closer to 1 suggesting a better fit). Table 7 presents the model fit indices for the confirmed structural model.

The study investigated the relationship between LMS usage and students' academic performance. The study adopted D&M IS success model by adding users' self-efficacy to be one of the factors that influence LMS usage and student satisfaction among university students. The construct relationship was established using the Bootstrapping technique in Partial Least Square to estimate the significance level of the latent variables. The eleven hypotheses were all put to the test. The hypotheses testing findings are shown in Table 7 below.

Table 7. Path coefficient and p-values

Structural Relationship	Hypotheses	Standardized Beta (B)	T-Statistics (*t*-Value > 1.99)	P Values	Status of the Hypothesis
SQ → LU	H1	0.155	2.122	0.034**	Supported
SQ → SAT	H2	0.129	1.527	0.127	Not supported
IQ → LU	H3	0.175	2.184	0.029**	Supported
IQ → SAT	H4	-0.002	0.024	0.981	Not Supported
SEQ → LU	H5	0.012	0.190	0.849	Not Supported
SEQ → SAT	H6	0.274	4.124	<0.0001**	Supported

Structural Relationship	Hypotheses	Standardized Beta (B)	T-Statistics (*t*-Value > 1.99)	P Values	Status of the Hypothesis
SE → LU	H7	0.343	5.153	<0.0001**	Supported
SE → SAT	H8	0.170	2.172	0.030**	Supported
LU → SAT	H9	0.092	1.292	0.197	Not Supported
SAT → AP	H10	0.698	19.575	<0.0001**	Supported
LU → AP	H11	0.167	3.448	0.001**	Supported

The construct relationships were analyzed using the Bootstrapping technique in Partial Least Square (PLS) to estimate the significance levels of the latent variables. Hypotheses H1 to H11 were tested (see Table 7). System quality showed a significant effect on LMS usage (β = 0.155, t-value = 2.122, P < 0.034), thus supporting H1. System quality had an insignificant effect on satisfaction (β = 0.129, t-value = 1.527, P < 0.127), so H2 is not supported. Information quality significantly affected LMS usage (β = 0.175, t-value = 2.184, P < 0.029), thus supporting H3, but had no significant effect on satisfaction (β = -0.002, t-value = 0.024, P < 0.981), leaving H4 unsupported. IT service quality did not significantly affect LMS usage (β = 0.012, t-value = 0.190, P < 0.849), hence H5 is not supported. However, IT service quality had a positive effect on satisfaction (β = 0.274, t-value = 4.124, P < 0.0001), supporting H6.

Self-efficacy was found to significantly influence LMS usage (β = 0.343, t-value = 5.153, P < 0.0001), supporting H7, and also positively affected satisfaction (β = 0.170, t-value = 2.172, P < 0.030), supporting H8. LMS usage did not significantly affect satisfaction (β = 0.092, t-value = 1.292, P < 0.197), leaving H9 unsupported. Satisfaction significantly influenced academic performance (β = 0.698, t-value = 19.575, P < 0.0001), supporting H10. Lastly, LMS usage positively affected academic performance (β = 0.167, t-value = 3.448, P < 0.001), supporting H11.

4. Discussions and managerial implications

Discussion

This research scrutinizes the multifaceted factors influencing Learning Management System (LMS) usage among university students. The initial hypothesis posits a positive correlation between LMS system quality and its usage, a well-established connection supported by Nawaz (2019) and Petter and McLean (2009). Their works underscore that an LMS's effectiveness, characterized by convenience, adaptability, and understandability, directly influences its utilization. This resonates with Trentin's (2009) argument that a poorly designed or operated LMS hinders the achievement of expected outcomes, emphasizing the organization's commitment to a robust LMS platform.

Contrastingly, the second hypothesis reveals an insignificant impact of system quality on student satisfaction, deviating from previous literature (Mtebe, Raisamo, 2014; Nawaz, 2019). This suggests that student satisfaction may not solely hinge on LMS system quality or that the system did not meet overall expectations, aligning with Bokhari's (2001) view that user satisfaction assesses an e-learning system's capability to meet users' requirements and ensure satisfaction.

The third hypothesis scrutinized the association between information quality and LMS usage, revealing a significant role in students' engagement with the learning management system. This aligns with prior studies by Al-Azawei (2019) and Mtebe & Raisamo (2014), establishing the significance of information quality in higher educational institutions. Al-Azawei (2019) linked information quality to content format, accuracy, relevancy, and current information, indicating that undergraduate students value complete, relevant, and accurate information on the LMS. Consequently, students demonstrate a heightened interest in using the LMS when information is sufficient, correct, and pertinent to their learning process.

However, hypothesis four revealed an insignificant relationship between information quality and student satisfaction, contrary to findings by Al-Azawei (2019) and Mtebe and Raisamo (2014). While these studies emphasized the positive impact of information quality on user satisfaction, the Ghanaian context suggests a lack of relevance in terms of completeness, accuracy, and relevancy influencing student satisfaction. This deviation may stem from students generalizing

their responses based on overall satisfaction with LMS usage, reflecting an ongoing adjustment phase for many students navigating learning management system utilization.

Hypothesis five failed to find support, presenting a deviation from studies by Chiu et al. (2016) and Nawaz (2019) that endorsed the connection between service quality and LMS usage. Service quality, denoting the support level for end-users, is pivotal in shaping students' LMS utilization, satisfaction, and learning effectiveness (Aldholay et al., 2018). While past research highlighted the positive influence of online service quality on LMS acceptance, use, and satisfaction, this study uncovered an insignificant relationship between information technology service quality and LMS usage. This discrepancy may be elucidated by students' inclination to seek assistance from peers rather than relying on the commitment, technical prowess, and empathy of the IT staff.

In contrast, hypothesis six yielded statistically significant results, aligning with research by Chiu et al. (2016), Nawaz (2019), and Ojo (2017) that supported the association between service quality and user satisfaction. Nawaz (2019) emphasized service delivery, encompassing adequate explanations and helpful assistance through online mediums, echoing DeLone and Mclean's (2003) multifaceted description of service quality. The significant relationship observed among IT service quality, student satisfaction, and LMS usage implies contentment with the services provided by the LMS staff. This suggests the staff's commitment, prompt response, technical expertise, and empathy positively impact student satisfaction, fostering increased LMS usage and a favorable attitude toward the system.

Hypothesis seven's investigation revealed a significant relationship between LMS users' self-efficacy and LMS usage, aligning with prior studies (Alvarez-Risco et al., 2020; Aldholay et al., 2018). Aldholay et al. (2018) highlighted that students' confidence in web navigation, email usage, and internet document downloading positively influences their capacity to engage with a learning management system. The observed significance suggests that students, equipped with self-assurance, are adept at locating and retrieving information from the LMS.

Building on prior research, our findings support hypothesis eight: students' satisfaction thrives when LMS users feel confident navigating the platform. This aligns with studies by Lee & Lee (2008), Aldholay et al. (2018), and Alvarez-Risco et al. (2020). This signifies that higher self-efficacy among undergraduate students in terms of information retrieval and file downloading positively correlates with greater satisfaction with the LMS. The implication is that students, feeling confident in utilizing LMS resources, not only exhibit elevated satisfaction but are also inclined toward increased LMS usage.

Our findings regarding LMS usage (hypothesis nine) diverged from some past studies (Aldholay et al., 2018; Oguguo, 2021). While a direct correlation wasn't found, this aligns with information systems research by Ojo (2017) and Al-Azawei et al. (2017). However, hypothesis ten revealed a positive and statistically significant connection between student satisfaction and academic performance. This aligns with Shneiderman (2010) and Aldholay et al. (2018), suggesting satisfied students at our university effectively utilized the LMS, potentially leading to faster learning, efficient assignment completion, and stronger knowledge acquisition. Essentially, satisfied students viewed the LMS as a valuable tool for academic success.

Ultimately, LMS usage demonstrated a significant influence on student academic performance. This result aligns with prior information system literature, such as the work of Isaac et al. (2017). The positive association indicates that increased LMS usage among undergraduate students correlates with improved academic performance, suggesting that the LMS facilitated rapid learning, knowledge acquisition, and assignment completion, motivating students to persist in its usage.

Implications for Educational Management

The findings of this study have significant ramifications for maximizing the potential of learning management systems (LMS) in public universities in Ghana. The significant weight attributed to factors like system quality, information quality, and users' self-efficacy provides actionable insights for managers of tertiary institutions. Focusing on enhancing user-friendliness, clarity of interface, and regular content updates by instructors can demonstrably increase LMS adoption and student satisfaction.

However, the curious disconnect between LMS utilization and student satisfaction necessitates further action. University management and lecturers must leverage the platform's communication features to cultivate a sense of community, replicating the valuable social aspects

of face-to-face interactions. Mere file exchange doesn't suffice; harnessing the platform's communication tools holistically is key to building student engagement and satisfaction.

Furthermore, the study identifies self-efficacy as a crucial predictor of both satisfaction and usage. This underscores the need for a holistic approach to LMS implementation, considering user confidence as an integral facet influencing its success. University administrators should consider expanding online activities to foster self-efficacy and maximize the benefits of online learning. The predictive power of both LMS use and student satisfaction on academic performance further validates the platform's significance. Universities must emphasize the pedagogical value of the LMS, invest in system quality, ensure faculty buy-in, and provide efficient support services to optimize student outcomes. These recommendations highlight the multifaceted impact of LMS on the educational landscape and the intricate interplay of factors shaping student success.

While this study provides valuable insights, it is essential to acknowledge several limitations. First, the sample size of 232 respondents, although robust, falls short of the ideal for achieving a 95 % confidence level with a 5 % margin of error, which may affect the precision of the findings. Additionally, potential response bias and the cross-sectional nature of the research present limitations that could influence the generalizability of the results. Future research should consider larger samples and a longitudinal design to further explore factors such as institutional performance, cultural influences, and the evolving impact of technological advancements on LMS usage. Such ongoing research is critical to help universities keep pace with the dynamic landscape of educational technology and fully realize the potential of LMS to benefit students and educators.

5. Conclusion

This study reveals that LMS usage is significantly influenced by system quality, information quality, and user self-efficacy, ultimately impacting student satisfaction and academic performance. While service quality positively correlates with student satisfaction, its direct impact on LMS usage is minimal.

To optimize LMS effectiveness, Ghanaian universities should invest in user-friendly systems, provide accurate and relevant information, and empower students through training and support. Building a sense of community within the LMS platform and fostering a positive user experience is equally crucial.

This research contributes to the understanding of LMS implementation in understudied contexts like Ghana. Future studies should explore the long-term impact of LMS on student outcomes and the role of institutional culture in shaping LMS adoption and use.

By prioritizing user-centric design, fostering a supportive learning environment, and continuously evaluating LMS effectiveness, institutions can harness the full potential of this technology to enhance student success.

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