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PAPER

Factors Influencing Student Satisfaction with LMS Mobile Application: A TAM-Based SEM Analysis

Aseel Ajlouni[1](✉), Asmaa AlOmary[2], Mohammad Al-Smadi[3], Mohammad Al-Abdallat[4], Ferial Abu Awwad[1]

[1]The University of Jordan, Amman, Jordan

[2]Al-Ahliyya Amman University, Amman, Jordan

[3]Middle East University, Amman, Jordan

[4]Zarqa University, Zarqa, Jordan

a.ajlouni@ju.edu.jo

ABSTRACT

Mobile applications for learning management systems (LMS) are becoming extremely common in higher education institutions, with student satisfaction (SS) being crucial for their adoption and effectiveness. This study addresses the gap in understanding factors influencing SS with LMS mobile applications by employing structural equation modeling (SEM) based on the technology acceptance model (TAM). Quantitative study was adopted in this study, involving 475 undergraduate students. The findings of the study revealed that students' satisfaction with mobile applications for LMS is significantly and positively influenced by external factors (mobile application self-efficacy, content quality, and enjoyment), as well as perceived ease of use and perceived usefulness. The results provide practical insights for decision-makers, professionals, and developers in higher educational institutes on how to effectively implement e-learning systems using mobile applications.

KEYWORDS

technology acceptance model (TAM), mobile application, students' satisfaction, learning management system (LMS), structural equation modeling (SEM)

1 INTRODUCTION

Technological advancements have profoundly improved our lifestyles, especially in the field of education [1–2], where smartphone devices and their applications offer an effective learning environment. They serve as social platforms, allowing students to participate and enhance learning through collaborative and authentic interaction [3]. The proliferation of emerging technologies has spearheaded a revolution in global education, facilitating the widespread adoption and integration of distance learning practices driven by their benefits, including supporting educational sustainability, facilitating lifelong learning, and reducing overall education costs. These advantages have contributed to global trends toward the shift from traditional to e-learning [4–6].

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A learning management system (LMS) is a learning platform designed to aid teaching efforts and enhance students' learning. LMS is widely employed in e-learning in the form of distance and blended learning platforms [7–11]. In this context, [11] underscores the significance of enhancing e-learning systems and providing comprehensive student training to address negative perceptions associated with technology and learning platforms such as LMS, promoting their widespread adoption, and fostering a more positive educational experience. Currently, the use of LMS and e-learning platforms has gained prominence globally, reshaping the landscape of learning and teaching [12–13]. Furthermore, mobile devices have become essential tools in educational systems. Students are increasingly using mobile devices as an integral part of distance education [14–16], highlighting their widespread adoption. The majority of university students own mobile devices, underscoring the extensive utilization of these tools in educational contexts [17–18]. Hence, the integration of mobile applications into LMS has become imperative within university settings, catering to the contemporary demands and preferences of students. Recognizing this trend, universities worldwide are increasingly adopting mobile application services to facilitate mobile learning and accommodate diverse learning modalities. These applications provide numerous pedagogical advantages to students [19]. Moreover, the emergence of the COVID-19 pandemic has spurred a transition towards e-learning, leading adoption of e-learning in higher education, including within Jordan [20]. This underscores the growing acknowledgment of the importance of digital platforms in delivering education effectively, reflecting a broader global trend towards embracing technology in academic settings. On the other hand, the introduction of technological tools into students' lives necessitates modern studies that address student satisfaction (SS) with these tools and their impacts, such as addiction to these tools or their satisfaction with integrating them into teaching and learning [21–24].

Universities, compelled to implement online and blended learning courses, are adopting innovative instructional strategies and learning tools to achieve appropriate e-learning quality. This includes activating LMS and mobile applications for LMS in order to meet students' diverse learning needs. With these new learning environments, evaluating students' satisfaction with mobile applications for LMS is essential in adapting to new learning environments. Despite the importance and benefits of LMS in supporting all modalities of learning—i.e., face-to-face, blended, and online learning—there is a lack of previous studies addressing SS with mobile applications for LMS. These applications are critical in adapting and ensuring effective engagement with educational material.

Student satisfaction is crucial in the realm of education, as it plays a vital role in evaluating online courses and is closely linked to the overall quality of the program and student performance. Also, it correlates with dropout rates, commitment to completing online courses, learning success, and loyalty. Additionally, it serves as a predictor of learning outcomes and performance [25–30]. This underscores the importance of regularly investigating student satisfaction, especially in new or evolving learning environments.

Prior research has predominantly concentrated on students' satisfaction with LMS systems provided by universities in specific countries [30–33], neglecting to explore their satisfaction with the corresponding mobile applications and the factors influencing it. Consequently, this study seeks to bridge this knowledge gap by investigating the elements influencing SS with LMS mobile applications, employing a modified version of the TAM as a theoretical framework for this investigation. This study is critical for advancing educational literature, as it addresses the lack of understanding regarding SS with mobile applications for LMS and the underlying factors influencing it.

2 THEORETICAL FOUNDATIONS AND RESEARCH MODEL

The technology acceptance model (TAM) is one of the most important and widely accepted models [31–32] due to its simplicity and comprehensibility [36–37] and its effectiveness in predicting and elucidating user acceptance and usage of information technology [34] [38–39]. Widely applied across various technology-related scenarios, TAM is acknowledged as a robust model for examining the adoption of online learning technologies [35]. TAM is a framework commonly used to explore user acceptance of technology, which comprises two crucial elements: perceived ease of use (PEU) and perceived usefulness (PU). These factors have been identified as influential in the adoption of information systems. PU indicates how much individuals, including students, think that using information systems and technology will boost their learning efficiency [40–41]. PU is also considered one of the most important elements in determining the likelihood of using a particular technology [42–43]. Students use an e-learning system if they feel it will support their learning goals and increase their academic achievement [4].

Conversely, PEU pertains to the degree to which an individual perceives using a particular system as easy. It reflects the level to which an individual believes that utilizing a technology is straightforward [40, 42]. Within the realm of e-learning, PEU measures the ease of use of the e-learning system and the students' perceptions. PEU is concerned with studying the principles behind the efficiency or precision of e-learning tools and approaches [4].

Previous studies revealed that the PU and PEU may be influenced by numerous external factors [44–46]. Therefore, various potential motivational aspects impacting learners' acceptance of technology have been investigated within the educational context. Hence, external variables were added to the TAM model to better predict users' acceptance of IT systems and provide a more comprehensive explanation [19, 47].

Scholars can adapt the TAM to fit specific contexts [48], integrating factors that influence technology acceptance. After TAM validation, researchers explored external variables impacting PU and PEU [49]. TAM has been expanded with external factors to support e-learning adoption. A meta-analysis by [50] identified self-efficacy, subjective norm, enjoyment, computer anxiety, and experience as key factors. Self-efficacy was the primary predictor of PEU, with enjoyment, experience, computer anxiety, and subjective norms also influential. Enjoyment was the primary predictor of PU, followed by subjective norms, self-efficacy, and experience.

In contemporary educational settings, certain study endeavors have utilized the TAM framework to assess student satisfaction, such as mobile and virtual learning environments [51–54]. In this context, some studies have reported a clear relationship between PU and PEU and SS [4, 51]. Given that mobile applications for LMS exhibit unique features, it is crucial to modify TAM to accurately capture the factors influencing SS with LMS mobile applications. In light of the TAM-based e-learning and SS literature, we propose the study model for this study.

2.1 Enjoyment

Perceived enjoyment encapsulates individuals' perception of the enjoyment derived from using a specific system, irrespective of its performance outcomes [50, 56]. Study by [57] has underscored the significance of perceived enjoyment as a predictor of learners' intention to utilize educational platforms. Furthermore,

it has been demonstrated that enjoyment significantly impacts students' PU of e-learning [58]. Additionally, perceived enjoyment has a favorable impact on PEU [59]. As a result, the following hypotheses are proposed:

H1: "Student enjoyment positively affects students' perceived usefulness of the mobile app for the learning management system."
H2: "Student enjoyment positively affects students' perceived ease of use of the mobile app for the learning management system."

2.2 Social influence

Social influence (SI) is described as the alteration in a person's thoughts, emotions, beliefs, or actions caused by interactions with another individual or group. Furthermore, individuals might adjust their opinions when influenced by someone perceived as an expert in the relevant subject matter [60]. SI also describes the collective influence on an individual's decisions, such as when a student feels their feelings, behaviors, opinions, and decisions are affected by others, such as a teacher who encourages them to use technology. This influence leads them to believe that using the technology will achieve the desired learning goals and ensure the success of the educational process [44]. According to [50–55], a correlation exists between subjective norms, SI, and the acceptance, satisfaction, and intention towards e-learning systems. Students were observed to be greatly impacted by both their peers and instructors. Challenges and obstacles related to e-learning have led to students' negative perceptions of using it [61]. The study by [62] revealed that SI significantly affects the PEU of e-learning. Indicates a substantial influence of instructors and mentors on students' perceptions of these constructs. A further study by [63] was examined Social influence as subjective norms and revealed that it significantly affected the perceived usefulness of the e-learning system. Thus, the following hypotheses are proposed:

H3: "Student social influences positively affect students' perceived usefulness of the mobile app for the learning management system."
H4: "Student social influences positively affect students' perceived ease of use of the mobile app for the learning management system."

2.3 Mobile app for LMS self – efficacy (MSE)

Mobile self-efficacy (MSE) is pivotal in understanding student behavior with modern technologies such as mobile apps. It denotes an individual's confidence in handling specific tasks [64], often seen as a key determinant of behavior [65]. In the realm of LMS mobile apps, MSE reflects users' confidence in managing LMS. While study on MSE's impact on e-learning satisfaction is limited, studies show its significant influence on technology acceptance in education. Previous focus was on variables such as computer self-efficacy, crucial in predicting PEU and PU in e-learning contexts [66].

Previous research has shown that students who are confident in their computer skills are more likely to participate effectively in MOOCs [67]. High computer self-efficacy is associated with a better awareness of the PEU and PU of e-learning systems. Additionally, it found that self-efficacy predicts students' PU of e-learning systems [50]. Both computer self-efficacy and computer playfulness significantly

impact the PEU of e-learning systems [68]. Blended learning self-efficacy influences students' PEU of e-learning systems [42]. Furthermore, computer self-efficacy affects ease of use, which in turn influences the intention to use e-learning [69]. Study also indicates that computer self-efficacy positively influences the intention to use e-learning [70]. Based on these findings, the following hypotheses are proposed:

H5: "Students' mobile app for LMS self-efficacy positively affects students' perceived usefulness of the mobile app for the learning management system."
H6: "Students' mobile app for LMS self-efficacy positively affects students' perceived ease of use of the mobile app for the learning management system."

2.4 Content quality (CQ)

Perceived content quality (CQ) denotes the suitability of learning materials for users [71]. In this study, indicators for assessing perceived CQ relate to valuable information crucial for users of online or blended learning systems. CQ, encompassing essential information, significantly impacts SS with e-learning [72]. Literature confirms the positive association between perceived information quality and PEU [73], as well as the influence of course and service quality, moderated by PU [74]. Moreover, [72] found that perceived content quality affects PU, while perceived system quality affects PEU. Additionally, [68] established that system quality significantly affects the PEU of e-learning systems. Furthermore, information quality positively influences both the PEU and PU of e-learning systems. Based on these findings, the following hypotheses are proposed:

H7: "Content quality positively affects students' perceived usefulness of the mobile app for the learning management system."
H8: "Content quality positively affects students' perceived ease of use of the mobile app for the learning management system."

2.5 Student satisfaction with mobile application for LMS

Educational satisfaction encompasses the comprehensive assessment and emotional reaction to educational services [75]. SS is the positive evaluation students make of their educational experiences and outcomes, which are shaped by continuous interactions in campus life. SS also reflects their immediate attitude toward the educational services they receive [76–77]. In the context of mobile applications for LMS, SS encompasses the comprehensive assessment and emotional reaction to mobile applications for LMS services.

In the literature, no study assesses students' satisfaction with mobile applications for LMS. The study by [78] underscores the crucial impact of SS on the effectiveness of e-learning. And [79] study revealed that using LMS increases satisfaction and quality of learning. Further Some prior studies revealed that there is a close, extraordinary, and highly positive impact for PEU and PU on the satisfaction, attitudes, or acceptance of the e-learning system [44], [68], [76–80]. Findings by [81] revealed that individuals' attitudes toward technology usage were significantly predicted by their perceptions of its PU and PEU. Moreover, PU strongly and significantly predicted behavioral intentions to use technology [82–83].

Similarly, [84] found that PEU and PU positively impacted students' satisfaction with online educational classes. [44] also suggested that PEU and PU mediated the influence of factors such as educational quality, social influence, and perceived enjoyment on students' satisfaction with using e-learning systems. Additionally, [85] discovered a positive association between social presence, online learning self-efficacy, and student satisfaction, particularly within the online learning environments of the University of Jordan. In a systematic review, [86] highlighted the importance of improving self-efficacy, PEU, and the effectiveness of mobile learning platforms in education, [87] revealed that computer self-efficacy, social influence, enjoyment, PU, and PEU influenced the actual use of e-learning systems among university students. Finally, [88] demonstrated that the quality of content and service positively influenced the intention to utilize mobile learning platforms. Therefore, subsequent assumptions are suggested:

H9: "Student perceived usefulness positively affects students' satisfaction with the mobile app for learning management system."
H10: "Student perceived ease of use positively affects students' satisfaction with the mobile app for the learning management system."
H11: "Student enjoyment positively affects students' satisfaction with the mobile app for the learning management system."
H12: "Student social influences positively affect students' satisfaction with the mobile app for the learning management system."
H13: "Content quality positively affect students' satisfaction with the mobile app for the learning management system."
H14: "Mobile App for LMS self-efficacy positively affects students' satisfaction with the mobile app for the learning management system."

Taking into account the aforementioned concepts, this study explores what influences SS with LMS mobile applications, using SEM. It expands TAM by including external factors such as social influence, content quality, enjoyment, and self-efficacy with the mobile app for LMS. The proposed model demonstrated in Figure 1 considers the unique features of LMS mobile applications and students in online and blended learning. It investigates how these factors directly and indirectly impact SS through PEU and perceived usefulness.

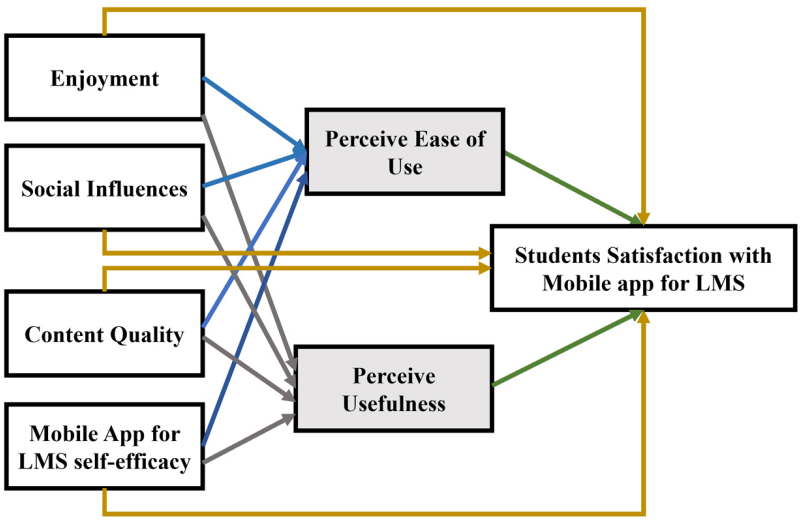

Fig. 1. The theoretical framework guiding the study

3 RESEARCH METHODOLOGY

In this study, quantitative study was employed using purposive sampling to understand and investigate relationships among variables. The target participants were undergraduate students with experience using mobile apps for LMS. Utilizing a purposive sampling approach proves effective when examining a specific area involving informed specialists or selecting experienced professionals within that domain. For instance, this method was applied to select university students who have experience using mobile apps for LMS.

The research took place during the first semester of the academic year 2022–2023 at Al-Ahliyya Amman University (AAU). The approval number (KMT-S-NRA-107) was issued by the ethics committee and is documented accordingly in compliance with ethical standards at AAU. Additionally, student consent was obtained for participation in the study. Students were informed of the study objectives, and then we collected data from students who wanted to be part of the study using a valid tool. In this study, the SEM technique was utilized. It is a statistical method commonly employed in quantitative study to examine the relationships between constructs and noted indicators.

3.1 Study setting

The study was conducted at AAU, a prominent private university in Jordan, dedicated to improving learning quality through effective and contemporary learning settings. At AAU, the Moodle LMS version 4.2.2 is fully implemented, including its mobile application. This LMS mobile app is a mobile version of Moodle and supports a variety of class formats, including traditional, blended, and fully online classes at AAU. All courses offered at AAU had a virtual course on the LMS, which was organized and directed by the course instructors. The Moodle LMS features a user-friendly interface that promotes accessibility and usability for both students and instructors. Moodle offers a wide range of educational activities and resources. The LMS provided instructional materials, platforms for quizzes, assignments, and exams, and facilitated interaction through discussions, wikis, and messages. Instructors could monitor students' participation and access statistical data regarding their achievements and activities, providing feedback as necessary. Students could access the LMS using their mobile app. The implementation of Moodle at AAU underscores the institution's commitment to leveraging technology to enhance teaching effectiveness and student learning outcomes.

The survey was given to participants in Arabic, the official language of Jordan. And distributed through a link shared in students' social media groups, such as WhatsApp, as well as posted on the LMS. Data collection occurred over three weeks.

3.2 Participants

The study population consisted of 5348 undergraduate students (43% female, 57% male) from AAU who were enrolled in the first term of the 2022–2023 academic year. All students at AAU are users of the Moodle LMS. The study sample included 475 undergraduates' students. Purposive sampling was applied among the study populations to accomplish the study's purposes. The relevant needed size for the study was verified using Thompson's equation [89] at a .05 error margin and

a 95% proportion of confidence. The inclusion criteria for the purposive sampling in this study at AAU are: 1) Undergraduates who were registered in the first semester of the academic year 2022–2023. 2) enrolled in at least one fully online course or blended learning course. 3) LMS mobile application users.

A total of 475 students participated in the study and met the inclusion criteria. Of these participants, 54.3% were male and 45.7% were female. The distribution of students by year of study was as follows: 34.3% were first-year students, 23.4% were second-year, 20.4% were third-year, and 21.8% were in their fourth year or beyond. Regarding academic performance, 32.4% of the students had an excellent GPA, 39.2% had a very good GPA, 22.5% had a good GPA, and 5.9% had a poor GPA. In terms of digital skills, 39.4% of the students reported having superb digital skills, 57.9% had outstanding digital abilities, and 5.9% had poor digital abilities. Additionally, 63.4% of the undergraduates were studying in scientific fields, 13.9% in the humanities, and 22.7% in health-related fields. The sample was suitable for the study, encompassing all undergraduates who were willing to participate. Table 1 presents the undergraduates' demographic data.

Table 1. The participants' demographic data (N = 475)

No.	Variable	Value	F	P
2	Gender	Male	258	54.3%
		Female	217	45.7%
3	Academic Level	First	163	34.3%
		Second	111	23.4%
		Third	97	20.4%
		Fourth and more	104	21.8%
4	GPA	Excellent	154	32.4%
		Very good	186	39.2%
		Good	107	22.5%
		Poor	28	5.9%
5	Level of Digital Skills	Excellent	187	39.4%
		Good	275	57.9%
		Poor	13	2.7%
6	Faculty	Scientific	301	63.4%
		Humanities	66	13.9%
		Health	108	22.7%

Note: F: frequency, P: percentage.

3.3 Data collection tools

An online self-report survey was employed to gather data for the study, consisting of two parts. The first part gathered demographic information, such as gender, faculty, academic level, digital skills, GPA, and the student's academic year level. The second part comprised seven subscales to assess study variables, which included PEU subscale, enjoyment (EN) subscale, SI subscale, CQ subscale, MSE subscale,

perceived usefulness (PE) subscale, and SS) subscale. A five-point Likert scale was used, with responses ranging from 1 (representing 'strongly disagree') to 5 (representing 'strongly agree'). These subscales were adapted from previously established scales available in the literature, as displayed in Table 2. An expert panel evaluated the content validity of the questionnaire. Furthermore, internal validity and reliability were confirmed by conducting a pilot study involving a sample of 60 undergraduate students from AAU who were not part of the study.

Pearson's numerical measures were calculated between each item within the subscale and the overall subscale score, all of which were statistically significant at $p < 0.05$ and fell within an acceptable range. Additionally, Cronbach's alphas were calculated for each subscale, as depicted in Table 2, confirming the validity and reliability of the questionnaire.

Table 2. Cronbach's alphas and Pearson correlation coefficient

Scale	Item	Statements	References	Range of r	α
PEU	1	I interact easily with the educational resources available on the mobile App for LMS (i.e., videos and files).	[90]	0.723–0.808	0.897
	2	I easily utilize the elements of the mobile App for LMS (i.e., forums and messages).			
	3	I engage with the mobile App for LMS effortlessly.			
	4	I easily navigate the activities of the mobile App for LMS (i.e., tests and assignments).			
EN	5	Using the mobile app for LMS stimulates my imagination.	[68, 90]	0.819–0.879	0.936
	6	Engaging with the mobile app for LMS sparks my interest.			
	7	I find using the mobile app for LMS enjoyable.			
	8	Using the mobile app for LMS sparks my curiosity.			
SI	9	My professors' beliefs influence my opinion about using the mobile app for LMS.	[68, 90, 91]	0.750–0.877	0.912
	10	My colleagues' beliefs influence my opinion about using the mobile app for LMS.			
	11	The beliefs of influential individuals regarding my behavior affect my opinion about using the mobile app for LMS.			
CQ	12	The resources and activities available on the LMS App meets all my educational needs.	[68]	0.770–0.812	0.908
	13	The resources and activities available on the LMS App is up-to-date.			
	14	The resources and activities available on the LMS App is organized and coordinated in a suitable manner.			
	15	The resources and activities available on the LMS App is of high quality in terms of design (quality of images, sound, and text).			

(Continued)

Table 2. Cronbach's alphas and Pearson correlation coefficient *(Continued)*

Scale	Item	Statements	References	Range of r	α
MSE	16	I feel assured using the mobile app for LMS, even without guidance from others.	[90, 92]	0.754–0.816	0.905
	17	I am confident in my ability to solve problems and overcome challenges while using the mobile app for LMS.			
	18	I have acquired the essential skills to effectively use the mobile app for LMS at my university.			
	19	I am confident in my ability to utilize the mobile app for LMS to accomplish my learning tasks.			
PU	20	Utilizing the mobile app for LMS enhances the effectiveness of my learning.	[90, 93]	0.684–0.866	0.914
	21	Utilizing the mobile app for LMS provides me with increased autonomy in my learning.			
	22	I believe that the mobile app for LMS enhances my learning.			
	23	I find that the mobile app for LMS useful in accessing educational content at any time and place.			
SS	24	I am pleased with the utilization of mobile App for LMS.	[94–96]	0.800–0.875	0.942
	25	I am satisfied with the quality of services provided by the mobile app for LMS.			
	26	I aim to keep utilizing the LMS mobile app moving forward.			
	27	I plan to suggest the mobile app for LMS to other students and colleagues.			
	28	Overall, I feel content with the quality of the mobile app for LMS.			

Notes: α: Cronbach's alpha; r: Pearson correlation coefficient.

3.4 Data analysis

SEM was the main statistical method used in this study to analyze the gathered data. It is sophisticated statistical methods that provide more reliable conclusions even when there is measurement error; it provides a framework for testing theoretical models and allows to examine complex relationships between variables, including direct and indirect effects, which traditional methods may not capture comprehensively, providing a holistic understanding of the phenomena under study [97].

The model was developed by specifying the latent factors (SI, EN, CQ, MSE, PU, PEU, and SS) and their respective observed indicators (survey items) based on the theoretical framework. Pearson's correlation analyses initially identified correlations between the variables, and the estimation method was conducted to test the hypothetical model. Afterward, we examined skewness and kurtosis to ensure a normal distribution, finding that the data showed a normal distribution with skewness

ranging from –0.508 to –0.973 and kurtosis ranging from 0.292 to 1.711 [98]. Linearity assumptions were also verified. The direct and indirect impacts of variables were examined within the organizational model, and various group SEM techniques were employed to explore moderator factors.

A critical ratio for differences highlighted a significant discrepancy at the $p < 0.05$ level. Given that the chi-square ($\chi 2$) statistic is influenced by sample size, we also considered other indicators such as the Comparative Fit Index (CFI), the Goodness of Fit Index (GFI), and the Root Mean Square Error of Approximation (RMSEA) to evaluate the GFI of the model. Hypotheses were tested based on the estimated results obtained from these assessments. The data was processed using AMOS software version 24.

4 FINDINGS

4.1 Initial analyses

Collinearity statistics between EN, SI, CQ, MSE, PU, PEU, and SS are displayed by extracting VIF results in Table 3.

Table 3. VIF results among the factors

Variable	PEU	EN	SI	CQ	MSE	PU	SS
PEU		2.874	2.994	2.828	2.767	2.990	2.977
EN	3.322		2.985	3.442	3.458	3.223	3.448
SI	1.648	1.422		1.588	1.639	1.649	1.649
CQ	3.673	3.869	3.746		3.457	3.882	3.715
MSE	4.995	5.400	5.373	4.803		4.639	5.356
PU	6.211	5.792	6.222	6.206	5.338		4.416
SS	5.310	5.322	5.343	5.101	5.293	3.792	1

Table 3 displays VIF results for collinearity statistics among all variables (PEU, EN, SI, CQ, MSE, PU, and SS). The VIF coefficients ranged between 1.422 and 6.222. The VIF value obtained is between 1 and 10. Which indicates that there are no multicollinearity symptoms.

4.2 Goodness of fit statistics

The results show that the CMIN was 3.935, the CFI was 0.929, the GFI was 0.828, and the RMSEA was 0.079. This implies that the model provides a precise representation of the observed data and effectively captures the relationships among variables in the dataset.

4.3 Test of the measurement pattern

As displayed in Figure 2 and Table 3, EN, SI, CQ, and MSE directly affected PEU and PU. Additionally, PEU and PU directly impacted SS. The model accounted for 87.1% of the difference in SS, 77.1% in PEU, and 86.9% in perceived usefulness.

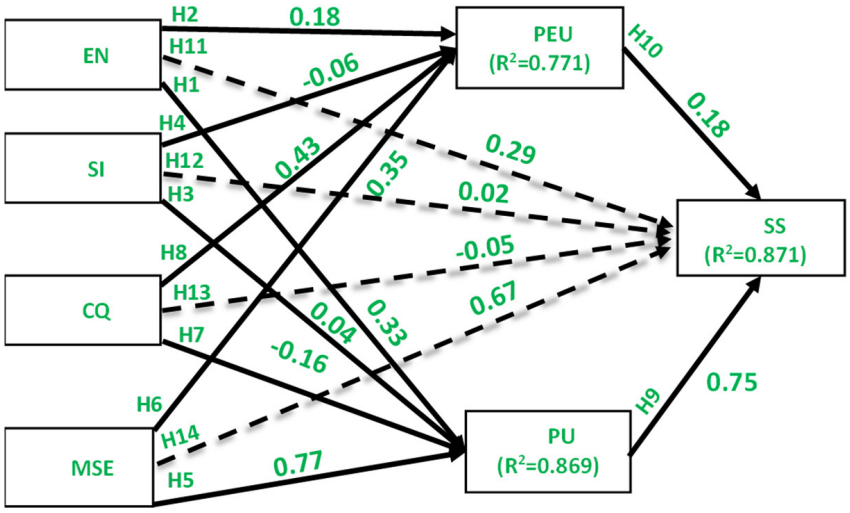

Fig. 2. Standardized coefficients of SEM for the model

Figure 2 likely displays the standardized coefficients obtained from the SEM analysis for the model. It reveals how strong and in which direction the relationships between the constructs are. These coefficients allow for a comparison of the relative importance of each construct in influencing the others. Overall, the analysis and results presented in the explanation suggest that the measurement model tested through SEM provides insights into the relationships between the constructs and their impact on SS, PEU, and perceived usefulness.

Table 4. Direct and indirect values between study variables

Hypotheses No.	Variables		Direct Effect	Indirect Effect	Result
2	EN	PEU	0.181*	–	AP
4	SI		0.058	–	UAP
8	CQ		0.429*	–	AP
6	MSE		0.347*	–	AP
1	EN	PU	0.327*	–	AP
3	SI		0.035	–	UAP
7	CQ		0.159*	–	AP
5	MSE		0.774*	–	AP
9	PU	SS	0.787*	–	AP
10	PEU	SS	0.178*	–	AP
11	EN	SS	–	0.289*	AP
12	SI		–	0.017	UAP
13	CQ		–	0.049*	AP
14	MSE		–	0.671*	AP

Note: *P < 0.05, AP: approved, UAP: unapproved.

From Table 4, it is revealed that all hypotheses have been proven, except for hypotheses (H3, H4, and H12), which were rejected, suggesting positive impacts for

EN, CQ, and MSE on PU, PEU, and SS when using the mobile app for LMS. Additionally, there are positive impacts for PU and PEU on SS from using the mobile app for LMS. Conversely, the results indicate no impact for SI on PU, PEU, and student satisfaction.

These outcomes suggest that the relationships proposed in the accepted hypotheses are supported by the analysis (see Figure 3), while the unaccepted hypotheses did not meet the predefined criteria.

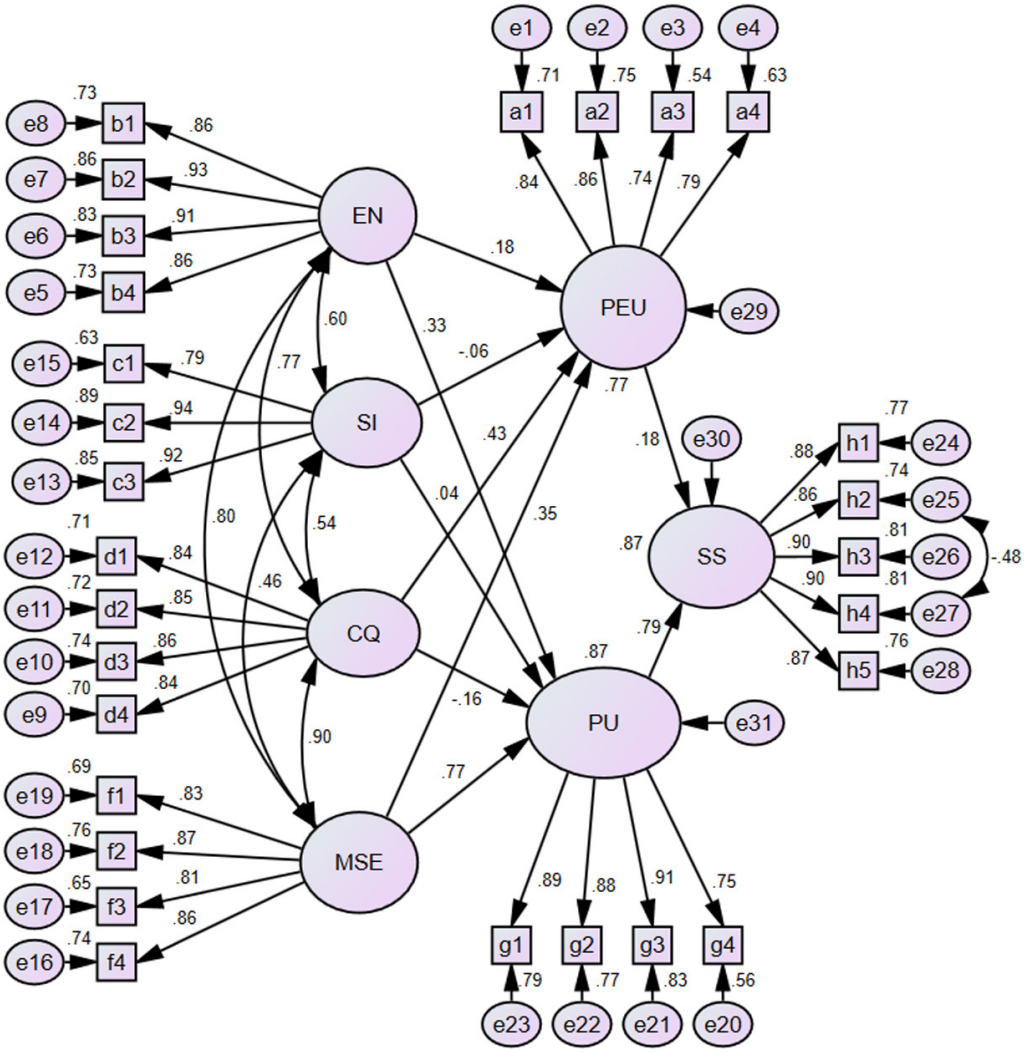

Fig. 3. The relationships proposed in the accepted hypotheses

5 DISCUSSION

This study examined SS with the mobile app for the LMS and the factors influencing it using the SEM approach, based on the TAM theory. Unlike prior study that has generally examined factors influencing satisfaction with eLearning systems or the acceptance and intention to use mobile applications, our study specifically targets the factors impacting students' satisfaction with the LMS Mobile App through the mediation of the TAM constructs PU and PEU of the LMS mobile app. Our findings reveal that factors such as EN, CQ, and MSE directly affect the PU of the LMS mobile app and PEU, which subsequently positively influence students' satisfaction with the

LMS mobile app. According to our model and structural equations, prioritizing EN, CQ, and MSE emerges as a pivotal approach for enhancing the success of e-learning and fostering students' satisfaction within an educational setting. These factors indirectly impact student satisfaction, thus influencing the effectiveness of e-learning systems. Therefore, emphasizing CQ, EN, and MSE leads to increased student satisfaction. The findings robustly supported the proposed study hypothesis and model.

Our study results are in line with previous findings indicating a relationship between content quality and PEU in LMS mobile learning. This underscores the importance of content quality in influencing SS with the platform. Therefore, when content quality is high, students are more satisfied. These results align with the study by [88], which found that content quality has significant and direct effects on the PU of mobile learning platforms, positively influencing the intention to use these platforms. However, it contradicts our finding that content quality has no significant effect on the PEU of mobile learning platforms.

The study findings indicate a direct influence of mobile applications on LMS self-efficacy on PEU and PU, which subsequently affects SS indirectly. This implies that students who are confident in their capacity to efficiently use the mobile application for LMS are more inclined to view it as convenient and advantageous, thereby elevating their overall satisfaction with the learning process. Essentially, students' confidence in their proficiency with the mobile application significantly influences their perceptions and satisfaction with the learning platform. This underscores the significant role of an individual's confidence in their capacity to utilize the LMS mobile application effectively for learning purposes. It encompasses confidence in students' skills, knowledge, and proficiency in utilizing the mobile application for LMS. This encourages decision-makers at the university to offer workshops and manuals for using and installing the mobile application for LMS, especially for first-semester students. These results are consistent with the study by [48], which found that computer self-efficacy affects both PEU and perceived usefulness.

The study revealed that student enjoyment significantly impacts PU, and PEU of the LMS mobile app. Moreover, it indirectly affects SS with the app. These findings are consistent with previous study, such as [44], which suggests that PEU and PU act as mediators between perceived enjoyment and satisfaction with e-learning systems. Similarly, [57] found that perceived enjoyment impacts PU and PEU, which subsequently affect the intention to use online platforms.

These results highlight the important role of personal feelings such as relaxation, joy, and pleasure when learning using new technology or applications on students' satisfaction. The study's results imply that if students perceive their learning experience as enjoyable on a new platform, they're more likely to see it as user-friendly and beneficial, leading to higher satisfaction. This underscores the importance of considering learners' enjoyment when implementing or designing online or blended learning courses, applications, or systems.

The analysis confirmed that the PEU and PU of the LMS mobile application directly impact students' satisfaction. These findings are consistent with previous study utilizing the TAM to examine factors influencing SS on e-learning and mobile platforms. For instance, [55] found that PEU and PU in online classes positively impact educational satisfaction. Similarly, [84] demonstrated that both PEU and PU significantly enhance student satisfaction. Furthermore, [99] and [100] revealed that PEU and PU positively influence user satisfaction in various contexts, including smartphone purchases. These findings suggest that improving e-learning platforms' usability and utility can enhance student satisfaction. Universities should offer continuous training and guidance to enhance students' PEU and provide instructional materials for using e-learning platforms.

These findings provide an intriguing perspective on the impact of social influences on mobile learning platforms and student satisfaction. The analysis indicates that social influences did not significantly impact PEU, PU, or student satisfaction. This aligns with the study findings of [58], which reported that subjective norms do not affect the PEU of e-learning systems, consistent with the current analysis. This suggests that individuals may not perceive their interactions with e-learning platforms as significantly influenced by the norms and expectations of their social circles. However, the study findings contrast with some previous study findings, such as [101], which found a strong influence of social factors, including peers and instructors, on students. This discrepancy indicates a potential variation in how social influences are perceived or experienced across different contexts or populations. While the current analysis did not find a direct impact of social influences, it is crucial to recognize that social pressures and expectations may still play a role in shaping attitudes and behaviors related to mobile learning and applications, possibly in more indirect ways or in combination with other factors.

However, the contradictory findings from [101], indicating a high influence of social influences, such as colleagues and instructors, on students, suggest a potential discrepancy in how social influences are perceived or experienced across different contexts or populations. While the current analysis did not find a direct impact, it is essential to acknowledge that social influences and pressures may still play a role in shaping attitudes and behaviors related to mobile learning and applications, although indirectly or in conjunction with other factors.

Additionally, the positive correlation found between subjective norms and PEU and PU [50] prompts further inquiry into the intricate dynamics of social influences within e-learning settings. It suggests that, in some cases, individuals may perceive greater utility or ease of use in e-learning systems when they perceive social approval or endorsement from their peers or instructors.

In summary, these contradictory results highlight the complex role of social influences in the realm of e-learning. While the current analysis did not find a direct impact, it's essential for future study to delve deeper into the mechanisms through which social influences shape perceptions and attitudes related to satisfaction. Understanding these dynamics can inform the design of more effective e-learning platforms and strategies for promoting student engagement and satisfaction.

6 CONCLUSIONS

This study investigated factors affecting SS with LMS mobile applications using structural equation modeling, which expanded on the TAM. The findings emphasize the significance of factors such as PU, content quality, PEU, enjoyment, and LMS self-efficacy in determining student satisfaction.

The extended of TAM. The findings emphasize the significance of factors such as PU, content quality, PEU, enjoyment, and LMS self-efficacy in determining student satisfaction. The findings showed that external factors such as content quality, enjoyment, and self-efficacy in using the mobile app for LMS directly impact the PU and PEU of the LMS mobile app. Consequently, this positively affects students' satisfaction with the LMS mobile app.

The results underscore the crucial role of satisfaction in ensuring the continued utilization of LMS mobile applications. By comprehending and addressing these factors, educational institutions, instructors, and developers can enhance the design and implementation of LMS mobile applications and e-courses, ultimately leading

to increased SS and engagement with e-learning platforms. Specifically, universities should consistently provide training to enhance students' self-efficacy with LMS mobile apps and workshops for instructors to develop enjoyable e-courses with high-quality content. Such initiatives have a direct effect on PU and PEU, leading to an enhancement in student satisfaction.

Looking ahead, further study in this domain can offer deeper insights into the dynamics of student satisfaction, informing ongoing improvements to LMS mobile applications to meet student needs. Additionally, this study highlights the pressing need for study on the social influences within e-learning environments, an area that has received limited attention and produced contradictory results thus far.

It's essential to acknowledge several limitations of this study. These include the relatively small sample size, which was drawn from a single private university in Jordan. Additionally, the investigation only touched upon external factors such as enjoyment, content quality, mobile app efficacy, and social influences to a limited extent. Rectifying these constraints in future study endeavors can lead to a more thorough comprehension of SS within e-learning environments.

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8 AUTHORS

Aseel Ajlouni is an Assistant Dean for Development, Academic Advising, and Community Service at the School of Educational Sciences, the University of Jordan. She has published several research papers on integrating technology in the classroom, online teaching and learning (E-mail: a.ajlouni@ju.edu.jo).

Asmaa AlOmary is an Associate Professor in educational studies majoring in Islamic approach. She is currently working at Al-Ahliyya Amman University, College of Arts and Sciences, Department of Social and Human Sciences. Her research interests include educational studies and e-learning, Islamic Studies.

Mohammad Al-Smadi is a Lecturer at Middle East University. His research interests include computer graphic design, multimedia, applied interfaces in e-learning, and blended learning.

Mohammad Al-Abdallat is a Lecturer at the Faculty of Educational Sciences at Zarqa University, Zarqa, Jordan. His research interests include: education, artificial intelligence technology in education, mobile learning, e-learning, and blended learning.

Ferial Abu Awwad is a Professor in Educational Psychology at the School of Educational Sciences and Vice Dean of the Faculty of Graduate Studies for Humanities Affairs at the University of Jordan.