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Research Article

System Quality and Student's Acceptance of the E-learning System: The Serial Mediation of Perceived Usefulness and Intention to Use

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Abstract

This study explores the mechanism through which system quality influences e-learning system acceptance. Precisely, this study aims to examine how perceived usefulness and intention to use serially mediate the impact of system quality on actual use. The data were collected from three public universities in Jordan. Structural equation modeling was employed to examine 336 questionnaires. The findings reveal that system quality significantly affects perceived usefulness and intention to use, perceived usefulness significantly affects intention to use and actual use, where the intention to use significantly affects actual use of the e-learning system as well. Furthermore, the study also confirms that system quality does not affect the e-learning system actual use directly but indirectly and serially through the two acceptance variables, perceived usefulness and intention to use. Thus, this study improves the understanding of student's acceptance and behavior towards the e-learning system in Jordan public universities and the effect of system quality attributes on this relationship. Also, this study set certain directions for the decision-makers and university management in designing their strategies.

Keywords: actual use, e-learning system, intention to use, perceived usefulness, serial mediators, system quality

INTRODUCTION

Academic institutions invest in e-learning system to derive several educational and non-educational benefits; for-instance, quick access to education, learner's flexibility to interact, greater self-efficacy, knowledge creation, and reduction in cost (Alkhawaja & Abd Halim, 2019). E-learning systems are advanced internet-based applications that academic staff, students, and trainers use at educational institutions. Combining Information Communication Technology (ICT) with education resulted in e-learning system platforms implementation in higher education with positive impacts on educational goals in developing countries, such

as increased student learning, effective management, and reduced cost (Alkhawaja & Abd Halim, 2019; Bhuasiri et al., 2012; Hadullo et al., 2017; Kanwal & Rehman, 2017; Mwakyusa & Mwalyagile, 2016).

Despite the growing importance of e-learning systems, developing countries are struggling to offer successful e-learning systems. Among the announced e-learning projects in the developing context, only 15% were successful, 40% partially failed, and 45% failed (Almaiah et al., 2020). In Jordan, many public university students do not use e-learning systems and prefer traditional face-to-face interaction (Jaber, 2016; Kanwal & Rehman, 2017), and this lack of usage could be a major reason for the e-learning system failure (Shah & Attiq, 2016). However, the main reason behind the non-adoption of e-learning systems can be associated with technological problems (Al-araibi et al., 2019). Therefore, the determinants of students' level of acceptance of the e-learning system in developing countries should be explored. To fill the identified research gap, this study uses the Technology Acceptance Model (TAM) of Davis (1989) expanded by the DeLone & McLean Information System Success Model (William & Ephraim, 2003) to investigate how system quality influences the actual use of e-learning systems among Jordanian students through serial mediation of the acceptance variables; perceived usefulness and intention to use.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Information System Success Model (DL&ML)

Due to the inter-related, complex, and multi-dimensional structure of information systems, early attempts remained nascent in conceptualizing information system success. To manage inconsistencies, DeLone and McLean (1992) presented a success model that was later improved to address changes in the information system over time. The modified DL&ML model comprises six elements: system quality, information quality, service quality, user satisfaction, intention to use, and outcomes. Users' positive experience with a system improves intention to use and satisfaction, which further influences the individual and organization level (DeLone & McLean, 2003). **Figure 1** shows an example of modified DL&ML model.

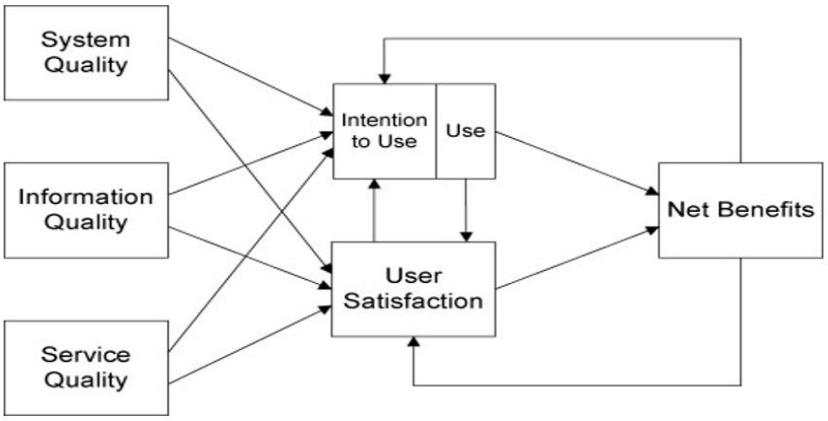

Figure 1. The updated IS success model (DeLone & McLean, 2003)

Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) (Bagozzi et al., 1992) is a common model behind explaining the acceptance of information systems. TAM outlines the procedural relationship between belief and behavior via attitude and intention, enabling an understanding of new technology adoption specially in the education field (Maphosa, 2021). This model helps explain the factors influencing behavioral intention to accept and adopt new technologies from end-users' perspectives (Chao, 2019). The model is an extension of Fishbein's theory of reasoned action (Fishbein, 1979). TAM posits that perceived usefulness and perceived ease of use drive individuals' attitudes toward their intention to use an information system, which may be converted into the actual use of the information system. Also, perceived usefulness may have a direct impact on perceived ease of use. Among the components of TAM, both perceived usefulness and perceived ease of use are the

principal determinants that directly or indirectly explain the behavioral intention to accept new technologies (Lai, 2019). In the context of the information system, the D&M model and TAM are the most popular models used to explain the adoption and success of information systems in education (Abdullah & Ward, 2016; Almaiah, 2018; Almaiah et al., 2016, 2020). **Figure 2** shows an example of TAM.

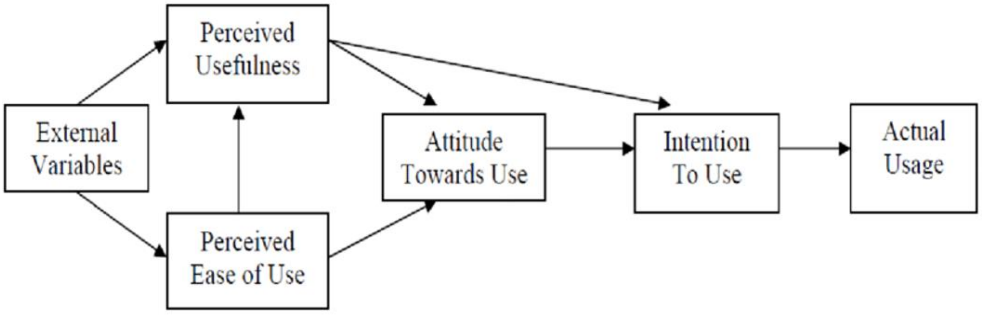

Figure 2. Technology Acceptance Model (TAM)

The Effect of System Quality on Acceptance

System quality is reflected through the functionalities of a system that are supposed to best address user needs with ease and minimal disruption (William & Ephraim, 2003). System quality has been found to be a key determinant of the system's success and has a strong direct influence on perceived usefulness from students' perspective (Alshurideh et al., 2019; Calisir et al., 2014; Rui-Hsin & Lin, 2018). For example, in a sample of 189 university students, Jaber (2016) found that 70% of the respondents mentioned that they prefer and would use beneficial e-learning systems that save effort and time and are available at any time with quick navigation tools. Accordingly, this study posits the following hypothesis:

H1 System quality in terms of adaptability, availability, reliability, usability, and response time has a significant effect on perceived usefulness.

Moreover, users are more likely to use an information system perceived as useful (Ma'arop & Embi, 2016). Likewise, the value that students can gain from a system is a main element in assessing the students' intention to use the educational information system (Calisir et al., 2014; Davis, 1989; Fathema et al., 2015; Hariguna et al., 2017). Almaiah and Alismaiel (2019) illustrated that perceived usefulness is one of the most significant factors of users' intentions towards the usage of learning systems. Accordingly, the following hypothesis is posited:

H2 Perceived usefulness has a significant effect on the intention to use.

The TRA, which is the basis for TAM, posits that behavioral intentions are the most common predictors of human behaviors. Hence, an individual's intention to carry out a specific task is the instant predictor of actual behavior (Ajzen & Fishbein, 1980). Behavioral intentions are derived through certain motivational factors, which are "indications of how hard people are planning to try and how much effort they are planning to exert to perform the behavior" (Ajzen, 1991, p. 181) In the e-learning context, Almaiah and Alyoussef (2019) confirmed the positive impact of intention to use on actual use. Hence, the following hypotheses are posited:

H3 Intention to use has a significant effect on actual use.

H4 Perceived usefulness and intention to use serially mediate the relationship between system quality and actual use.

Ghazal et al. (2017) revealed that system quality has a greater impact on user intention to use, and e-learning systems with technical issues and other difficulties may negatively impact user intention to use it. According to Costa et al. (2016), although system quality plays an important role in determining intention to use, usage depends on the features that a system offers. Therefore, the following hypothesis is posited.

H5 System quality in terms of adaptability, availability, reliability, usability, and response time has a significant effect on the intention to use the e-learning system.

Almaiah and Alismaiel (2019) suggested that perceived usefulness is a crucial factor affecting the use of information systems, and users will use a system if they find it beneficial for their performance. Furthermore, prior research established the statistically positive impact of perceived usefulness on actual use (Alenazy et al., 2019; Algunto et al., 2017; Larmuseau et al., 2018). Thus, the following hypothesis is posited:

H6 Perceived usefulness has a significant effect on actual use.

Systems that are easy and available and have attractive features will encourage users to use the system more often (Mohammadi, 2015). Freeze et al. (2010), Zuama et al. (2017), and Aldholay et al. (2018) found a positive effect of system quality on e-learning system actual use, and supported the significant impact of system quality on students' actual use. Therefore, the following hypothesis is posited:

H7 System quality in terms of adaptability, availability, reliability, usability, and response time has a significant effect on actual use.

RESEARCH METHODOLOGY

Instrument Development

This study used a quantitative approach in which a survey was developed and adapted from several established work as shown in **Table 1**. **Figure 3** shows the theoretical framework of our study. Items were rated on a ten-point interval scale from "Strongly Disagree" to "Strongly Agree." Three specialists who were PhD holders in information system, management, and management information science involved in the e-learning field evaluated each question of the instrument, and appropriate changes were made. Using back-to-back approach, the instrument was translated to the Arabic language as it is the respondent's native language. Also, distributing the survey in Arabic is expected to increase the understanding level, which make answering it easier and, accordingly, increase the response rate. The survey was proceeded with a cover letter and directions to fill the survey, Then, a pre-test was conducted on 50 students selected randomly from two public universities to enhance the instrument development based on student understanding (Alkhawaja et al., 2020). Finally, a pilot study was conducted on 150 students from three public universities and 120 response questionnaires were analyzed. Using IBM-SPSS version 24, data was checked and found to be normally distributed and free of outliers. Then, the reliability of items was tested. The five dimensions of system quality, perceived usefulness, intention to use, and actual use were found reliable with Cronbach's alpha > 0.7 as illustrated in **Table 1**.

Sampling and Data collection

The population of the current study comprised all public university students in Jordan. According to the Ministry of Higher Education (MOHE), there are more than 209,000 students in 10 public universities in Jordan. Four public universities were selected using multi-stage cluster sampling, one from the north, two from the middle, and one from the south regions. The data were collected through a self-administrated survey by distributing 422 questionnaires among the students from February to April 2019. Of these, 369 questionnaires were returned, producing a response rate of 93%. Of these, 336 questionnaires were suitable for analysis. The collected data was tested and found to be normally distributed and free of outliers.

Table 1. Instrument development

Construct	Dimension	Source	Number of items	Cronbach's alpha
System quality	Adaptability	(Amin et al., 2016; Liao & Huang, 2009; Ren et al., 2017)	6	0.914
	Availability	(Al-Fraihat et al., 2020; Amin et al., 2016; Ren et al., 2017)	5	0.844
	Response Time	(Amin et al., 2016; Freeze et al., 2010; Ren et al., 2017)	4	0.875
	Reliability	(Ren et al., 2017; Udo et al., 2011)	4	0.854
	Usability	(Almaiah & Al Mulhem, 2018; Koohang & Paliszkiewicz, 2016)	5	0.849
Perceived usefulness		(Almaiah & Alismaiel, 2019; Ghazal et al., 2017; Wong, 2015)	6	0.914
Intention to use		(Calisir et al., 2015; Mohammadi, 2015; Tsai et al., 2017)	6	0.946
Actual use		(Bastola et al., 2019; Freeze et al., 2010; Mohammadi, 2015)	6	0.958

Of the respondents, 184 (55%) were female, and 152 (45%) were male. Concerning age, 122 (36%) respondents were in the age of 18 to 22, 153 (46%) were in the age range of 23 to 26, and 61 (18%) were within the age group of 27 years and above. Furthermore, most respondents (50%) had 8 to 10 years of internet experience, while 112 (33%) respondents had 4 to 7 years of internet experience, and only 14 (5%) students had 1 to 3 years of experience using the Internet.

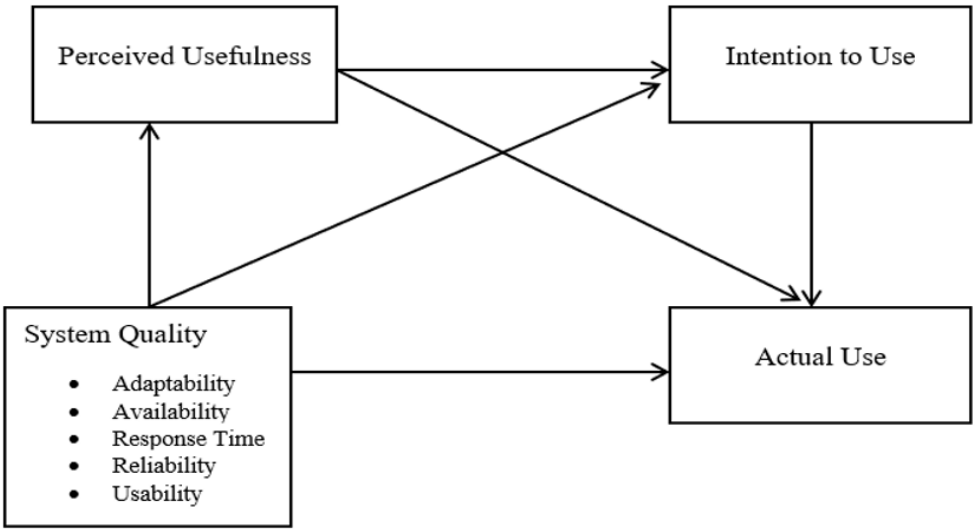

Figure 3. Theoretical framework

Measurement Model

Structural Equation Modeling (SEM) through AMOS 24 was employed to determine the construct validity and examine hypothesized paths. Confirmatory Factor Analysis (CFA) was conducted to assess the discriminant and convergent validity during the first stage. In this regard, the measurement model was developed. As illustrated in **Table 2**, the model fitness indices showed that the measurement model is fit with all fit indices falling under the recommend range i.e., CFI > 0.90, TLI > 0.90, $\chi 2/df < 3$, RMSEA < 0.08 (Bagozzi & Yi, 1988; Bollen & Hoyle, 2012; Browne & Cudeck, 1992; Hair et al., 2014). Bagozzi and Yi (1988) suggested that the convergent validity of the constructs will be satisfied if the value of composite reliability (CR) > 0.7, standardized factor loadings > 0.5 and average variance extracted (AVE) > 0.5. System quality scored 0.973 CR and 0.878 AVE, perceived usefulness scored 0.948 CR and 0.759 AVE, intention to use scored 0.940 CR and 0.731 AVE and actual use scored 0.957 CR and 0.791 AVE.

Table 2. Fitness indices for measurement model

Fit indices	Measurement model				Cut off value
	System quality	Perceived usefulness	Intention to use	Actual use	
χ2	554.639	24.911	26.750	26.801	
p value	000	002	002	002	
χ2 /df	2.150	2.968	2.972	2.798	< 3
AGFI	.930	.944	.931	.941	≥ .80
TLI	.979	.989	.986	.988	≥ .90
CFI	.980	.992	.992	.993	≥ .90
IFI	.980	.993	.992	.993	≥ .90
RMSEA	.059	.073	.077	.077	≤ .08

Using the Fornell and Larcker (1981) method, the discriminant validity was evaluated. **Table 3** reveals that the value of the square root of AVE on the diagonal is larger than the corresponding correlation among the variables. So, discriminant validity is also satisfied.

Table 3. Discriminant validity

	CR	AVE	ITU	SYSQ	PU	AU
ITU	0.940	0.731	**0.855**			
SYSQ	0.973	0.878	0.722	**0.937**		
PU	0.948	0.759	0.805	0.689	**0.871**	
AU	0.957	0.791	0.609	0.480	0.649	**0.889**

Note: Squared AVE are reported in the diagonal

Structural Model and Hypotheses Testing

After the assessment of the measurement model, a structural model was developed to examine the hypothesized paths. In this study, the second-order construct system quality was simplified and transformed into a first-order construct through an item-parceling procedure (Awang et al., 2015). **Table 4** and **Figure 4** shows that the model is fitted with all fit indices fall under the recommended range (Chisq/df<3; CFI>0.90; TLI>0.90; RMSEA<.08) (Bagozzi & Yi, 1988; Bollen & Hoyle, 2012; Browne & Cudeck, 1992; Hair et al., 2014).

Table 4. Fitness indices for structural model

Fit indices	Structural model	Cut off value
χ2	476.198	
p-value	0.000	
χ2 /df	2.126	< 3
AGFI	0.869	≥ .80
TLI	0.972	≥ .90
CFI	0.975	≥ .90
IFI	0.975	≥ .90
RMSEA	0.058	≤ .08
SRMR	0.0346	≤ .08

Table 4 presents the results of the hypotheses testing. **H1** posited that system quality in terms of adaptability, availability, reliability, usability, and response time would significantly affect perceived usefulness. **H1** was supported as the standardized β value (0.689) from system quality to users' perceived usefulness was significant with $p < 0.05$. **H2** posited that perceived usefulness would have a significant impact on students' intention to use. **H2** was also supported as the standardized β value (0.585) from perceived usefulness to users' intention to use is significant with $p < 0.05$. **H3** posited that students' intention to use would have a significant effect on actual use. **Table 4** shows that **H3** is supported because the standardized β value (0.254) from users' intention to use to actual use was significant with $p < 0.05$. **H5** posited that system quality in terms of adaptability, availability, reliability, usability, and response time would significantly affect students' intention to use the e-learning system. **H5** is supported as the standardized β value (0.319) from system quality to users' intention to use is significant with $p < 0.05$. **H6** posited that students' perceived usefulness

would have a positive impact on actual use. **H5** was supported as the standardized β value (0.456) from perceived usefulness to actual use was significant with $p < 0.05$. **H7** posited that system quality would have a direct effect on students' actual use of e-learning systems. As **Table 5** shows, **H7** was not supported as the standardized β value (-0.017) from system quality to actual use is insignificant with a p-value greater than 0.05. **Table 4** shows the results of the hypothesis testing, and **Figure 4** illustrates the structural model.

Table 5. Results of hypotheses testing

			Estimate	S.E.	p-value
PU	←	SYSQ	.689	.047	***
ITU	←	PU	.585	.049	***
ITU	←	SYSQ	.319	.048	***
AU	←	ITU	.254	.084	.002
AU	←	PU	.456	.081	***
AU	←	SYSQ	-.017	.069	.794

Testing of Serial Mediation (H4)

As SEM programs, like AMOS, offer greater flexibility and model specification and estimation options, the indirect effect, and total effect will be calculated simultaneously using AMOS software, and the specific indirect effect for each mediator will be calculated using AMOS user-defined estimands (Amos Development Corporation, 2013). Additionally, Preacher and Hayes (2008) recommended performing the resampling method of bootstrapping (Bollen & Stine, 1990). In this technique, the indirect effect is considered statistically significant if its confidence interval (upper and lower) does not contain zero or a p-value less than 0.05 in statistical programs (Hayes, 2012; Pieters, 2017). The bootstrapping method was performed using AMOS with 1000 bootstraps and 95% confidence intervals. The result of bootstrapping can be reported to demonstrate the presence of a mediation relationship in a model by proving the significance of the indirect effects (Hayes, 2009).

The results in **Table 6** demonstrate that the indirect effect through both mediators serially is significant. Additionally, the total indirect effect of the serial mediators in the link between system quality and actual use was confirmed to be significant. Hence, **H4** is well supported.

Table 6. Bootstrapping results of mediating hypotheses

Path	Estimate	S.E.	Lower	Upper	p-value	
SYS-PU-AU	.102	.045	.023	.208	.004	Significant
SYS-ITU-AU	.049	.031	.008	.137	.015	Significant
SYS-PU-ITU-AU	.177	.053	.033	.279	.002	Significant
Total Effect	.204	.097	.008	.394	.042	Significant

CONCLUSIONS AND DISCUSSION

In the last decade, information systems have revolutionized the learning environment of educational institutions. This is very true in developed countries. However, in developing countries, e-learning systems are taking time to be accepted by users. Drawing on the TAM and D&M model framework, the current study examined how perceived usefulness and intention to use serially mediate the impact of system quality on actual use. Results showed that system quality is significantly linked with perceived usefulness. This finding supports previous studies (Alshurideh et al., 2019; Cheng, 2012; Hariguna et al., 2017). This result indicates that e-learning systems with a high level of quality will be perceived as a useful system by students.

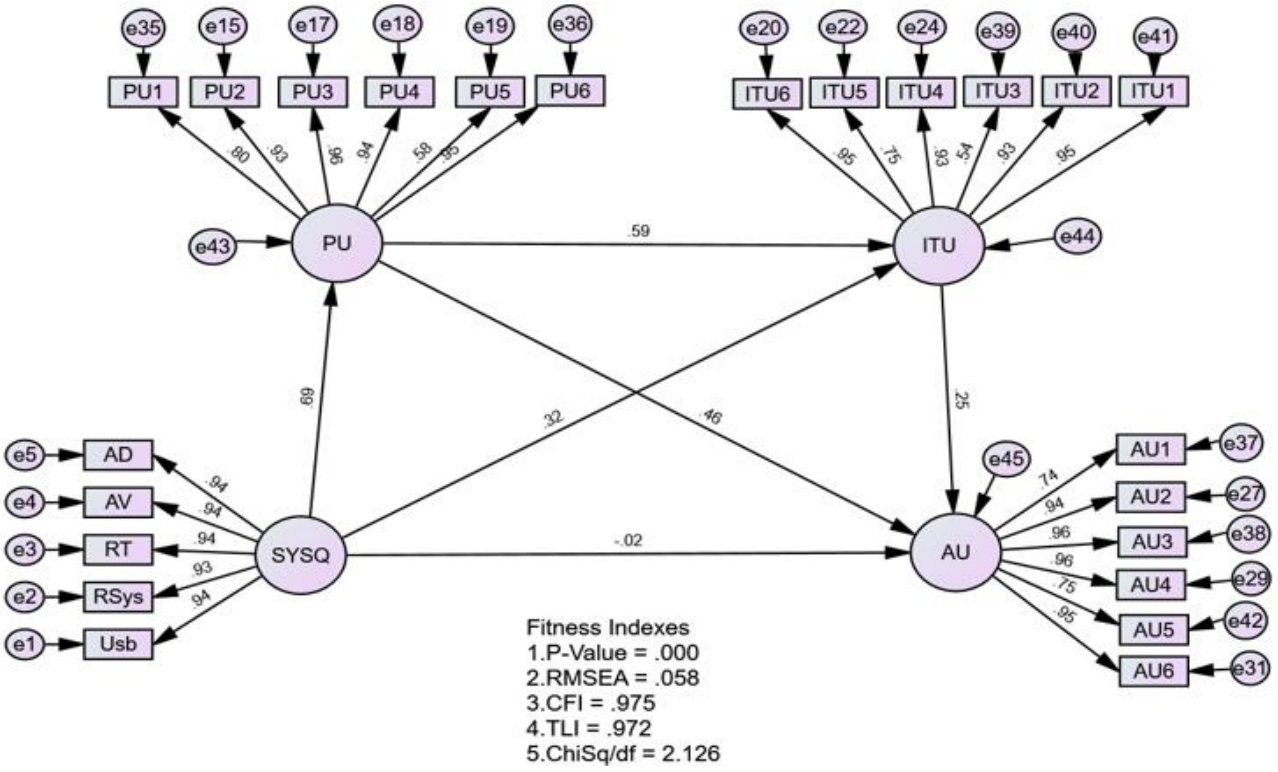

Figure 4. Structured model

This study found that perceived usefulness was significantly and positively linked with users' intention to use, supporting many studies (Alshurideh et al., 2019; Calisir et al., 2014; Davis, 1989; Fathema et al., 2015). This finding indicates that when students perceive the e-learning system as useful, they will develop their intentions towards using or keep using the e-learning system.

In addition, this study reveals a positive association between users' intention to use and actual use, which supports prior studies (Salloum et al., 2019; Sharma, 2019). However, the direct effect of system quality on actual use was insignificant. This result might be related to student's expertise level in using information systems in general and the e-learning system specifically, where students with more experience will tend to overcome the difficulties in using a system (Freeze et al., 2010). Another reason might be related to the freedom of use; if the usage of the e-learning system is compulsory, students will be forced to use an e-learning system regardless of its low quality (Yakubu & Dasuki, 2018). Another possible reason that students in Jordan Universities use the e-learning system to reach studying materials not to use activities, which leads the students to be forced to use the e-learning system to get the materials regardless of the system quality or the difficulties that they might face (Hijazi et al., 2020).

These direct causation relations resulted in an indirect effect of system quality on student's actual use. Consequently, both mediators serially and significantly mediated the effect of system quality on actual use. This finding supports the theoretical rationale of TAM, where user's behaviors can be predicted from the number of benefits they gain from using an information system; if the information system is useful for their performance, users develop their intentions to use the information system, which leads to final behavior, the actual use (Davis, 1989; Venkatesh et al., 2000).

This study concludes that system quality does not directly affect students' actual use of the e-learning system. Instead, students' actual behavior towards using the e-learning system in Jordan public universities is related to a series of psychological actions that result in actual use. The level of system quality offered by the e-learning system in public universities affects the student's actual use indirectly, where system quality is linked with student's level of usefulness that they gain from using the e-learning system, which is linked with their positive intentions to use these systems, which finally leads to their decision actually to use the e-learning system.

Understanding the mechanism of acceptance is vital for universities as student's acceptance and usage is the anchor of the system success. Students are the most important stakeholders that interact with the system and can determine the system difficulties, defects and errors. Decision makers in universities are advised to pay extra attention to the factors that affect student's acceptance and actual use of the e-learning system to ensure the success of implementation.

LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

The current study has certain limitations. First, this study is cross-sectional. Therefore, future study is required to examine the influence of e-learning systems on actual use over a certain period, as e-learning systems need time to get familiar with a particular context. Second, this study employed a cross sectional method through distributing surveys to collect information due to time and cost restraints. Future study is recommended to experiment to assess the effectiveness of e-learning system through interviews to explore more in-depth factors behind the actual use. Future studies can incorporate service quality and information to provide a more comprehensive understanding of the factors affecting the actual use.

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Data availability: Data generated or analysed during this study are available from the authors on request.

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