Exploring the Impact of Technology Attributes on Usefulness and Acceptance of Technology: A Study on e-University Learning Systems

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***Abstract*—The global COVID-19 epidemic has had a considerable influence on the educational sector, leading to a shift away from traditional education and toward e-learning education. This change has made it more difficult for students to adopt modern technologies, such as e-learning systems. The objective of this research is to investigate the influence of technological attributes on the usefulness and acceptance of e-learning systems among Jordanian students. A convenience sample of 343 questionnaires was distributed to Jordanian private university students and evaluated using a five-point Likert scale. The descriptive statistics and sub-hypotheses were examined with SPSS regression analysis. The main hypotheses were evaluated using SEM in AMOS. The study found that technology attributes significantly impact the perceived usefulness and acceptance of e-learning systems, both jointly and separately. Acceptance of e-learning systems has been positively impacted by perceived usefulness. Moreover, it found that acceptance of e-learning systems has been positively impacted by technology attributes via usefulness. The study suggested that universities and educational institutions address these attributes to improve students' perceived usefulness and acceptability of e-learning technologies.**

***Keywords*—technology attributes, perceived usefulness, technology acceptance, e-learning systems, higher education**

I. Introduction

The technology revolution is presently ushering in a new age for humanity. Maintaining knowledge in a variety of domains is one of the most important behavioral characteristics of functioning civilizations. Over its lengthy history, humanity has undergone numerous stages of development, starting with the slow but steady acquisition of knowledge. Knowledge exchange and preservation have undergone unprecedented changes as a result of the technological revolution of the contemporary era. Therefore, rapid technology makes it easy for people to obtain information [1]. In addition, the internet, cellphones, and computers have all contributed to the increased accessibility and transferability of information compared to earlier times. Nowadays, a large quantity of information can be technology-saved, and users may quickly access a wealth of knowledge on a range of issues. These technologies can assist human learning and knowledge growth in fascinating ways [2]. Furthermore, it has been found that these innovative technologies increase individual enthusiasm and engagement, which raises academic performance [3]. The internet, in particular, has transformed the way information is exchanged and kept. Social media, blogs, and other online platforms have evolved into spaces where people as well as organizations may interact and collaborate to generate new knowledge [4]. Copious amounts of data are maintained on the internet and online databases, where anybody with an internet connection may quickly access them. With the increasing opportunities and challenges brought about by the technology revolution, it is more vital than ever to utilize discretion and critical thinking while obtaining and using knowledge.

By the end of 2019, the COVID-19 pandemic had reached approximately 213 countries and territories globally [5]. In an effort to halt its rapidly expanding outbreaks, most countries have imposed strong social distancing regulations and shuttered superfluous enterprises, including those in higher education. According to Mailizar *et al.* [6, 7], the COVID-19 epidemic has created severe disruptions in higher education systems around the world, with numerous countries closing their schools, colleges, and universities. Furthermore, during this time, COVID-19 began controlling students' personal lives, making traditional ground-based learning impossible [8]. In Jordan, the Higher Education Ministry has recommended all educational institutions mandate e-learning technology. As a result, all universities, colleges, and schools had to adjust to give classes using e-learning technologies [9]. This sudden, abrupt transformation has raised numerous issues for both universities and students. This move to e-learning has compelled universities to modernize their technological infrastructure, implement e-learning systems or platforms, give staff and students training on how to utilize e-learning technology successfully, and select high-quality information and content [10, 11]. Furthermore, following the COVID-19 outbreak, the Higher Education Ministry of Jordan mandated that universities and educational institutions deliver 10%–20% of their courses via e-learning

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technologies.

In the Jordan context, several studies have explored the influence of technology attributes on the usefulness and acceptance of e-learning systems. Al-Okaily *et al*. [12] found that perceived usefulness and ease of use directly influence e-learning acceptance, with partial support for the mediation effect. Masa'deh *et al*. [13, 14] found positive correlations between student satisfaction, behavioral intention, and quality characteristics, while Barakat *et al*. [15] found unsatisfactory or very unsatisfactory experiences with e-learning. Nsairat *et al*. [16] deemed e-learning a viable alternative. Al-Tammemi [17] suggest Jordanian students should be encouraged to adopt e-learning systems, while Al-Momani *et al.* [18] found average academic issues during the Corona pandemic, and Al-Gharaibeh *et al*. [19] recommend limiting e-learning to emergency cases and certain subjects.

The use of technology in e-learning has increased recently [20, 21]. The COVID-19 epidemic has highlighted the significance of integrating technology into education. Technology was crucial to ensuring that learning continued despite the constraints of educational institutions having to transition to remote learning. According to Tagimaucia *et al*. [22], technology is the only method to connect students during these challenging times. Furthermore, the COVID-19 epidemic has underlined the importance of investing in an effective technology infrastructure. Many countries and nations encountered obstacles such as insufficient internet availability, a lack of device access, and students and instructors with inadequate skills. To address these gaps, governments, educational institutions, and technology firms have collaborated to close the digital divide and provide equal access to education for everyone. During this period, innovative teaching approaches have arisen that use a variety of technological systems and platforms to provide high-quality education. Virtual classrooms, video conferencing, e-learning management systems, and interactive educational tools are already commonplace for many students and teachers [22, 23]. These technology attributes allow teachers to create interesting and interactive learning experiences that encourage student cooperation and engagement, even in distant settings. In addition, there are a number of issues that require constant attention and development, including protecting the confidentiality and security of student data, granting equal access to technology, and resolving the drawbacks of online education. In conclusion, e-learning technologies have become more popular, and the necessity for a new infrastructure for them has become evident as a result of the COVID-19 epidemic and technology [24–26]. It is crucial to fully utilize e-learning's potential for the benefit of future generations, as it presents countless opportunities to enhance teaching and learning.

The study's novelty lies in focusing on students' experiences and attitudes with e-learning technology provided by universities after five years post-COVID-19. Moreover, the study aims to fill knowledge gaps and provide insights for higher education institutions to enhance e-learning success and expand educational opportunities.

Thus, the main goal of this study is to evaluate the impact of technological attributes on the usefulness and acceptance of e-learning systems by Jordanian students after the COVID-19 epidemic and Jordanian universities' five-year e-learning implementation. Based on the introduction provided above, the objectives of this study are as follows:

1) To determine and clarify the effects of technology attributes on students' perceptions of the usefulness and acceptance of e-learning systems.
2) Understanding the rationale for adopting or rejecting e-learning systems relevant to technological attributes.
3) To add to the body of knowledge about technology's usefulness and acceptance.
4) This study can help university administrators understand why students use or reject e-learning technologies.

In light of the previously mentioned objectives, the present study aims to answer the following questions:

1) To what extent do technological attributes influence students' perceptions of the usefulness of e-learning systems?
2) To what extent can technological attributes affect students' acceptance of e-learning systems?
3) To what degree can usefulness, as a moderator, have a significant impact on the relationship via technological attributes and the acceptance of e-learning systems?

II. Literature Review

A. E-Learning System

Numerous academic institutions have created extensive e-learning systems, which are now essential for conducting remote education. E-learning had been known, but it had never become a part of our lives until the COVID-19 epidemic [22, 27]. E-learning is defined as educational activities in which students are taught directly or indirectly using electronic technology, applications, and the internet [28, 29]. E-learning is a process of delivering, organizing, and managing e-learning activities within a system, including student enrollment, tests, assignments, course descriptions, lesson plans, communications, syllabuses, essential course resources, and so on [30]. According to Farid *et al*. [31], an e-learning system may include (i) learning methods (lecture, discussion, guided practice, reading, games, case studies, and simulation), (ii) delivery methods (live classroom or computer-mediated), (iii) scheduling (synchronous or asynchronous), and (iv) levels of guidance. E-learning system components may affect students' overall learning experiences and may offer a framework for assessing the technological attributes of an e-learning system [32].

B. Technology Attributes

Some technological attributes have an impact on the usefulness and acceptance of the e-learning systems discussed and investigated in this study, such as ease of use, system quality, content quality, and system usefulness. They are presented below.

C. Ease of Use (PEU)

Ease of Use (PEU) is defined as the degree to which students believe using an e-learning system will be simple [33, 34]. Azahar [35] states that the success of any information system is determined by how users use it. In this study, perceived ease of use refers to students' views towards the assumption that using a learning system will improve their learning experiences and performance. Furthermore, previous studies [36–40] have shown that perceived ease of use has a significant impact on the usefulness and acceptance of e-learning systems and technology.

D. System Quality (SQ)

System quality refers to the attributes associated with the features, functionality, speed, and content of the university's e-learning system [41]. The willingness and acceptability of students to use an e-learning system have been determined to be critical to its performance [42]. Users will be more likely to use systems that are simple, accessible, and offer appealing features [43]. In this study, system quality refers to how factors such as accessing or navigating, responsiveness, layout and design, and attractive appearance influence users' perceptions of e-learning systems. Furthermore, studies by Al-Adwan *et al*. [44–47] found that system quality has an influence on the usefulness and acceptance of e-learning systems, while Jung *et al*. [48] highlights that system quality, information quality, and service quality are crucial for an e-learning system's success.

E. Content Quality (CQ)

Content quality refers to the level of materials and information offered to students via the e-learning system. According to Alzahrani and O'Toole [49], content quality is a student's assessment that programs are applicable, up-to-date, and sufficient. Content quality is crucial for students when deciding whether to continue using the online platform for learning activities after completing the present courses. Furthermore, Nikou and Maslov [50] refers to content quality indicators as relevancy, ease of perception, readability, format, level of detail, and timeliness. In this context, content quality refers to material that is easy to absorb, meets the specified requirements, is clear and understandable, and is provided in an appropriate format. Previous studies by Al-Fraihat *et al*. [45, 46, 51–53], found that content quality significantly influences the usefulness and acceptance of e-learning systems, while Bandura [54] found no significant influence.

F. System Efficacy (SE)

Efficiency is one of the attributes considered crucial to system quality. System efficiency is the ability of the system to provide desired results while using as few resources as possible. The usefulness and acceptance of e-learning technologies are measured by the number of activities performed by students and the ability of the system to achieve their study goals and objectives quickly and accurately [55, 56]. In other words, system efficiency is determined by how effectively inputs are transformed into outputs [57]. In this context, a higher level of e-learning efficiency signifies effective learning and application. Studies by Alayacyac *et al*. [58–64] have found that system efficacy enhances student satisfaction and acceptance of technology, while technical problems decrease satisfaction and acceptance of technology, according to Elshami *et al*. [65, 66].

G. Perceived Usefulness (PU)

Perceived Usefulness (PU) is known as the extent to which people think using modern technology will help them perform better at work [67, 68]. Similarly, Kaur *et al*. [33, 69], described perceived usefulness as the degree to which users believe that a system can support them in achieving teaching and learning objectives. Moreover, if students believe the system is extremely beneficial, they are more likely to ignore potential usability limitations, resulting in greater acceptance rates. On the other hand, if students believe the system is ineffective, even if it is simple and of excellent quality, they may reject its implementation. Investigating predictors of the perceived usefulness of the system will assist in determining the appropriate settings and conditions that ensure higher levels of engagement and continuity. Numerous studies have found that the usefulness of e-learning systems significantly influences their acceptance. This is supported by Mailizar *et al*. [40, 44, 46, 70–74], while Taat *et al*. [75, 76] found that the usefulness had no impact on acceptance of e-learning systems.

H. Acceptance of the System (Acceptance)

In their research, [77, 78], distinguish between the terms technology acceptability and technology acceptance, with technology acceptability referring to one's perception of a system prior to use and technology acceptance referring to one's perception of the system after use. Acceptance of technology is defined as the likelihood of potential users using it for their duties [79–81]. Acceptance of technology is recognized as one of the most important prerequisites for the e-learning system's efficacy. In this study, technology acceptance refers to students' perceptions regarding the e-learning system as a means of receiving education, continuing to use the system in the future, and recommending the system to colleagues. Studies by Ajina *et al*. [29, 53, 82, 83], found that technology attributes had a significant impact on acceptance of the system. Conversely Ho *et al*. [84–86] found no impact.

III. MATERIALS AND METHODS

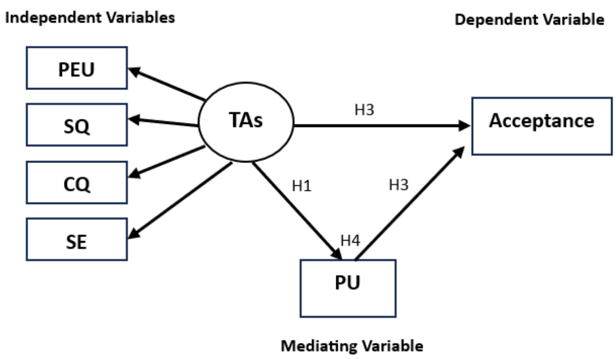

Fig. 1. Proposed model for the relationship between the variables of Technology Attributes (TAs), Perceived Usefulness (PU), and perceived acceptance (Acceptance) of the e-learning system.

This section explains the study's model. The proposed model, illustrated in Fig. 1, investigates the main hypotheses. As shown in Fig. 1, Technology Attributes (ATs) are used as independent variables—Perceived Ease of Use (PEU), System Quality (SQ), Content Quality (CQ), and System Efficacy (SE)—and Perceived Usefulness (PU) and Perceived Acceptance (Acceptance) of e-learning systems as dependent variables. Moreover, Perceived Usefulness (PU) is used as a mediator to investigate the relationship between Technology Attributes (ATs) and perceived acceptance (Acceptance) of the e-learning systems.

A. Data Collection

The sample for this study was made up of undergraduate students from Jordan's private universities. 347 questionnaires were collected using a convenient sampling technique, and 23 were invalid due to missing information. Therefore, 324 questionnaires were valid for statistical analysis, or 93% of the total. SPSS and AMOS were used to analyze the data. Sub-hypotheses and descriptive statistics are analyzed using regression in SPSS, and the main hypotheses were evaluated using the SEM in AMOS. The questionnaire was divided into two sections. The first section of the questionnaire gathered demographic information from participants, such as their gender, study level, and college affiliation. In the second section, participants were asked to evaluate several technology attributes on a Likert scale ranging from 1 to 5, with 1 indicating strongly disagree and 5 indicating strongly agree. They were also asked to evaluate the e-learning system's usefulness and acceptance using the same scale.

B. Descriptive Statistics

Table 1 illustrates the characteristics of the research sample based on the student gender, study level, and college affiliation. According to students' gender, 52.7% were females, while the remaining 47.3% were males. As for students' studying level, 29.3% of the students were first-year students, 37.4% were second-year students, 19.3% were third-year students, and 14% were fourth-year students. Furthermore, the study also examined the students' college affiliation. The majority of students (42%) attended humanities colleges, while the remaining 58% attended science colleges.

Table 1. Demographics sample categorized according to the student gender, study level, and college affiliation

Demographics		Frequency	Percent	Cumulative Percent
Student gender	Male	162	47.2	47.2
	Female	181	52.8	100.0
Student study level	First year	101	29.3	29.3
	Second year	128	37.4	56.7
	Third year	66	19.3	86
	Fourth year	48	14	100.0
Student college affiliation	humanity colleges	144	42.0	42.0
	Science colleges	199	58.0	100.0

C. Questionnaire Analysis

Table 2 presents the mean and standard deviation of responses to study statements. The mean scores show that participants had attitudes toward the statements, since all means were greater than the scale mean of 3.00, indicating a positive outcome. The statement "there is little effort required to interact with the system" scored the highest mean with 4.070/5.00, suggesting that participants found that interaction with the system does not require much effort. While the statement "I will advise e-learning to my colleagues" had the lowest mean score of 3.405/5.00, indicating that participants were less inclined to recommend the system to their colleagues, Moreover, Table 2 presents the means for all the variables included in the study, and each variable had a mean higher than the scale mean of 3.00, indicating that the respondents had positive opinions on each variable. The variable "ease of use" had the highest mean score of 3.868/5.00, indicating that participants perceived the system to be easy to use, while the variable "content quality" had the lowest mean score of 3.605/5.00.

Table 2. Descriptive statistics of the technology attributes, usefulness and acceptance

	Statement	M	S.D	Alpha	Tolerance	VIF
Ease of Use	It takes a little skill to use the system.	4.053	1.103	0.784	0.426	2.347
	It is easy to become familiar with the system.	3.720	1.218			
	The system provides the necessary confidence.	3.630	1.228			
	Interaction with the system does not require much effort.	4.070	0.944			
	Mean	3.868	0.880			
System Quality	I have no difficulty accessing or navigating the system.	3.975	1.000	0.864	0.270	3.705
	The system provides an immediate response.	3.580	1.170			
	Layout and design are applicable.	3.712	1.113			
	The system has an attractive appearance.	3.716	1.123			
	Mean	3.746	0.930			
Content Quality	The content is easy to absorb.	3.724	1.186	0.807	0.391	2.557
	The content is clear and understandable.	3.588	1.204			
	The system meets the specified requirements.	3.523	1.211			
	The system presents the information in an appropriate format.	3.584	1.155			
	Mean	3.605	0.947			
System Efficacy		3.749	1.098	0.768	0.328	3.045
	Using the system allows me to learn more successfully.	3.975	1.032			
	The system improves my learning performance.	3.403	1.337			
	The system helps me do tasks quickly.	3.700	1.170			
	The system saves me time.	3.700	1.171			
	Mean	3.709	0.961			
Usefulness		3.447	1.362	0.866		
	The system is helpful in my studies.	3.642	1.272			
	The system improves my ability to do tasks.	3.811	1.198			
	The system allows me to complete tasks.	3.720	1.160			
	Mean	3.640	1.058			

Acceptance	I decided to use the system to receive my education.	3.638	1.342	0.936
	I will continue using the system in the future.	3.551	1.342	
	I plan to use the system in the future.	3.724	1.318	
	I will recommend the system to my colleagues.	3.405	1.361	
	Mean	3.612	1.229	

D. Internal Consistency and Validation

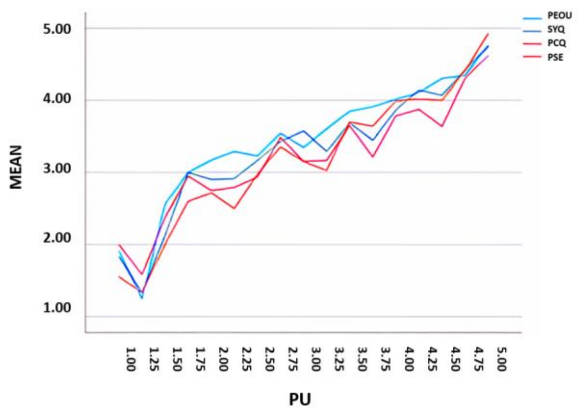

Fig. 2. Relationship between the variables of Technology Attributes (TAs)—Perceived Ease of Use (PEU), System Quality (SQ), Content Quality (CQ), and System Efficacy (SE)—and perceived acceptance (Acceptance). and Perceived Usefulness (PU).

Cronbach alpha was used to evaluate the scale's reliability, as shown in Table 2, and alpha values greater than > 0.70 indicated a reliable scale, as stated by Gujarati and Porter [87]. Cronbach alpha results show that all values are above a standard threshold of 0.70, indicating that the study's scale is reliable. Table 2 shows that the Variance Inflation Factor (VIF) values are less than 10, indicating that the variables do not exhibit considerable multicollinearity. A VIF value below 10 is considered acceptable. Furthermore, the tolerance values in Table 2 are greater than 0.10, indicating the lack of multicollinearity. A tolerance value above 0.10 indicates that there is no excessive correlation between predictor variables. Therefore, based on the alpha values for internal consistency and the VIF and tolerance values for multicollinearity, the scale used in the study is reliable, and there is no multicollinearity among the variables as suggested by Shevlin and Miles [88]. Furthermore, Fig. 2 illustrates the relationships between each independent variable mentioned in the hypotheses related to perceived usefulness. The technology attributes' independent variables—ease of use, system quality, content quality, and system efficacy—have a positive relationship with perceived usefulness, the dependent variable, as they tend to go upward in line. This indicates that when the independent variables of the technology attributes go up, so does perceived usefulness.

IV. Result and Discussion

A. Testing of Sub-Hypotheses

This study used a regression analysis to evaluate the relationship between the independent variables (ease of use, system quality, content quality, and system efficacy) and the dependent variables (usefulness and acceptance of e-learning systems). Table 3 and Table 4 present the findings.

Table 3. Results of impact of technology attributes on perceived usefulness of the system

ANOVA					
R	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**F**	**Sig.**
0.840	0.705	0.700	0.57900	142.404	0.000
Coefficients					
	B	**Std. Error**	**Beta**	**t**	**Sig.**
Ease of use	0.293	0.065	0.244	4.528	0.000
System quality	0.041	0.077	0.036	0.526	0.599
Content quality	0.068	0.063	0.061	1.079	0.282
System efficacy	0.632	0.068	0.575	9.356	0.000

Table 4. Results of impact of technology attributes on perceived acceptance of the system

ANOVA					
R	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**F**	**Sig.**
0.693	0.515	0.498	0.63332	107.632	0.000
Coefficients					
	B	**Std. Error**	**Beta**	**t**	**Sig.**
Ease of use	0.467	0.054	0.377	8.595	0.000
System quality	0.369	0.069	0.249	4.375	0.000
Content quality	0.162	0.067	0.132	2.142	0.002
System efficacy	0.337	0.066	0.281	5.362	0.000

As indicated in Table 3, the regression analysis findings reveal that the technological attributes of e-learning systems have a favorable influence on the perceived usefulness of the system. The *F* value (142.404) is statistically significant (*Sig.* = 0.000), indicating that there is a significant relationship between the independent variables of technology attributes and the dependent variable perceived usefulness of an e-learning system. This finding supports sub-hypothesis H1. Furthermore, the correlation coefficient (R) = 0.840 suggests a significant positive relationship between technology attributes and perceived usefulness. The coefficient of determination (adjusted R^2) = 0.700 indicates that the technology attributes of e-learning systems examined in this study account for 70% of the variance in perceived usefulness. The remaining 30% can be attributed to technological attributes that were not considered. Additionally, simple regression analyses were used to investigate the effect of each individual variable on perceived usefulness. The variables ease of use and system efficacy had significant coefficients ($P \leq 0.05$) on perceived usefulness. However, the variables of system quality and content quality did not have a significant impact on perceived usefulness, as evidenced by their coefficients (*Sig.* > 0.05).

As shown in Table 4 the regression analysis findings suggest that the relationship between the independent variables (technology attributes) and the dependent variable (acceptance of the e-learning system) is statistically significant, as indicated by the estimated F value of 107.632 (*Sig.* = 0.000). This finding supports sub-hypothesis 2. Furthermore, the correlation coefficient (R) = 0.693 indicates a significant positive relationship between technology attributes and systems' acceptance. According to the adjusted (R^2) = 0.498 coefficients of determination, the technology attributes of e-learning systems investigated in this study account for. 49.8% of the variance in system acceptance. Other technological attributes that were not explored could account for the remaining 51.2%. Additionally, simple regression analyses were conducted to determine how every variable impacted system acceptance. The study found significant coefficients ($P \leq 0.05$) for ease of use, self-efficacy, system quality, and content quality, indicating their impact on system acceptance. Moreover, Fig. 3 shows the relationships between each independent variable mentioned in the hypotheses related to perceived acceptance. The independent variables of technology attributes—ease of use, system quality, content quality, and system efficacy—have a positive relationship with perceived acceptance, the dependent variable, as they tend to go upward in line. This means that when the independent variables of technology attributes go up, so will perceived acceptance.

B. Testing Main Hypotheses

To examine the study's main hypotheses, a variety of fit indices should be used, as recommended for SEM applications. As shown in Table 5, the ($\chi 2/df$) is estimated at 4.087, which is lower than the suggested value of 5. This shows that the model accurately fits the data. The AGFI was found to be 0.833, exceeding the advised threshold of 0.80. This suggests a good match between the models. The RMSEA was found to be 0.061, which is less than the desired threshold of 0.10. This suggests a good fit between the model and the data. The NFI is 0.901, the CFI is 0.959, and the GFI is 0.936. All of these indicators exceed the usual value of 0.9, demonstrating the model's adequacy. Finally, Table 5 shows that all indicators fall within the recommended range as recommended by Shevlin and Miles [88–91]. As a result, the model meets the study's requirements.

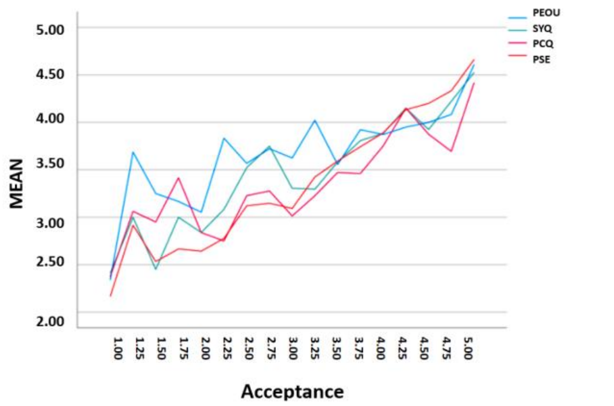

Fig. 3. Relationship between the variables of Technology Attributes (TAs)—Perceived Ease of Use (PEU), System Quality (SQ), Content Quality (CQ), and System Efficacy (SE)—and perceived acceptance (Acceptance).

Table 5. Values of fit indices for the structural equation model

Indicator	AGFI	χ2/df	GFI	RMSEA	CFI	NFI
Value of Recommended	> 0.80	< 5	> 0.90	≤ 0.10	> 0.9	> 0.9
Value of Model	0.833	4.087	0.936	0.061	0.959	0.928

Moreover, in this study, the main hypotheses were evaluated using the path coefficient analysis of the SEM method. Table 6 and Fig. 2 illustrate an overview of the direct and indirect impacts of the latent variables. There are direct and indirect effects from the data, and all of them are significant at $P < 0.05$. The following are hypotheses that were proposed and their findings:

The results from Table 6 and Fig. 4 of the path model suggest that the technology attributes of the e-learning system used in this study have a positive and direct impact on perceived usefulness. The t-value for this relationship is 29.801, and the standardized coefficient (β) for this relationship is 0.89, and it is statistically significant with a p-value of .000. Therefore, hypothesis (H1) can be accepted based on these results. Similarly, the results of Hypothesis H2 indicate that technology attributes have a significant direct effect on the acceptance of e-learning systems. The t-value for this relationship is 2.927, and the standardized coefficient is 0.395. The p-value is .003, indicating that this relationship is statistically significant at the 0.05 level. This supports hypothesis (H2). Additionally, hypothesis H3 examines the impact of perceived usefulness on the acceptance of e-learning systems. The t-value for this relationship is 3.622, and the standardized coefficient is 0.474. The p-value is .000, indicating that this relationship is also statistically significant at the 0.05 level. This supports hypothesis (H3). Lastly, hypothesis H4 focuses on the indirect effect of technology attributes on the acceptance of e-learning systems through perceived usefulness. The results indicate that this indirect effect is statistically significant. The standardized coefficient is 0.352. The p-value is .000, indicating that this indirect effect is significant at the 0.05 level. This supports hypothesis (H4). Overall, the results support the hypotheses that the technology attributes directly influence perceived usefulness and the acceptance of e-learning systems. Additionally, technology attributes indirectly impact the acceptance of e-learning systems through their effect on perceived usefulness.

Table 6. Direct and indirect testing results

Variables			Direct impact	Indirect impact	T-value	P	Results
Perceived usefulness	<----	Technology attributes	0.890		29.801	0.000	Accepted
Acceptance of the system	<----	Perceived usefulness	0.395		2.927	0.003	Accepted
Acceptance of the system	<----	Technology attributes	0.474	0.352	3.622	0.000	Accepted

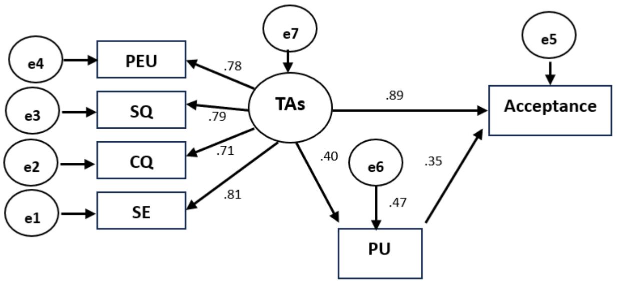

Fig. 4. Direct and indirect results between the variables of Technology Attributes (TAs)—Perceived Ease of Use (PEU), System Quality (SQ), Content Quality (CQ), and System Efficacy (SE)—Perceived Usefulness (PU), and perceived acceptance (Acceptance) of the e-learning systems.

C. Discussion

The purpose of this study was to find out students' perceptions regarding the technology attributes of e-learning systems offered by Jordanian private universities. This study used a quantitative approach, with a questionnaire distributed to 343 Jordanian students. These students were selected because they frequently use e-learning systems in their studies and are familiar with the technology. Based on the facts presented, it is concluded that all hypotheses were accepted in this study.

The study revealed that technological attributes improved perceived usefulness and acceptance of e-learning systems. Furthermore, the findings demonstrated a positive relationship between technological attributes and acceptance of the e-learning system, using perceived usefulness as a mediator.

The study emphasizes the importance of technological attributes in attracting students and fostering positive attitudes toward the e-learning system. The study's first sub-hypotheses were confirmed, and the results showed that technological attributes impacted the perceived usefulness of e-learning systems. The study's findings suggest that upgrading technological attributes might increase perceived usefulness. The study found that perceived usefulness was positively impacted by ease of use (β = 24.4%; P = 0.000) and system efficacy (β = 57.5%; P = 0.000), but not by system quality (β = 3.6%; P = 0.059) or content quality (β = 6.1%; P = 0.028). The findings of ease of use and system efficacy agree with the studies of [36, 38–40, 58–64], but contrast with the studies of [44–47, 51–53].

The study's second sub-hypothesis was confirmed, providing evidence that supports the idea that strengthening the technology attributes proposed in this study can lead to increased e-learning system acceptance. In addition, all technology attributes of ease of use, system quality, content quality, and system efficacy had a significant impact on e-learning system acceptance. The findings indicated that ease of use (β = 37.7%; P = 0.000), system quality (β = 24.9%; P = 0.000), content quality (β = 13.2%; P = 0.002), and system efficacy (β =.28.1%; P = 0.000) had a positive and statistically significant impact on perceived acceptance of e-learning systems. The findings on ease of use, system quality, content quality, and system efficacy agree with the studies of [36–40, 44–46, 51–53, 58–64], while disagreeing with the study of [54], who found that the content quality had no significant influence.

The SEM analysis also found that technology attributes significantly impacted the perceived usefulness and acceptance of e-learning systems, both directly and indirectly. The perceived usefulness was positively impacted by technology attributes, including ease of use, system quality, content quality, and system efficacy (β = 89%; P = 0.000). The acceptance of e-learning systems was significantly impacted by technology attributes (β = 47.4%; P = 0.000). The acceptance of e-learning systems had also been positively impacted by technology attributes (β = 0.395; P = 0 .003). Furthermore, the findings showed that the acceptance of e-learning systems was positively impacted by technology attributes via perceived usefulness (β = 35.2%; P = 0.000). The study findings agree with previous studies of [29, 53, 82, 83], who found technology attributes had a significant impact on perceived usefulness and acceptance of e-learning systems, while disagreeing with previous studies of [84–86], who found no impact. Furthermore, the results of this study are consistent with the studies of [40, 44, 46, 70–74], who found that perceived usefulness has a direct impact on acceptance of e-learning systems, while disagreeing with the studies of [75, 76]. Moreover, this study confirms Jordanian research that perceived usefulness and ease of use directly influence e-learning acceptance, positively affecting student satisfaction, behavioral intention, and quality attributes [12–14, 21, 67]. The study differs from previous research [15], which revealed unsatisfactory student experiences.

The e-learning system in Jordan gained popularity during and after the COVID-19 pandemic, with students increasingly relying on electronic learning technologies for their studies. The study's findings give evidence to support the idea that improving e-learning technology attributes can lead to higher usefulness and acceptance due to ease of use, system quality, content quality, and system efficacy. Perceptions of the system's usefulness and acceptance also increase future attendance. Universities need to measure student acceptance levels, identify and eliminate difficulties, and provide reliable service measurement to ensure e-learning systems are accepted and student satisfaction is achieved.

The study found that students in Jordan's private universities have positive attitudes towards e-learning activities, indicating that the usefulness of technology attributes is widely accepted. Understanding the advantages and benefits of technology attributes is crucial for the success of e-learning activities. As a result, educational institutions should provide students with opportunities to acquire e-learning skills and allocate resources to enhance their technology skills, thereby motivating them to embrace e-learning systems and their technology.

V. Conclusions

In recent years, e-learning has emerged as one of the most convenient ways to acquire knowledge and skills without having to attend in-person classes. E-learning technologies are being used by educational universities all around the world in times of emergency (COVID-19) as well as to reach out to students who are located far away. The purpose of this study was to better understand the impact of technological attributes on the perceived usefulness and acceptance of e-learning systems in institutions of higher education. The study found, through various statistical analyses, that all indicated technological attributes (ease of use, system quality, content quality, and system efficacy) have a significant positive impact on perceived usefulness and acceptance of e-learning systems. Furthermore, perceived usefulness of technology has a significant positive impact on the attributes and acceptance of the e-learning system as a mediator. The study suggested that universities and educational institutions address the technological attributes identified in this study to increase students' perceived usefulness and acceptance of e-learning systems.

Moreover, this study, like other empirical studies, has limitations. First, our study's findings were based on self-administered questionnaires and respondents' perceptions. The study had a limited sample size, which was obtained in Jordan. Therefore, future studies should increase the sample size to improve the validity of the results, and these findings should be used with caution in other contexts. Second, the sample included survey participants from private universities. A future study might involve investigating public universities and examining differences across a wide range of education levels. Finally, this study focused on four independent variables; future studies might consider more variables to gain a more complete picture of the topic.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Conceptualization, JMMJ and FO; methodology, AMZ; validation, JMMJ, ONB, and AMZ; formal analysis, AAA; investigation, NAA; resources, AAA; data curation, FO and ONB; writing—original draft preparation, JMMJ and AAA; writing—review and editing, ONB and NAA; supervision, JMMJ; project administration, FO and AMZ. All authors have approved the last version.

References

[1] M. L. Bernacki, J. A. Greene, and H. Crompton, "Mobile technology, learning, and achievement: Advances in understanding and measuring the role of mobile technology in education," *Contemporary Educational Psychology*, 2020, vol. 60, 101827. https://doi.org/10.1016/j.cedpsych.2019.101827

[2] V. Getuli, P. Capone, A. Bruttini, and S. Isaac, "BIM-based immersive Virtual Reality for construction workspace planning: A safety-oriented approach," *Automation in Construction*, vol. 114, 103160, Mar. 2020. doi: 10.1016/j.autcon.2020.103160

[3] J. Zhu *et al*., "The impact of short videos on student performance in an online-flipped college engineering course," *Humanities and Social Sciences Communications*, vol. 9, no. 1, Sep. 2022. doi: 10.1057/s41599-022-01355-6

[4] J.-A. Moreira, A. Reis-Monteiro, and A. Machado, "Higher education distance learning and e-learning in prisons in Portugal," *Comunicar*, vol. 25, no. 51, pp. 39–49, Feb. 2017. doi: 10.3916/c51-2017-04

[5] J. M. M. Joudeh, N. A. Abu-Loghod, J. A. Khader, I. L. Mukattash, A. M. Zamil, and M. Abu-Samak, "An assessment of healthcare services in Jordanian public hospitals from the perspective of COVID-19 patients in the aftermath of COVID-19," *International Journal of Membrane Science and Technology*, vol. 10, no. 4, pp. 612–619, Sep. 2023. doi: 10.15379/ijmst.v10i4.2099

[6] M. Mailizar, A. Almanthari, S. Maulina, and S. Bruce, "Secondary school mathematics teachers' views on e-learning implementation barriers during the COVID-19 pandemic: The case of Indonesia," *Eurasia Journal of Mathematics Science and Technology Education*, vol. 16, no. 7, p. em1860, May 2020. doi: 10.29333/ejmste/8240

[7] N. N. Luu, C. M. Yver, J. E. Douglas, K. K. Tasche, P. G. Thakkar, and K. Rajasekaran, "Assessment of YouTube as an educational tool in teaching key indicator cases in otolaryngology during the COVID-19 pandemic and beyond: Neck dissection," *Journal of Surgical Education*, vol. 78, no. 1, pp. 214–231, Jul. 2020. doi: 10.1016/j.jsurg.2020.06.019

[8] J. M. M. Joudeh, M. Allan, N. A. Abu-Loghod, J. A. Khader, and J. A. Al-Gasawneh, "Are customers behaving differently in the post-COVID-19 era, and how is this affecting worker satisfaction?" *International Journal of Membrane Science and Technology*, vol. 10, no. 3, pp. 2727–2736, Sep. 2023. doi: 10.15379/ijmst.v10i3.2029

[9] S. Al-Salman and A. S. Haider, "Jordanian university students' views on emergency online learning during COVID-19," *Online Learning*, vol. 25, no. 1, Mar. 2021. doi: 10.24059/olj.v25i1.2470

[10] L. Canals and A. Al-Rawashdeh, "Teacher training and teachers' attitudes towards educational technology in the deployment of online English language courses in Jordan," *Computer Assisted Language Learning*, vol. 32, no. 7, pp. 639–664, Dec. 2018. doi: 10.1080/09588221.2018.1531033

[11] M. I. Alkhawaja and M. S. B. A. Halim, "Challenges of e-learning system adoption in Jordan higher education," *International Journal of Academic Research in Business and Social Sciences*, vol. 9, no. 9, Sep. 2019. doi: 10.6007/ijarbss/v9-i9/6317

[12] M. Al-Okaily, H. M. Alqudah, A. Matar, A. Lutfi, and A. Taamneh, "Impact of COVID-19 pandemic on acceptance of e-learning system in Jordan: A case of transforming the traditional education systems," *Humanities & Social Sciences Reviews*, vol. 8, no. 4, pp. 840–851, Sep. 2020. doi: 10.18510/hssr.2020.8483

[13] R. Masa'deh, D. Almajali, A. Alrowwad, R. Alkhawaldeh, S. Khwaldeh, and B. Obeidat, "Evaluation of factors affecting university students' satisfaction with e-learning systems used during COVID-19 crisis: A field study in Jordanian higher education institutions," *International Journal of Data and Network Science*, vol. 7, no. 1, pp. 199–214, Dec. 2022. doi: 10.5267/j.ijdns.2022.11.003

[14] M. Alksasbeh, M. Abuhelaleh, M. A. Almaiah, M. Al-Jaafreh, and A. A. Karaka, "Towards a model of quality features for mobile social networks apps in learning environments: An extended information system success model," *International Journal of Interactive Mobile Technologies (iJIM)*, vol. 13, no. 05, p. 75, May 2019. doi: 10.3991/ijim.v13i05.9791

[15] M. Barakat *et al.*, "The era of e-learning from the perspectives of Jordanian medical students: A cross-sectional study," *Heliyon*, vol. 8, no. 7, p. e09928, Jul. 2022. doi: 10.1016/j.heliyon.2022.e09928

[16] N. Nsairat, H. N. Fakhouri, R. Alsawalqa, and F. Hamad, "Music students' perception towards music distance learning education during COVID-19 pandemic: Cross-sectional study in Jordan," *International Journal of Interactive Mobile Technologies (iJIM)*, vol. 16, no. 06, pp. 135–158, Mar. 2022. doi: 10.3991/ijim.v16i06.27193

[17] A. B. Al-Tammemi, "The battle against COVID-19 in Jordan: An early overview of the jordanian experience," *Frontiers in Public Health*, vol. 8, May 2020. doi: 10.3389/fpubh.2020.00188

[18] M. O. Al-Momani, I. G. Alrabadi, M. M. Al-Mzary, H. M. Danaa, and S. S. Al-Jarah, "Academic problems facing university students under the corona pandemic from their viewpoints," *IJERI International Journal of Educational Research and Innovation*, no. 19, pp. 187–208, May 2023. doi: 10.46661/ijeri.6411

[19] S. Al-Gharaibeh, H. A. Hijazi, H. M. Alzoubi, A. A. Abdalla, L. S. Khamash, and N. Y. Kalbouneh, "The impact of e-learning on the feeling of job alienation among faculty members in Jordanian

universities," *ABAC Journal*, vol. 43, no. 4, Sep. 2023. doi: 10.59865/abacj.2023.50

[20] R. Navarrete and S. Luján-Mora, "Bridging the accessibility gap in open educational resources," *Universal Access in the Information Society*, vol. 17, no. 4, pp. 755–774, Mar. 2017. doi: 10.1007/s10209-017-0529-9

[21] D. Almajali, Q. Hammouri, and S. Barakat, "E-learning through COVID-19 crisis in developing countries," *International Journal of Pharmaceutical Research*, vol. 13, no. 01, Apr. 2021. doi: 10.31838/ijpr/2021.13.01.732

[22] V. Tagimaucia, G. S. D'Souza, and S. P. Chand, "Exploring online physical education teaching: What have we done and what have we learnt?" *The International Review of Research in Open and Distributed Learning*, vol. 25, no. 1, pp. 127–151, Mar. 2024. doi: 10.19173/irrodl.v25i1.7431

[23] V. Singh and A. Thurman, "How many ways can we define online learning? A systematic literature review of definitions of online learning (1988–2018)," *American Journal of Distance Education*, vol. 33, no. 4, pp. 289–306, Oct. 2019. doi: 10.1080/08923647.2019.1663082

[24] N. L. S. Habeahan, S. M. R. Leba, W. Wahyuniar, D. B. Tarigan, S. I. Asaloei, and B. R. Werang, "Online teaching in an Indonesian higher education institution: Student's perspective," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 11, no. 2, p. 580, Jun. 2022. doi: 10.11591/ijere.v11i2.21824

[25] C. D. Patitsa, A. G. Sahinidis, P. A. Tsaknis, and V. Giannakouli, "Big five personality traits and students' satisfaction with Synchronous Online Academic Learning (SOAL)," *Corporate and Business Strategy Review*, vol. 2, no. 2, pp. 8–16, Jan. 2021. doi: 10.22495/cbsrv2i2art1

[26] J. M. M. Joudeh, F. Omeish, S. Alharthi, N. A. Abu-Loghod, A. M. Zamil, and A. H. M. Joudeh, "Exploring the impact of e-WOM information via social media on customer purchasing decision: A mediating role of customer satisfaction," *Data & Metadata*, vol. 3, Oct. 2024. doi: 10.56294/dm2024.449

[27] S. Şenel and H. C. Şenel, "Remote assessment in higher education during COVID-19 pandemic," *International Journal of Assessment Tools in Education*, vol. 8, no. 2, pp. 181–199, Jan. 2021. doi: 10.21449/ijate.820140

[28] A. Shahzad, R. Hassan, A. Y. Aremu, A. Hussain, and R. N. Lodhi, "Effects of COVID-19 in e-learning on higher education institution students: The group comparison between male and female," *Quality & Quantity*, vol. 55, no. 3, pp. 805–826, Aug. 2020. doi: 10.1007/s11135-020-01028-z

[29] M. Haghshenas, "A model for utilizing social software in learning management system of e-learning," *Quarterly Journal of Iranian Distance Education*, vol. 1, no. 4, pp. 25–238, Spring 2019. doi.org/10.30473/idej.2019.6124.

[30] S. Bauk, S. Šćepanović, and M. Kopp, "Estimating students' satisfaction with web based learning system in blended learning environment," *Education Research International*, vol. 2014, pp. 1–11, Jan. 2014. doi: 10.1155/2014/731720

[31] S. Farid, R. Ahmad, M. Alam, A. Akbar, and V. Chang, "A sustainable quality assessment model for the information delivery in E-learning systems," *Information Discovery and Delivery*, vol. 46, no. 1, pp. 1–25, Dec. 2017. doi: 10.1108/idd-11-2016-0047

[32] Y. Alami and I. E. Idrissi, "Students' adoption of e-learning: Evidence from a Moroccan business school in the COVID-19 era," *Arab Gulf Journal of Scientific Research*, vol. 40, no. 1, pp. 54–78, Jul. 2022. doi: 10.1108/agjsr-05-2022-0052

[33] S. S. Binyamin, M. Rutter, and S. Smith, "Extending the technology acceptance model to understand students' use of learning management systems in Saudi higher education," *International Journal of Emerging Technologies in Learning (iJET)*, vol. 14, no. 03, p. 4, Feb. 2019. doi: 10.3991/ijet.v14i03.9732

[34] N. F. Azahar, "Study of technology acceptance of Computerized Maintenance Management Systems (CMMS) as a tool for measuring contractor's performance: A case study of public work department, Putrajaya," Doctorate Dissertation, University of Malaya, (Malaysia), ProQuest Dissertations Publishing, 2017, 30600059

[35] F. Kanwal and M. Rehman, "Factors affecting e-learning adoption in developing countries–empirical evidence from Pakistan's higher education sector," *IEEE Access*, vol. 5, pp. 10968–10978, Jan. 2017. doi: 10.1109/access.2017.2714379

[36] A. N. Alkhaldi, M. Ali, S. M. Mahmoud, Z. A. Alrefai, and Y. Bahou. "Challenges facing students to adopting the blackboard system: The case study of the University of Ha'il in Saudi Arabia," *International Journal of Advanced and Applied Sciences*, vol. 8, no. 5, pp. 1–13, Feb. 2021. doi: 10.21833/ijaas.2021.05.001

[37] G. K. W. Wong, "Understanding technology acceptance in pre-service teachers of primary mathematics in Hong Kong," *Australasian Journal of Educational Technology*, vol. 31, no. 6, Dec. 2015. doi: 10.14742/ajet.1890

[38] B. Zogheib, A. Rabaa'i, S. Zogheib, and A. Elsaheli, "University student perceptions of technology use in mathematics learning," *Journal of Information Technology Education Research*, vol. 14, pp. 417–438, Jan. 2015. doi: 10.28945/2315

[39] F. Abdullah, R. Ward, and E. Ahmed, "Investigating the influence of the most commonly used external variables of TAM on students' Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) of e-portfolios," *Computers in Human Behavior*, vol. 63, pp. 75–90, May 2016. doi: 10.1016/j.chb.2016.05.014

[40] M. Mailizar, D. Burg, and S. Maulina, "Examining university students' behavioural intention to use e-learning during the COVID-19 pandemic: An extended TAM model," *Education and Information Technologies*, vol. 26, no. 6, pp. 7057–7077, Apr. 2021. doi: 10.1007/s10639-021-10557-5

[41] M. A. Almaiah, A. Al-Khasawneh, and A. Althunibat, "Exploring the critical challenges and factors influencing the E-learning system usage during COVID-19 pandemic," *Education and Information Technologies*, vol. 25, no. 6, pp. 5261–5280, May 2020. doi: 10.1007/s10639-020-10219-y

[42] R. A. Zuama, J. M. Hudin, D. Puspitasari, E. H. Hermaliani, and D. Riana, "Quality dimensions of Delone-McLean model to measure students' accounting computer satisfaction: An empirical test on accounting system information," presented at 2018 6th International Conference on Cyber and IT Service Management (CITSM), Aug. 2017. doi: 10.1109/citsm.2017.8089318

[43] Y. B. Limbu and L. Pham, "Impact of e-learning service quality on student satisfaction during the COVID-19 pandemic: A systematic review," *Knowledge Management & e-Learning*, vol. 15, no. 4, pp. 523–538, Dec. 2023. doi.org/10.34105/j.kmel.2023.15.030

[44] A. S. Al-Adwan, N. A. Albelbisi, O. Hujran, W. M. Al-Rahmi, and A. Alkhalifah, "Developing a holistic success model for sustainable e-learning: A structural equation modeling approach," *Sustainability*, vol. 13, no. 16, p. 9453, Aug. 2021. doi: 10.3390/su13169453

[45] D. Al-Fraihat, M. Joy, R. Masa'deh, and J. Sinclair, "Evaluating e-learning systems success: An empirical study," *Computers in Human Behavior*, vol. 102, pp. 67–86, Aug. 2019. doi: 10.1016/j.chb.2019.08.004

[46] A. I. Alzahrani, I. Mahmud, T. Ramayah, O. Alfarraj, and N. Alalwan, "Modelling digital library success using the DeLone and McLean information system success model," *Journal of Librarianship and Information Science*, vol. 51, no. 2, pp. 291–306, Aug. 2017. doi: 10.1177/0961000617726123

[47] Y.-S. Wang, H.-Y. Wang, and D. Y. Shee, "Measuring e-learning systems success in an organizational context: Scale development and validation," *Computers in Human Behavior*, vol. 23, no. 4, pp. 1792–1808, Dec. 2005. doi: 10.1016/j.chb.2005.10.006

[48] Y. Jung, B. Perez-Mira, and S. Wiley-Patton, "Consumer adoption of mobile TV: Examining psychological flow and media content," *Computers in Human Behavior*, vol. 25, no. 1, pp. 123–129, Sep. 2008. doi: 10.1016/j.chb.2008.07.011

[49] M. G. Alzahrani and J. M. O'Toole, "The impact of internet experience and attitude on student preference for blended learning," *Journal of Curriculum and Teaching*, vol. 6, no. 1, p. 65, Mar. 2017. doi: 10.5430/jct.v6n1p65

[50] S. Nikou and I. Maslov, "Finnish university students' satisfaction with e-learning outcomes during the COVID-19 pandemic," *International Journal of Educational Management*, vol. 37, no. 1, pp. 1–21, Aug. 2022. doi: 10.1108/ijem-04-2022-0166

[51] K. Bashir, "Assessment of instructional design quality and students' perceived learning outcomes with cisco e-learning courses in Uganda," *The Uganda Higher Education Review Journal*, vol. 10, no. 2, pp. 206-222, May. 2021. doi: 10.58653/nche.v10i2.12

[52] W. Puriwat and S. Tripopsakul, "The impact of e-learning quality on student satisfaction and continuance usage intentions during COVID-19," *International Journal of Information and Education Technology*, vol. 11, no. 8, pp. 368–374, Jan. 2021. doi: 10.18178/ijiet.2021.11.8.1536

[53] Z. Zhang, T. Cao, J. Shu, and H. Liu, "Identifying key factors affecting college students' adoption of the e-learning system in mandatory blended learning environments," *Interactive Learning Environments*, vol. 30, no. 8, pp. 1388–1401, Feb. 2020. doi: 10.1080/10494820.2020.1723113

[54] A. Bandura, "Self-efficacy," *Google Books*.
[55] V. Nagy and L. Duma, "Measuring efficiency and effectiveness of knowledge transfer in e-learning," *Heliyon*, vol. 9, no. 7, p. e17502, Jun. 2023. doi: 10.1016/j.heliyon.2023.e17502
[56] T. N. Hashem, S. Asad, and S. lnmer, "Comparative Study of the Challenges in Learning English as a Second Language among the Students of King Khalid University, K.S.A and Isra University, Jordan," *Test Engineering and Management*, vol. 83, pp. 6565–6574, July/August 2020.
[57] D. Chauhan, "Techno-pedagogical competency among teachers in relation to their attitude towards teaching," *Forum for Education Studies*, vol. 2, no. 2, p. 566, Apr. 2024. doi: 10.59400/fes.v2i2.566
[58] J. R. S. Alayacyac, J. C. Regidor, J. H. S. Caballo, J. E. Abellanosa, and G. J. G. Monaghan, "Computer self-efficacy and effectiveness of quipper learning management system," *American Journal of Smart Technology and Solutions*, vol. 3, no. 1, pp. 17–21, Mar. 2024. doi: 10.54536/ajsts.v3i1.2428
[59] A. Alshammari and M. F. Alanazi, "Use of technology in enhancing learning among nurses in Saudi Arabia; a systematic review," *Journal of Multidisciplinary Healthcare*, vol. 16, pp. 1587–1599, Jun. 2023. doi: 10.2147/jmdh.s413281
[60] W. Barhoumi, F. Algharbawi, A. J. Nashwan, N. Alkarbi, and L. Labidi, "Faculty members perspectives on the impact of educational technology on the teaching and learning process at the University of Sharjah," *Arab Journals Platform*. https://digitalcommons.aaru.edu.jo/isl/vol12/iss6/32
[61] C. González, D. López, L. Calle-Arango, H. Montenegro, and P. Clasing, "Chilean university students' digital learning technology usage patterns and approaches to learning," *ECNU Review of Education*, vol. 5, no. 1, pp. 37–64, Feb. 2022. doi: 10.1177/20965311211073538
[62] S. Shehzadi, Q. A. Nisar, M. S. Hussain, M. F. Basheer, W. U. Hameed, and N. I. Chaudhry, "The role of digital learning toward students' satisfaction and university brand image at educational institutes of Pakistan: A post-effect of COVID-19," *Asian Education and Development Studies*, vol. 10, no. 2, pp. 276–294, Sep. 2020. doi: 10.1108/aeds-04-2020-0063
[63] S. A. Raza, W. Qazi, K. A. Khan, and J. Salam, "Social isolation and acceptance of the Learning Management System (LMS) in the time of COVID-19 pandemic: An expansion of the UTAUT model," *Journal of Educational Computing Research*, vol. 59, no. 2, pp. 183–208, Sep. 2020. doi: 10.1177/0735633120960421
[64] G. Öztürk, A. Karamete, and G. ÇetiN, "The relationship between pre-service teachers' cognitive flexibility levels and techno-pedagogical education competencies," *International Journal of Contemporary Educational Research*, vol. 7, no. 1, pp. 40–53, Jun. 2020. doi: 10.33200/ijcer.623668
[65] W. Elshami, M. H. Taha, M. Abuzaid, C. Saravanan, S. A. Kawas, and M. E. Abdalla, "Satisfaction with online learning in the new normal: perspective of students and faculty at medical and health sciences colleges," *Medical Education Online*, vol. 26, no. 1, Jan. 2021. doi: 10.1080/10872981.2021.1920090
[66] F. D. Davis, "Perceived usefulness, perceived ease of use, and user acceptance of information technology," *MIS Quarterly*, vol. 13, no. 3, p. 319, Sep. 1989. doi: 10.2307/249008
[67] J. M. M. Joudeh, F. Omeish, N. A. I. Haddad, O. N. Badran, A. M. Zamil, and J. A. Al-Gasawneh, "An evaluation of the determinants affecting students' satisfaction and intention to use e-learning tools: A study based on the technology acceptance model," *Journal of Infrastructure Policy and Development*, vol. 8, no. 8, p. 6218, Aug. 2024. doi: 10.24294/jipd.v8i8.6218
[68] K.-M. Lin, N.-S. Chen, and K. Fang, "Understanding e-learning continuance intention: a negative critical incidents perspective," *Behaviour and Information Technology*, vol. 30, no. 1, pp. 77–89, Mar. 2010. doi: 10.1080/01449291003752948
[69] B. Kaur, J. Kaur, S. K. Pandey, and S. Joshi, "E-service quality: Development and Validation of the scale," *Global Business Review*, vol. 24, no. 5, pp. 953–971, May 2020. doi: 10.1177/0972150920920452
[70] A. Ashrafi, A. Zareravasan, S. R. Savoji, and M. Amani, "Exploring factors influencing students' continuance intention to use the learning management system (LMS): A multi-perspective framework," *Interactive Learning Environments*, vol. 30, no. 8, pp. 1475–1497, Feb. 2020. doi: 10.1080/10494820.2020.1734028
[71] I. Amin, A. Yousaf, S. Walia, and M. Bashir, "What shapes e-learning effectiveness among tourism education students? An empirical assessment during COVID19," *Journal of Hospitality Leisure Sport & Tourism Education*, vol. 30, 100337, Sep. 2021. doi: 10.1016/j.jhlste.2021.100337.
[72] A. Tarhini, K. Hone, X. Liu, and T. Tarhini, "Examining the moderating effect of individual-level cultural values on users' acceptance of E-learning in developing countries: a structural equation modeling of an extended technology acceptance model," *Interactive Learning Environments*, vol. 25, no. 3, pp. 306–328, Jan. 2016. doi: 10.1080/10494820.2015.1122635
[73] T. E. Jatmikowati, A. U. Rachman, and A. B. Adwitiya, "Technology acceptance model in using e-learning on early childhood teacher education program's student during pandemic," *Jurnal Obsesi Jurnal Pendidikan Anak Usia Dini*, vol. 5, no. 2, pp. 1501–1511, Dec. 2020. doi: 10.31004/obsesi.v5i2.801
[74] N. Li, X. Zhang, and M. Limniou, "A country's national culture affects virtual learning environment adoption in higher education: A systematic review (2001–2020)," *Interactive Learning Environments*, vol. 31, no. 7, pp. 4407–4425, Aug. 2021. doi: 10.1080/10494820.2021.1967408
[75] M. S. Taat and A. Francis, "Factors influencing the students' acceptance of e-learning at teacher education institute: An exploratory study in Malaysia," *International Journal of Higher Education*, vol. 9, no. 1, p. 133, Dec. 2019. doi: 10.5430/ijhe.v9n1p133
[76] V. Distler, C. Lallemand, and T. Bellet, "Acceptability and acceptance of autonomous mobility on demand," in *Proc. CHI 2018 (CHI '18)*, ACM, New York, USA, Article 612, Apr. 2018. doi: 10.1145/3173574.3174186
[77] C. Nadal, C. Sas, and G. Doherty, "Technology acceptance in mobile health: Scoping review of definitions, models, and measurement," *Journal of Medical Internet Research*, vol. 22, no. 7, e17256, Jul. 2020. doi: 10.2196/17256
[78] P. Philippi *et al*., "Acceptance towards digital health interventions—model validation and further development of the Unified Theory of Acceptance and Use of Technology," *Internet Interventions*, vol. 26, 100459, Sep. 2021. doi: 10.1016/j.invent.2021.100459
[79] G. Al-Rawashdeh *et al*., "Factors influencing the acceptance of using telemedicine: A study of Jordanian public healthcare organizations," *International Journal of Data and Network Science*, vol. 7, no. 4, pp. 1707–1714, Jan. 2023. doi: 10.5267/j.ijdns.2023.7.020
[80] A. Lathifah, U. S. Putro, F. R. Rinawan, S. Novani, V. Hasyimi, and A. R. Tiara, "Understanding participation in value co-creation and acceptance of iposyandu by extending UTAUT among community health workers," *CommIT (Communication and Information Technology) Journal*, vol. 17, no. 2, pp. 185–197, Sep. 2023. doi: 10.21512/commit.v17i2.8567
[81] O. Noroozi, M. Alqassab, N. T. Kerman, S. K. Banihashem, and E. Panadero, "Does perception mean learning? Insights from an online peer feedback setting," *Assessment & Evaluation in Higher Education*, pp. 1–15, May 2024. doi: 10.1080/02602938.2024.2345669
[82] A. S. Ajina, J. M. M. Joudeh, N. N. Ali, A. M. Zamil, and T. N. Hashem, "The effect of mobile-wallet service dimensions on customer satisfaction and loyalty: An empirical study," *Cogent Business & Management*, vol. 10, no. 2, Jul. 2023. doi: 10.1080/23311975.2023.2229544
[83] N. Li, X. Zhang, and M. Limniou, "A country's national culture affects virtual learning environment adoption in higher education: A systematic review (2001–2020)," *Interactive Learning Environments*, vol. 31, no. 7, pp. 4407–4425, Aug. 2021. doi: 10.1080/10494820.2021.1967408
[84] N. T. T. Ho, S. Sivapalan, H. H. Pham, L. T. M. Nguyen, A. T. V. Pham, and H. V. Dinh, "Students' adoption of e-learning in emergency situation: The case of a Vietnamese university during COVID-19," *Interactive Technology and Smart Education*, vol. 18, no. 2, pp. 246–269, Dec. 2020. doi: 10.1108/itse-08-2020-0164
[85] E. Chung, G. Subramaniam, and L. C. Dass, "Online learning readiness among university students in Malaysia amidst COVID-19," *Asian Journal of University Education*, vol. 16, no. 2, p. 45, Aug. 2020. doi: 10.24191/ajue.v16i2.10294
[86] J. F. Hair Jr, G. T. M. Hult, C. Ringle, and M. Sarstedt, *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*, SAGE Publications, 2016.
[87] D. N. Gujarati and D. C. Porter, *Basic Econometrics*, McGraw-Hill Inc, 2015.
[88] M. Shevlin and J. N. V. Miles, "Effects of sample size, model specification and factor loadings on the GFI in confirmatory factor analysis," *Personality and Individual Differences*, vol. 25, no. 1, pp. 85–90, Jul. 1998. doi: 10.1016/s0191-8869(98)00055-5
[89] B. G. Tabachnick and L. S. Fidell, *Using Multivariate Statistics*, 2013.

[90] R. C. MacCallum, M. W. Browne, and H. M. Sugawara, "Power analysis and determination of sample size for covariance structure modeling," *Psychological Methods*, vol. 1, no. 2, pp. 130–149, Jun. 1996. doi: 10.1037/1082-989x.1.2.130

[91] L. Hu and P. M. Bentler, "Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives," *Structural Equation Modeling a Multidisciplinary Journal*, vol. 6, no. 1, pp. 1–55, Jan. 1999. doi: 10.1080/10705519909540118