

Research Article

Propose a New Quality Model for M-Learning Application in Light of COVID-19

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The coronavirus disease (COVID-19) prevented millions of students around the world from receiving their lessons, because of the closure of thousands of schools. The new COVID-19 global epidemic invaded the barriers of time and space. Using mobile phones in education is a new form of the distance learning system. M-learning is characterized by many characteristics, the most important of which are providing an interactive educational environment, flexibility in space and time, better adaptation to individual needs, acquisition of knowledge, interactive effectiveness, and developing self-learning skills for students. The main aim of this paper is to suggest a quality model for M-learning applications for children which contains the most common characteristics of M-learning, which must be taken into account when designing M-learning applications. Through previous studies related to the quality model for M-learning applications, we proposed two quality characteristics, technical and pedagogical. We proposed 8 subcharacteristics with their features following the structure of the IOS/IEC 912 and DeLone and McLean IS model to find the effect of technical and pedagogical factors on user satisfaction with M-learning applications for children. Results show that the proposed model can be useful and effective to ensure the development of high-quality M-learning applications.

1. Introduction

The COVID-19 crisis resulted in millions of students around the world being cut off from receiving their lessons, due to the closure of thousands of schools. Schools were closed as a result of the measures taken by the authorities to reduce the spread of COVID-19. Therefore, numerous educational foundations in Arab nations have turned to the choice of distance learning because the educational program should keep closing any instructive hole that may result from the emergency. Similarly, as the new corona pandemic, the virus attacked the boundaries, and the “distance learning” that went with the spread of the infection came to clear the hindrances of existence.

E-learning is characterized as an educational and instructive framework offering educational and preparing/instructive programs to undergraduates without restrictions of having space or time, using communication techniques and various technologies from the Internet, computers, smartphones, direct broadcast through electronic applications, and other technologies [1, 2]. Using mobile phones in learning is a new form of distance learning system [1]. There is a strong trend to use mobile learning (M-learning) in learning processes because one of its effects is to increase the motivation of the children to learn and improve communication with them through what they use from devices and technological applications, which may be reflected in improving their skills. Many decisions emphasized the

importance of using M-learning in educational processes [3, 4]. M-learning is characterized by many characteristics, the most important of which are providing an interactive learning environment, flexibility in space and time, better adaptation to individual needs, acquisition of knowledge, interactive effectiveness, developing self-learning skills for students, and the ability to communicate knowledge through various audio-visual media or reading [3].

Considering this knowledge explosion and the development of information and science, it is not at this point adequate to leave the teaching and properly shift to another level of education. It was necessary to prepare randomly in advance considering a clear philosophy that leads to the educational process and learning strategies for the children according to their capabilities and development requirements in a cultural environment and specific circumstances [3]. There are many good applications that children can learn but have no real learning goals because they do not follow quality models. So, parents need to note that just because an app is not in the "Education" section of digital stores, it does not mean it is non educational [5]. Most relevant studies that have addressed this problem provide few M-learning features such as usability, control, and flexibility while ignoring some important characteristics such as pedagogy, technology, and user satisfaction [5]. Although there were some critical interests in M-learning, people still neglect its advantages that we can have in the future through M-learning networks [6]. In this manner, as of late, an increment has been seen in the number of exact examinations planned to analyze the elements influencing M-learning acknowledgment and reception and the advantages colleges get from M-learning [7–10], while few have paid attention to examining the effect of quality factors on M-learning usage. These studies ignore the fact that quality factors serve as important roles for meeting students' perceptions and ensuring the successful development of M-learning applications, and, therefore, it is important for examining such factors.

Papadakis et al. [5] proposed quality model that will provide the developers with a guideline to building successful and effective children's mobile learning applications. The proposed model in this study will provide a base for building the children's mobile learning applications that meet these requirements by providing important characteristics such as pedagogy, technology, and user satisfaction.

Therefore, this study contributes to enriching the field of research in mobile learning applications especially in learning for children through proposing a new quality model that includes new important quality characteristics, analyzing the related previous studies, and the findings of the empirical study (questionnaire). Therefore, this finding may open the way for other researchers, especially those interested in children's mobile learning applications.

This paper aims to investigate previous studies related to the model of quality M-learning application for children. A quality model for M-learning application for children is suggested, which contains the most common characteristics of M-learning that must be taken into account in the design of learning for mobile applications. The validity of the proposed quality model is verified using the quantitative

method to set the M-learning application. The development of the M-learning model depends on the proposed model.

2. Theoretical Background

In this section, we briefly present the concepts related to e-learning, mobile learning, and M-learning quality.

2.1. E-Learning. E-learning is one innovation of educational technology and one form of distance education that depends on the use of computers and the use of the Internet and the technology associated with it in building and developing educational resources, with less time and effort, and the greatest benefit, anytime, anywhere, and most of the time; E-learning is in an environment away from the teacher, which provided more opportunity for more education to be received with ease [1]. E-learning is among the educational and technical methods available to everyone as it provides the students or the users with information and supports it with pictures, sounds, and graphics and also provides electronic libraries with high-quality technologies and other advantages. They consider the learner according to his educational ability and following his previous experiences. From this standpoint, we can say that E-learning is a way to transform class education into education with the help of technology [1].

2.2. Mobile Learning. Previous studies viewed the benefits derived from the M-learning system from the university students' perspective. For example, one main benefit of using an M-learning system is an increment like educating and learning, just as an improvement in the cooperation among understudies and teachers [8]. Moreover, M-learning systems help educational institutions increase student enrollment, enhance their reputation, respond quickly to change, and lower costs [8].

Mobile learning, otherwise called M-learning, is another approach to get to M-learning content. M-learning upholds continuous access to the learning process [11, 12]. It is based on wireless communications. So, the learner can access educational materials and seminars anytime and anywhere, and M-learning also refers to the use of mobile devices in the teaching and learning process, as it focuses on using the techniques available in wireless communication devices to communicate information outside the classroom. It should be possible to utilize gadgets and devices, for example, telephone, PC, or tablet [11]. You can adapt to any place and at whatever point you need [3].

2.3. M-Learning and Quality. The concept of quality in this study reflects a degree of excellence of learning content quality and learning service quality of the M-learning system. Because of increasing sophistication and, with it, challenges in the information systems field, higher education institutions are eager to enhance the quality of their systems as a means of maximizing their potential for growth [7]. The importance of quality factors has been widely examined in

prior research in several fields such as e-learning quality [13], learning management system quality [14], and M-learning quality [5]. It is a set of specifications required in M-learning environments to ensure its success and the quality of its design and development, so it becomes a tool to guide the production of M-learning systems and maintain their continuity; M-learning environment standards become exemplary performance measures, evaluation criteria, and guidelines for developments and improvements and a tool that helps in decision in the sense of a set of conditions required in M-learning environments to ensure the quality of their design [12, 14–16]. Providing quality in M-learning is a very important problem for any program or academic course. If quality is a prerequisite for the success of the educational process, quality becomes a necessary problem for M-learning in particular. The success of any educational system is highly dependent on its commitment to internationally agreed quality standards. The success of the portable learning system depends on the relevance of the outputs to goals considering their achievement of the approved quality standards [12]. Quality is nowadays a major issue in modern education especially for learning via mobile devices, where the application of quality can be a key factor in success [12].

According to the existing literature, in recent years, an increase has been observed in the number of empirical studies intended to examine the factors affecting acceptance, adoption, usage, and implementation of M-learning and the benefits universities derive from M-learning systems [6–9]. For example, Almaiah and Al Mulhem [4] proposed a new model to identify the most important factors that could motivate students to accept and use M-learning system. They identified 4 success factors of mobile learning, which were subdivided into the following categories: (i) innovative factors (security, protection, similarity, relatively favorable position, and trust), (ii) hierarchical components (protection from change and technological availability), (iii) social elements, and (iv) quality variables (nature of the framework, nature of substance, and nature of administration). Then, again, [6] inspected the impact of various components on M-learning applications improvement at three primary phases of utilization (static stage, association stage, and exchange stage).

The outcomes demonstrated that the main variables identified with the point of view of the user to think about when creating M-learning in three phases were framework similarity, security, data quality, awareness, seen practical advantage, self-viability, accessibility of assets, and trust [3]. Almaiah et al. [2] Led quantitative investigation with 275 undergrad Jordanian understudies at the college of Jordan and called attention to that trust, seen security, seen convenience, and seen handiness are fundamental variables for effective selection and usage of M-learning framework. Almaiah and Alismaiel [8] proposed a structure for M-learning acknowledgment dependent on integrating the Technology Acceptance Model (TAM) with the refreshed DeLone and McLean's model (DL&ML). The examination intended to research the impact of value components and individual variables on student's fulfillment and expectation

to the utilization of the M-learning network. The outcomes presumed that quality components identified with framework quality, data quality, and administration quality are fundamental measurements for guaranteeing understudies' fulfillment and goal to the utilization of the M-learning framework. Likewise, Almaiah et al. [9] proposed a half-breed quality model for M-learning dependent on researches of DeLone and McLean data framework achievement model (DL&ML) with the TAM model to look at the impact of 10 quality measurements on M-learning framework acknowledgment. They uncovered that the most basic components identified with incrementing the students acknowledgment were content plan quality, usefulness, UI configuration, learning content quality, openness, responsiveness, personalization, and intelligence. In another investigation, Almaiah et al. [9] created three structures for M-learning advancement dependent on quality variables got from the refreshed DeLone and McLean data framework achievement model.

Finally, a recent study conducted by Nizam Ismail et al. [6] investigated the important factors that affect students' acceptance of mobile learning. The study applied the Unified Theory of Acceptance and Use Technology (UTAUT) model and revealed that perceived data quality, similarity, trust, sense of awareness, and accessibility of assets, self-adequacy, and security are the principal sparks of understudies' acknowledgment of the M-learning framework and subsequently achievement of the execution of M-learning projects.

Based on Table 1, the majority of M-learning studies have considered students' perceptions for determining the factors that affect acceptance, adoption, and usage of mobile learning, while few studies have paid attention to users' perceptions of quality factors for M-learning applications. These studies ignore the fact that quality factors serve as important roles for meeting students' perceptions and ensuring the successful development of M-learning applications, and, therefore, they are important for examining such factors. The existing literature offers little insight into the quality factors of M-learning systems. There are a limited number of examples that look at this, including the studies by Almaiah et al. [9] and Qian et al. [10], which identified various M-learning quality factors in educational institutions. However, as far as we have been able to determine, few of these studies have empirically identified the important quality factors of M-learning applications development. Consequently, this study aims to propose and empirically examine a new model of the effect of quality factors on M-learning application development.

3. The Research Models and Hypothesis

There are a set of characteristics required in M-learning environments to ensure the quality of their design. Attention to quality standards has become a global movement, and it is a national demand in all areas, including education, so quality becomes a tool for guiding, producing, and maintaining portable learning systems [18]. There are many

TABLE 1: Related work.

Literature	Purpose of the study	Findings
Papadakis and Kalogiannakis (2017) [3]	Conducted quantitative study with 275 undergraduate Jordanian students at the University of Jordan to explore the students' acceptance of mobile information systems	Pointed out that trust, perceived security, perceived ease of use, and perceived usefulness are vital factors for successful adoption and implementation of the M-learning system They identified 4 success factors of mobile learning, which were subdivided into the following categories: (i) innovative factors (security, protection, similarity, relatively favorable position, and trust), (ii) hierarchical components (protection from change and technological availability), (iii) social elements, and (iv) quality variables
Almaiah and Mulhem (2019) [4]	Proposed a new model to identify the most important factors that could motivate students to accept and use the M-learning system	The outcomes demonstrated that the main variables identified with users' insights to contemplate when creating M-learning in three phases were framework similarity, security, data quality, mindfulness, seen practical advantage, self-viability, accessibility of assets, and perceived trust
Nizam Ismail et al. (2020) [6]	Inspected the impact of various components on M-learning applications improvement at three fundamental phases of use (static stage, communication stage, and exchange stage)	Pointed out that trust, perceived security, perceived ease of use, and perceived usefulness are vital factors for successful adoption and implementation of the M-learning system.
Almaiah and Alismaiel (2019)[8]	Conducted quantitative study with 275 undergraduate Jordanian students at the University of Jordan to explore the students' acceptance of mobile information systems.	They uncovered apparent data quality, perceived similarity, trust, a level of awareness, accessibility of assets, self-viability, and security, which are the primary inspirations of student's acknowledgment of the M-learning framework.
Almaiah et al. (2016) [9]	Developed three systems for M-learning development based on quality factors derived from the updated DeLone and McLean information system success model.	They revealed that the most critical factors relating to increasing the students' acceptance were content design quality, functionality, user-interface design, learning content quality, accessibility, responsiveness, personalization, and interactivity.
Alrasheedi and Capretz (2020) [1]	Proposed a hybrid quality model for M-learning based on combining the updated DeLone and McLean information system success model (DL&ML) with TAM model to examine the effect of 10 quality dimensions on M-learning system acceptance.	

foundations for quality paradigms to consider while designing and developing portable learning environments based on M-learning technology [1]. We have come up with a list of criteria for designing M-learning environments with a focus on the most common and important characteristics of M-learning to consider. After reviewing several studies and research, the quality model for children's M-learning applications in this paper is based on ISO 9126, the most widespread quality standard [19]. Additionally, the IS success measurement is one of the first to care about the effectiveness of information systems, which focuses on the functional requirements of information systems [19]. The proposed model defines two main characteristics: technology and pedagogy, each of them includes subcharacteristics as shown in Figure 1 which depicted the research model.

3.1. Technology. Technology factor can be defined as the utilization of actual hardware, software, and instructive hypothetical to encourage learning and improving the education. In this manner, technical elements affect students' satisfaction of M-learning applications [11, 12, 14–20]. Therefore, the following hypothesis is formulated to test the effect of technical factors on user satisfaction.

Hypothesis 1: technical factors have a significant effect on user satisfaction with M-learning applications for children.

The M-learning technical characteristics comprise the following subcharacteristics:

Functionality: the M-learning function shows the ability of the application to provide a function that meets the explicit and implicit needs of users under specific conditions of use, meaning what the program does to meet the needs [14–16]. The application includes all the features needed to accomplish the required tasks and provide an improved educational experience [21].

Hypothesis 1a: functionality has a significant effect on user satisfaction with M-learning applications for children.

Performance: the achievement of M-learning applications relies upon the obligation to execution and improved proficiency [12, 14–21]. Application reaction time execution should be adequately quick to meet the client's needs. Significant delay times can decrease revenue and weariness by students, bringing about reluctance to utilize these applications [12].

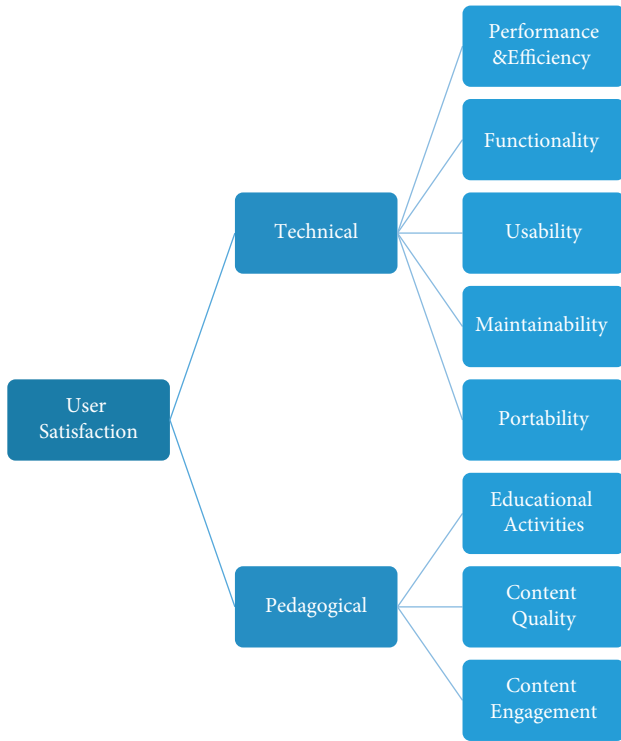


FIGURE 1: Quality model for M-learning application for children.

Hypothesis 1b: performance has a significant effect on user satisfaction with M-learning applications for children.

Usability: the ease of use in M-learning has been characterized as a subjective attribute that characterizes the best, productive, and good method of utilizing the UI [22]; it inspects the degree to which M-learning can accomplish explicit objectives in a powerful, proficient, and palatable way of use [21]. In learning conditions, particularly for cell phones, the interface ought to be not difficult to learn, perceive, and recall, since one of the significant focuses for clients is to acknowledge the program [11, 12]. The learning interface ought to be straightforward and simple to work by various age gatherings to guarantee better utilization of the application.

Hypothesis 1c: usability has a significant effect on user satisfaction with M-learning applications for children.

Portability: it is the ability to transfer an application from one environment to another, as well as the ability of the application to adapt to different mobile devices, with no further action configurations [15]. Besides, it is the ability of the application to be installed and uninstalled easily on different mobile devices [21].

Hypothesis 1d: portability has a significant effect on user satisfaction with M-learning applications for children.

Maintainability: it is the ability of the application to make adjustments that may include corrections, improvements, or adjustments to the program for changes in the environment, requirements, and functional

specifications (the effort required for modification); the application must be designed about ease of maintenance [21].

Hypothesis 1e: maintainability has a significant effect on user satisfaction with M-learning applications for children.

3.2. *Pedagogy.* Pedagogically sound design for M-learning application development is a key factor for providing a pleasant and rich learning experience in a mobile environment [19]. Therefore, pedagogical factors influence user satisfaction with M-learning applications for children [11, 12, 14–20].

Hypothesis 2: pedagogical factors have a significant effect on user satisfaction with M-learning applications for children.

The M-learning’s pedagogical characteristics comprise the following subcharacteristics:

Educational activities: it is a learning theory that relies upon the student in learning circumstance and incorporates all learning practices, as well as instructing methodology that intends to initiate and amplify the student’s part during learning through work and research. Therefore, it also relied on the student’s confidence in getting data and acquiring abilities. Furthermore, learning theory it is not just center on retention and teaching, but also focus on creating thinking and the capacity to take care of issues [12, 21].

Hypothesis 2a: educational activities have a significant effect on user satisfaction with M-learning applications for children.

Content quality: content quality must be valid, trustworthy, and accurate. In an M-learning environment, the content must consider the pedagogical aspects to generate efficient learning. It should be useful and appropriate for initial learning objectives, age, and level of the children [8]. It should also motivate the learner to plan educational goals in the M-learning environment in a correct, accurate, and clear manner consistent with the learning strategy in a way that serves the educational content provided to achieve the general and final objectives expected by the learner [22, 23].

Hypothesis 2b: content quality has a significant effect on user satisfaction with M-learning applications for children.

Content and engagement: to get children’s attention to the application, the content must be engaging. Effective content and participation in the mobile application are two measures that provide real insight into the success of the application [24, 25]. Negative content and low application sharing are a recipe for failure, while high engagement and retention are the opposite [19–26]. The success of the application can be determined through user engagement and activity, by using appropriate familiar content, language, and concepts [27].

Hypothesis 2c: content and engagement have a significant effect on user satisfaction with M-learning applications for children.

3.3. *User Satisfaction.* User satisfaction shows the user's response to the effective use of the information system [11, 21]. The user becomes satisfied with the system when it meets his requirements and needs. One prerequisite for successful M-learning is that students feel satisfied with the application of learning as a sign of the quality of education [19]. High user satisfaction contributes to greater educational outcomes. Therefore, technical factors and pedagogical factors influence user satisfaction with M-learning applications for children [16, 20, 28].

4. Research Methodology

The method used in this paper is based on a quantitative approach. The quantitative method provides advantages such as accurate, reliable, and fast data collection, a broader set of data analysis, elimination of bias, and tendency. Data for this paper were collected through the questionnaire because the questionnaire is the most common and practical way to collect data in quantitative studies. In our research, the sample was children who cannot understand how to fill the questionnaire and need more explanation about the questionnaire items. For this reason, we requested from the parents to help their children and explain the questions to them and then fill the form based on their answers. In the survey questionnaire, we mentioned that all answers from respondents will be confidential and we will minimize any risks of breach of confidentiality as presented in Appendix B.

The survey was conducted in Amman, Jordan. The questionnaire way is used to collect data for this study in both English and Arabic because many of the participants have Arabic as their own mother tongue; it was necessary to translate the questionnaire to reduce misunderstanding and help participants understand the research topic. The items of the questionnaire were adopted from related studies ([13, 29–31] and [32–38]) (see appendix A). The questionnaire uses Google Forms online and is delivered manually to the parents of the children. To verify the questionnaire, the researcher presented the tool to a committee composed of 4 faculty members at Al-Zaytoonah University with experience, expertise, and competence to measure the appropriateness of each element of the questionnaire in terms of language and formulate and achieve the goal. In line with their directives and proposals, the wording of some of their phrases was modified, and a few of them were added and deleted. The study community consists of parents of children in primary schools and preschools, between the ages of 3 and 12 years.

The data collected from the survey delivery included responses of 240 participants. 10 answers were rejected as they were incomplete. The statistical treatment of the data got by the researcher using the SPSS package was performed, and the data from 220 parents were analyzed. Therefore, the sample size in this paper suffices to represent the views of

parents about the quality of learning applications for children as an exploratory study.

The demographic composition of the research was 52.7% females and 47.3% male. Given the age group, it was 3 to 5 (31.8%), 6 to 8 (31.4%), and 9 to 12 (36.8%) as shown in Table 2. About children mainly using their smart devices with the highest video viewing rate of 56.5%, the gameplay rate is 45.7%, followed by the educational gaming operator with 26%, taking pictures and video with 17.9%, and completing schoolwork increased by 16.6%. As shown in Table 2, the number of hours spent by children on electronic devices in one day ranged from one to two hours, 32.3%, while their use of these devices ranged from 2 to 3 hours (25.9%) in the second place, from 3 to 4 hours (19.1%) in the third position, from 5 to 6 hours (8.2%) in the fourth position, and more than 6 hours (4.1%) per day in the fifth position. For children using their smart devices, the results showed that the highest response was to watching videos (56.5%), followed by playing games (45.7%), educational games operator (26%), and taking pictures and video (17.9%). 16.6% completed school work, as shown in Table 2.

5. Data Analysis and Result

The stability coefficient was calculated using the internal consistency method according to the Cronbach alpha equation. Table 3 shows the coherence coefficient according to the Cronbach alpha equation, as it becomes clear through it that stability of the test is high, which confirms that the test is of high stability. It can be used as a research measurement tool.

Multiple regression analysis was used for the effect of technical and pedagogical factors on user satisfaction with M-learning applications for children as shown in Table 4. The table made it clear that the effect is significant on a level of significance of $\alpha=0.05$ of the effect of technical and educational factors on user satisfaction with M-learning for children where the correlation coefficient R was 0.293 and the coefficient of explanation for explanatory variance R^2 was 0.077, that is, the technical and educational factors explained 7.7% of the variation that occurred on the user's satisfaction with the portable learning of children. The value of " F " was 10.185 and .000 represented a statistical significance, and there was the effect of technical factors and pedagogical factors on the user satisfaction with M-learning applications for children.

Results of a simple regression analysis of the effect of technical and pedagogical on user satisfaction with M-learning applications for children are shown in Table 5.

Hypothesis 1: "Technical factors have a significant impact on user satisfaction with M-learning applications for children" is accepted.

Hypothesis 1.a: "The functionality has a great impact on the user satisfaction with M-learning applications for children" is accepted.

Hypothesis 1.b: "The performance has a great impact on the user satisfaction with M-learning applications for children" is accepted.

TABLE 2: Results of the demographic questions.

	Categories	Frequency	Percent
Gender	Male	104	47.3
	Female	116	52.7
Age group	3-5	70	31.8
	6-8	69	31.4
	9-12	81	36.8
Time	Less than 30 minutes	23	10.5
	From 1 to 2 hours	71	32.3
	From 2 to 3 hours	57	25.9
	From 3 to 4 hours	42	19.1
	From 5 to 6 hours	18	8.2
Children mainly use their smart devices	More than 6 hours	9	4.1
	Do school work	37	16.6
	Watch the videos	126	56.5
	Playing games	102	45.7
	Taking photos and videos	40	17.9
	Educational game player	58	26

TABLE 3: The internal consistency coefficient of Cronbach alpha.

Variable	Internal consistency
Technical factors	0.801
Pedagogical factors	0.773
User satisfaction	0.620
The questionnaire	0.866

TABLE 4: Multiple regression analysis of the effect of technical and pedagogical factors on user satisfaction with M-learning applications for children.

Independent variable	Beta	T	Sig t	R	R ²	F	Sig f
Technical factors	0.211	2.646	0.009	0.293	0.077	10.185	0.000
Pedagogical factors	0.114	1.426	0.155				

TABLE 5: Results of a simple regression analysis of technical and pedagogical subhypotheses.

Hypothesis	R	R ²	Unstandardized coefficients		t	f	Sig	Results
			B	Std. error				
Technical	0.278	0.073	0.495	0.116	4.272	18.249	0.000	Accepted
Functionality	0.231	0.049	0.258	0.074	8.806	12.285	0.000	Accepted
Performance	0.162	0.022	0.177	0.073	2.424	5.878	0.016	Accepted
Usability	0.150	0.018	0.194	0.087	2.241	5.024	0.026	Accepted
Portability	0.225	0.046	0.212	0.062	3.414	11.657	0.001	Accepted
Maintainability	0.320	0.099	0.351	0.070	4.993	24.933	0.000	Accepted
Pedagogical	0.237	0.052	0.470	0.130	3.607	13.013	0.000	Accepted
Educational activities	.260	0.064	0.364	0.091	3.983	15.867	0.000	Accepted
Content quality	.099	0.005	0.134	0.091	1.471	2.163	0.143	Accepted
Content engagement	.235	0.051	0.268	0.075	3.577	12.793	0.000	Accepted

Hypothesis 1c: “The usability has a great impact on the user satisfaction with M-learning applications for children” is accepted.

Hypothesis 1d: “The portability has a great impact on the user satisfaction with M-learning applications for children” is accepted.

Hypothesis 1e: “The maintainability has a great impact on the user satisfaction with M-learning applications for children” is accepted.

Hypothesis 2:” Pedagogical factors have a significant impact on user satisfaction with M-learning applications for children” is accepted.

TABLE 6: Questionnaire items.

1. Technical factors		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1.1. Efficiency and performance factor						
1	The child takes a short time to learn and understand mobile apps					
2	Mobile learning applications respond quickly to complete a specific task					
3	Mobile learning applications provide appropriate assistance					
4	Mobile learning applications provide voice assistance					
1.2. Reliability factor						
1	In the event of application failures (such as disconnecting), the information entered into it must be preserved					
2	Ease of handling errors in mobile learning applications					
3	Mobile learning applications must resume work and recover lost data after failure					
4	Multiple versions of the application help reduce errors					
1.3. Usability factor						
1	The names of addresses, lists, and icons are compatible in mobile learning applications					
2	Mobile learning application options are easy to understand and use					
3	The child learns to use the mobile learning application easily without assistance					
4	Child uses mobile learning apps without much effort					
5	The mobile learning apps interface looks attractive to a child					
1.4. Functional factor						
1	Mobile learning apps contain a search engine, which facilitates the search for specific options					
2	Mobile learning applications contain easy and relatively complete options and meet the requirements of the child					
3	In mobile learning applications, the required tasks are performed and the result is as expected by the user					
1.5. Maintainability factor						
1	Easily diagnose errors in mobile learning applications					
2	Easily correct errors and problems in mobile learning applications					
3	If adjustments are made, the mobile learning apps will continue to work					
4	Edits in portable learning apps are easily tested					
1.6. Communication factor						
1	Mobile learning applications contain specific tools to stimulate communication with the child					
2	Mobile learning applications provide some form of social interaction/ simultaneous play/or screen sharing					
3	The application offers visual or auditory notes to children when they perform a certain task					
1.7. Advertisements factor						
1	Advertisements can completely distract the child's attention while using mobile learning applications					
2	Advertisements indirectly encourage the child to track ads and exit the application					
1.8. Portability factor						
1	Easily install mobile learning applications on mobile devices					
2	Mobile learning applications work regardless of device type					

TABLE 6: Continued.

2. Pedagogical factors		Strongly agree	Agree	Neutral	Disagree	Strongly disagree
2.1. Interactivity factor						
1	Child participates in mobile learning applications through activities that challenge the child					
2	Mobile learning applications reduce kid's keyboard usage, which means avoiding typing as much as possible					
3	The child is able to move freely and easily between different topics to choose the topic he wants					
4	Child controls the transition between the elements and contents of the mobile learning application					
5	The application allows the child to leave or return to mobile learning applications easily					
6	The user-interface helps the child to quickly access the required information					
7	Mobile learning applications to suit the capabilities of the targeted children					
8	The interface should be appropriate to the nature of the educational missions to be learned					
9	Displaying intense information on a single screen should be avoided in children's mobile learning applications					
2.2. Educational activities factor						
1	Mobile learning activities aim at the child's interaction					
2	Mobile learning activities shift from simple to complex					
3	Mobile learning activities must be provided in an attractive and linguistically accurate manner					
4	Mobile learning activities reflect the child's surrounding and realistic environment					
5	The goals of educational activities are beneficial to the child and develop the skills he applies to his life					
6	Mobile learning activities are clear and accurate					
7	The activities and educational materials used in the application must contain text, images, graphics, multimedia, games, sound, and others					
2.3. Content quality factor						
1	In a mobile learning application, the content provided must relate to specific educational goals					
2	In a child's mobile learning application, the general characteristics of the age group must be taken into account					
3	The child's mobile learning application takes into account the current and previous knowledge, so that there is an integrated link between old and new information					
4	In the mobile learning application for the child, we must take into account the individual differences between the children in terms of diversity in the content					
5	In a child's mobile learning application, the content should focus on building knowledge, not listing information					
6	In a mobile learning application for a child, the content must be attractive, modern and linguistically correct					
7	The educational content must conform to the standards of the quality of mobile learning applications					
2.4. Encouragement content factor						
1	The mobile learning app provides encouraging rewards for keeping children engaged					
2	The content of the mobile learning application is satisfactory, attractive and suitable for children					
3	The app provides useful and attractive educational activities for the child's attention					
4	The concepts used are familiar and compatible with children's mental models					
3. User satisfaction						
1	The mobile learning application performs the tasks in the best possible way and with the least time to reach the expected result					
2	The mobile learning application is effective in achieving the goals, accomplishing the mission and reaching the expected result					
3	In general, I am satisfied with mobile learning application because they are clear and consistent for children					
4	Be satisfied with mobile learning apps because they are attractive to children					

Hypothesis 2.a: “The educational activities have a great impact on the user satisfaction with M-learning applications for children” is accepted.

Hypothesis 2.b: “The content quality has a great impact on the user satisfaction with M-learning applications for children” is accepted.

Hypothesis 2.c: “The content engagement has a great impact on the user satisfaction with M-learning applications for children” is accepted.

6. Conclusion and Future Works

This paper focused on proposing a quality model for M-learning applications for children. The model was created primarily from systematic references conducted in this field. It can be useful for researchers, designers, and other developers in designing M-learning applications for children aged between 3 and 12 years. Using the quantitative method, the researchers distributed the questionnaire to 220 parents of children in preschools and primary schools. The results of the sample show the influence of technical and educational factors on user satisfaction with children’s mobile learning. The results of an analysis show acceptance of all subcharacteristics of the model which include functionality, performance, usability, portability, maintainability, educational activities, content quality, and content engagement; all subcharacteristics affect user satisfaction. The research presented interesting findings to the quality model for M-learning applications for children.

However, a single study cannot describe and solve the problem from all sides, so this paper has some limitations: The paper was conducted only in Amman, Jordan. The paper randomly selected 220 parents of children of different ages. The proposed model contains a specific set of quality characteristics, not all-inclusive. The results confirmed the impact of technical and pedagogical factors on user satisfaction with M-learning applications for children. The paper recommended the following: Benefiting from the results of the study when designing M-learning applications for children and enriching research in quality models for M-learning for children, especially in children learning. Educational institutions should plan to monitor, evaluate, and generalize the experience of the quality model for M-learning applications for children. One specific interesting avenue for future work would be to explore further into the antecedents to children satisfaction with M-learning application found in this study, namely, functionality, performance and efficiency, ease of use, portability, serviceability, educational activities, content quality, and content engagement. Another area of user-centric research in M-learning would be to determine the characteristics and behaviors of learners in various M-learning application adopter categories.

Appendix

A. Questionnaire Items

The questionnaire items are shown in Table 6.

B. Survey Consent Paragraph

You are being invited to participate in a research study titled: Propose a New Quality Model for M-learning Application In Light Of COVID-19. This study is being done by Ahmad Althunibat, Raneem Dawood, Mohammed Amin Almaiah and Feras Altarawneh from the Alzaytoonah University of Jordan. You were selected to participate in this study because you are parent of students used mobile learning. The purpose of this research study is to suggest a quality model for M-learning applications for children. If you agree to take part in this study, you will be asked to complete the survey/questionnaire on the next page. It will take you approximately 10 minutes to complete. You may not directly benefit from this research; however, The authors hope that your participation in the study can be useful for researchers, designers, and other developers in designing M-learning applications for children between 3 and 12 years old. To the best of our ability your answers in this study will remain confidential. The authors will minimize any risks to breach of confidentiality.

Data Availability

The SPSS data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest to report regarding this study.

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