

## Article

# A Conceptual Model to Investigate the Role of Mobile Game Applications in Education during the COVID-19 Pandemic

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**Abstract:** During the COVID-19 pandemic, educational mobile games may play a significant role to facilitate students' learning. Several studies have indicated that these games using mobile phones may improve students' learning motivation and effectiveness when they are equipped with appropriate learning strategies. However, investigating the impact of learning strategies in students' utilization of educational mobile games has received little scholarly attention during the COVID-19 pandemic. Hence, this research proposed two learning games scenarios to fill this gap. In the first scenario, students were offered an educational mobile game with a learning strategy called 'scaffolding strategy'; while in the second scenario, the same game was offered without the strategy. To achieve this objective, an experimental design with a research model was developed to examine the role of scaffolding learning strategy in students' use of educational mobile games. In this experimental study, 43 students from two classes participated in the two learning scenarios. The results indicate that educational mobile gaming with the scaffolding learning strategy significantly influenced students' utilization of the mobile game. In addition, the adoption of the learning strategy significantly affected students' perceived enjoyment, perceived usefulness, perceived ease of use, and behavioural intention to use, compared with the same game without the learning strategy. The results also indicate that the introduction of the scaffolding learning strategy into the educational mobile game will increase students' learning effectiveness and motivation.

**Keywords:** mobile games; scaffolding strategy; students' utilization; sustainability; TAM and TUT; COVID-19



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## 1. Introduction

Recently, the emergence of the COVID-19 has brought about an acceleration towards the use of mobile games in learning and education [1]. Educational mobile games have been increasingly regarded as a powerful tool to enhance students' learning motivation. They offer a learning environment in which students acquire knowledge from playing by using their mobile devices [2,3]. They also enable students to play an active role in learning, which is why they are regarded as more effective than educational computer games in terms of improving students' learning motivation [4]. Moreover, this kind of game requires students to accomplish a challenging task by which students can also develop their problem-solving capability [5], or acquire knowledge in particular subject through the drill-and-practice process [6]. In this case, students will become not only receivers of knowledge from their instructors but active knowledge constructors [7], and thus, they achieve meaningful learning. Hence, educational mobile games have attracted many researchers' attention and have been introduced into many disciplines.

Several studies have further indicated that educational mobile games will improve students' learning effectiveness when they are equipped with appropriate learning strategies [8,9]. They differ from educational computer games as educational mobile games must be designed to be entertaining, informative, and effective [10]; otherwise, they will have negative impacts on students' learning. For example, [11] stated that educational mobile

games need to be designed carefully, so as to avoid disappointing learning effectiveness caused by the conflict between gaming missions and learning tasks. Accordingly, integrating appropriate learning strategies into the educational mobile game context has become a crucial issue, for such integration can provide students with proper learning guidance or hints to ensure balance between gaming missions and learning tasks [12]. Researchers have thus incorporated learning strategies into the design of educational mobile games and explored their influence on students' learning effectiveness. For instance, [13] designed an educational mobile game application for math learning. The study adopted a digital role-playing game for students to learn number and calculation concepts in the mobile game application. This approach improved students' learning effectiveness on how to solve the equations during the game playing. [14] found that a mobile game improved students' learning effectiveness and awareness about important healthcare issues in teaching microbiology. [15] also confirmed that the combination of a mobile-based assessment strategy and educational mobile games can significantly improve students' learning effectiveness because it stimulates students thinking. This kind of game also encourages students to enjoy the learning process, and thus improves their motivation to learn effectively.

However, the important question as to whether the embedding of learning strategies will influence students' acceptance of educational mobile games has not been specifically addressed. Several studies have clearly indicated that a successful educational digital game should be accepted by students wholeheartedly in addition to improving students' learning effectiveness; otherwise, the effect will be negative [16]. Accordingly, investigation into students' acceptance of educational mobile games has been regarded as a vital issue and even as one of the criteria for evaluating the quality of educational mobile technologies [17,18]. More importantly, this kind of investigation not only helps designers or developers optimise educational technologies in a more effective manner, but also enables teachers to exploit the full potential of the technology [19]. While a majority of the literature concentrates on the factors that influence students' intention to use educational digital games [20], the role of learning strategies in students' acceptance of educational mobile games has received surprisingly little scholarly attention. As a result, this research tried to fill the gap by introducing learning strategies into the exploration of the factors behind students' acceptance of educational mobile games, thereby helping researchers design and develop more effective and acceptable educational mobile games.

To achieve this objective, we conducted an experimental study with two experimental design-based mobile games, one of which was supported by a learning strategy called the "scaffolding strategy" and the other was not. Then, we developed a research model by extending the technology acceptance model (TAM) [21], with technology utilization theory (TUT) to examine the effect of learning strategies on students' acceptance of educational mobile games. Accordingly, we designed a questionnaire to collect the students' opinions on the two mobile games, from which the role of learning strategies in students' acceptance of educational mobile games was assessed. Then, we analysed the collected data using structural equation modelling (SEM). Finally, this research provides useful suggestions for designers, developers and educational providers in order to help promote the further development and usage of educational mobile games effectively.

## 2. Literature Review

Educational mobile games are a new approach to learning and teaching through utilizing mobile devices. According to [22], introducing mobile games in learning and teaching has become one of the most interesting topics in education. In fact, there is an increasing research trend from many researchers towards investigating the usage of mobile games among students in the learning process [23]. Another study focused on studying the influence of these games on students' learning effectiveness [24]. Educational mobile games have been increasingly regarded as a powerful tool to enhance students' learning motivation. They offer a learning environment in which students acquire knowledge from playing by using their mobile devices [25]. It offers not only a mobile virtual learning space

and enables them to play an active role in learning, which is why they are regarded as more effective than educational computer games in terms of improving students' learning motivation [26]. Educational mobile games must be designed as entertaining, informative, and effective [27]; otherwise, they will have negative impacts on students' learning.

Several studies have investigated the role of digital and mobile games in enhancing the students' learning effectiveness. For example, [28] examined how mobile game application influenced math learning. They demonstrated that this approach improved students' learning effectiveness in learning number and calculation concepts during game play. [29] demonstrated that students could achieve better learning outcomes and motivation when using mobile games than with a non-gaming learning approach. A study conducted by [30] found that playing by educational mobile games has a positive effect on students' knowledge acquisition and engagement in learning. Since they can learn facts, acquire new knowledge, and engage with content very well by mobile game playing. In another study, [31] indicated that mobile gaming could show students the learning tasks and guide them to find the target; thus, this strategy will help to improve students' learning motivations, achievements and develop their skills in problem solving. [32] confirmed that there is need more research on the investigation about the crucial factors that enable students to use mobile games in effectively way. [19] mentioned that students' acceptance is the crucial significant factor in order to ensure the success and usage of mobile games in the learning environment among students.

In order to address this problem, many scholars have focused on understanding the main aspects that influence learners' usage and acceptance of digital games. For instance, [33] employed the TAM model to understand the main determinants that affect students' intention to use digital and mobile games. The study found that learners' usage of digital games was significantly impacted by self-efficacy and perceived ease of use. The researchers also recommended that the TAM model was a powerful in explaining the adoption of mobile games among learners. Another study conducted in China by [34] extended the TAM model to investigate the adoption and usage of mobile games in classroom among students. The study findings indicated that students' intention to use mobile games was positively affected by perceived ease of use and perceived usefulness. [35] also employed the TAM model to explore the main factors that affect students' usage of computer games. The results also confirmed that perceived ease of use and perceived usefulness had significant effect on students' intention to use computer games. Overall, previous studies did not pay attention to the critical role of learning strategies behind students' acceptance of educational mobile games. Thus, in our study we employed the TAM model to examine the effect of learning strategies on students' acceptance of educational mobile games.

#### *The Role of Mobile Games in the Learning Context*

Several mobile game applications are being developed and used in the learning and teaching context. Using mobile games in learning focuses on enhancing students learning skills in particular subjects such as English learning. In addition, these games also help in improving students critical thinking skills. Some other mobile games can be applied to improving knowledge in a specific subject such as math games. In contrast, some other games like chess cannot be classified as educational games because they do not deliver content or relay curriculum material, but only improve logic and thinking skills. Mobile games that contain curriculum contents or other educational material are referred to as educational games. In this study, we will focus on mobile games that can help students to improve their English knowledge and understanding. In addition, mobile games with the scaffolding strategy offer language practice, helping learners to enhance their skills in reading, writing, speaking and listening. They encourage students to interact and communicate. They create a meaningful context for language use. Mobile games are games that are developed to help students learn about specific subjects, reinforce development and help them in improving learning skills through they play. Through this paper, we

will provide evidence that the use of mobile games could support and increase English language learning outcomes.

### 3. Research Design

#### 3.1. Technology Acceptance Model (TAM)

In general, one of the critical concerns that plays an important role in the literature of mobile games is assuring learners' usage [14]. Many works have attempted to determine which factors influence students' acceptance of mobile games. Most of these papers have used the TAM model to explore adoption of mobile games in education [36,37]. In other words, researchers have employed the main constructs of TAM such as actual use and intention to use to study the acceptance.

The TAM model developed by [22], which has been widely used to study users' acceptance of educational technologies [38–40]. In fact, investigating the critical factors behind learners' choices of educational technologies has proven helpful in providing users with a more acceptable educational technology, and therefore has been widely regarded as a vital issue [41–44]. [22] developed the TAM based on five main constructs, namely, perceived usefulness (PU), perceived ease of use (PEU), attitude toward to use (ATU), behavioural intention (BI) and actual use (AU). PU means "the degree to which a person believes that using a particular system would enhance his or her job performance", PEU is "the degree to which a person believes that using a particular system would be free from effort," [22]. ATU is defined as the degree to which a user holds positive or negative feelings about using a particular technology, and BI is defined as the degree to which a user is willing to use a particular technology [22].

Due to the success the TAM model in exploring the user acceptance of technology, many researchers have used it extensively to clarify the factors that affect students' acceptance of educational digital games. For instance, [45] employed the TAM model to understand the main determinants that affect students' intention to use digital and mobile games. The study found that learners' usage of digital games was significantly impacted by self-efficacy and perceived ease of use. The researchers also recommended that TAM model was a powerful model in explaining the adoption of mobile games among learners. Another study conducted in China by [46] extended the TAM model to investigate the adoption and usage of mobile games in the classroom among students. The study findings indicated that students' intention to use mobile games was positively affected by perceived ease of use and perceived usefulness. [47] also employed the TAM model to explore the main factors that affect students' usage of computer games. The results also confirmed that perceived ease of use and perceived usefulness had significant effects on students' intention to use computer games. Overall, previous studies did not pay attention to the critical role of learning strategies behind students' acceptance of educational mobile games. Thus, in our study we employed the TAM model to examine the effect of learning strategies on students' acceptance of educational mobile games as shown in Figure 1.

#### 3.2. Technology Utilization Theory (TUT)

In the TUT, utilization of technology is determined by two main factors, namely, predictive effectiveness and the predictive efficiency, as illustrated in Figure 2. Effectiveness means capability of producing an effect. In other words, effectiveness means getting the right things done [48]. Predictive effectiveness means the expected effect or impact of the specific technology. On the other hand, Efficiency simply refers to the extent to which we create output out of particular amount of input [49]. In other words, efficiency means doing things in the most economical way. Predictive efficiency means the expected output created out of particular amount of input (eg. cost, time) for the specific technology.

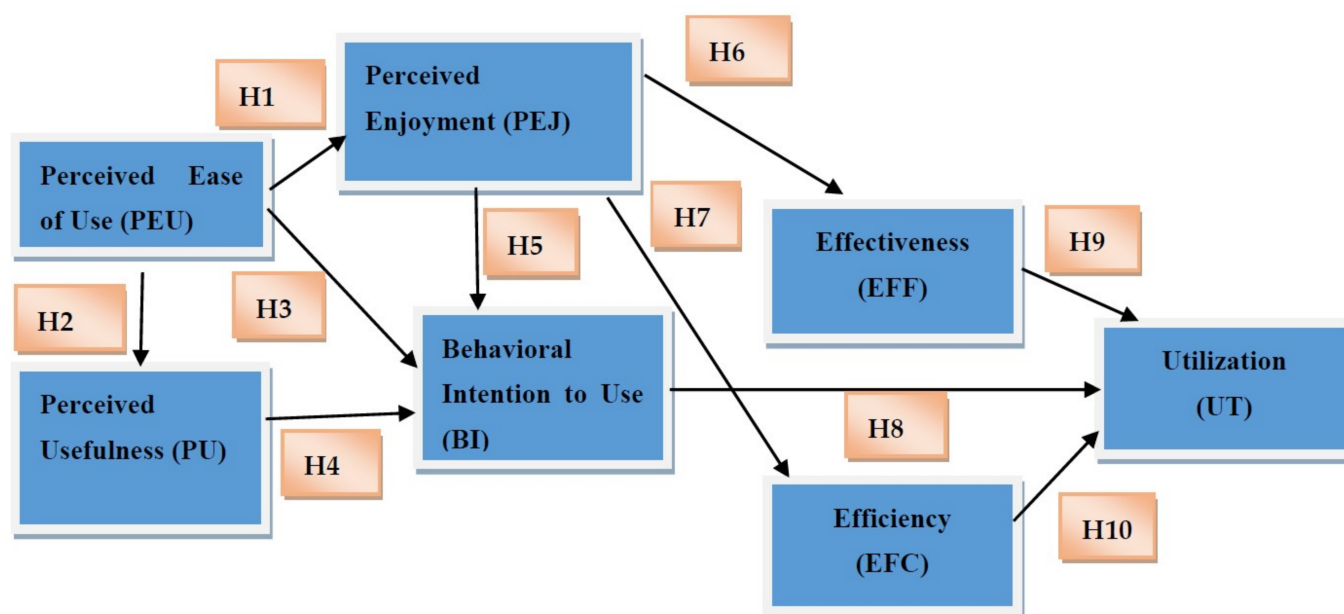


Figure 1. Research model.

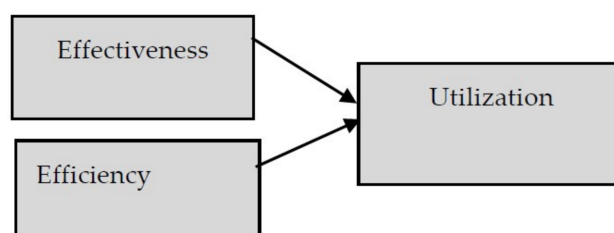


Figure 2. Technology Utilization Theory (TUT).

## 4. Methodology

### 4.1. Participants and Measurement

The participants in this experimental study were 43 students from the Educational Technologies Department enrolled in two classes of English language at King Faisal University, Saudi Arabia. Their average age was between 20 and 22 ( $SD = 0.91$ ), with an average of 5 years ( $SD = 4.22$ ) of experience in playing digital games and 3 years ( $SD = 3.67$ ) of experience in playing mobile games. This suggested that all the students in this study had considerable experience in playing digital and mobile games.

In the experimental design for this study, the participants were divided into an experimental group and a control group. The experimental group comprised 23 students from an English language class, while the control group comprised 20 students from another class. The participants in both groups were required to take a pre-test and fill in a pre-questionnaire concerning their familiarity with digital and mobile games. After that, the participants in the experimental group played the educational mobile game supported by a scaffold strategy to learn a vocabulary of fruits, while those in the control group played the same game without the assistance of the scaffolding strategy. At the end of the learning activity, the participants in both groups were requested to fill in a post-questionnaire concerning their views on the educational mobile games.

### 4.2. Scenario of the Experimental Design

In this study, the experimental design applied two educational mobile game applications in order to enhance students' skills in learning vocabulary of fruits. One of the applications was designed based on a scaffolding strategy, while the other application was not. According to [50], scaffolding strategy is one of the most effective learning strategies

in improving students' learning performance. Scaffolding refers to providing assistance according to students' requirements; such assistance varies with the increase in students' knowledge and ability [51,52] noticed when students first begin to use the educational computer game, they may lack the competence to tackle the challenges in the game, and therefore give up learning out of frustration. Accordingly, to avoid that, we designed an educational mobile game based on a scaffolding strategy that enables students to meet the challenges in the game and thereby immerse themselves in vocabulary learning. The game was developed using HTML5, so students could install the game on different mobile devices such as Android phones and iPhones.

Simply, the game requires students (players) to break through different barricades in different missions, through which the players developed a wider vocabulary of fruits. The main menu of the game based on a scaffolding strategy consists of three options: Play, Help, and Play More, as illustrated in Figure 3. The Play option leads the players directly into the game. The Help option offers the rules of the game to the players. The scenario of the game consists of two missions: the first is about a monkey try to collect the fruits by jumping to reach the outstanding fruits on the trees. After accomplishing the first mission, the player can guess the type of the fruit based on the alphabetical letters (A, B, C....). In this way, the game equips the players with the vocabulary of fruits required for accomplishing the second mission, in which they can learn the spelling and pronunciation of the vocabulary as well as the wholesomeness of the fruits. Figures 4 and 5 illustrate the scenes of the game based on a scaffolding strategy. In the game, students needed to control the monkey who jumps to collect the fruits from trees. To help students accomplish this task, the scaffolding strategy was adopted to provide them with timely tips. Then they must select the correct fruit based on the alphabetical letter within a limited period. On the other hand, Figure 3 shows the game that does not offer any tips to accomplish the task, that is, the scaffolding strategy is removed from the game. Accordingly, students who play the game without the assistance of a scaffolding strategy will face difficulty in the beginning because they obtain no tips from the game. In contrast, when introducing the scaffolding strategy, students need not face difficult challenges at the beginning of the game but incrementally adapt to the challenges in the game.



Figure 3. Mobile game without applying scaffolding strategy.



Figure 4. Mobile game applying the scaffolding strategy.



Figure 5. Mobile game applying the scaffolding strategy.

#### 4.3. Experimental Procedure

In order to conduct the experimental design, the participants were divided into an experimental group and a control group. The experimental group comprised 23 students from an advanced programming class, while the control group comprised 20 students from another class. The participants in both groups were required to take a pre-test and fill in a pre-questionnaire concerning their familiarity with digital and mobile games. After that, the participants in the experimental group played the educational mobile game supported by a scaffold strategy to learn a vocabulary of fruits, while those in the control group played the same game without the assistance of the scaffolding strategy. At the end of the learning activity, the participants in both groups were requested to fill in a post-questionnaire concerning their views on the educational mobile games. Figure 6 illustrates the steps of the experimental design.

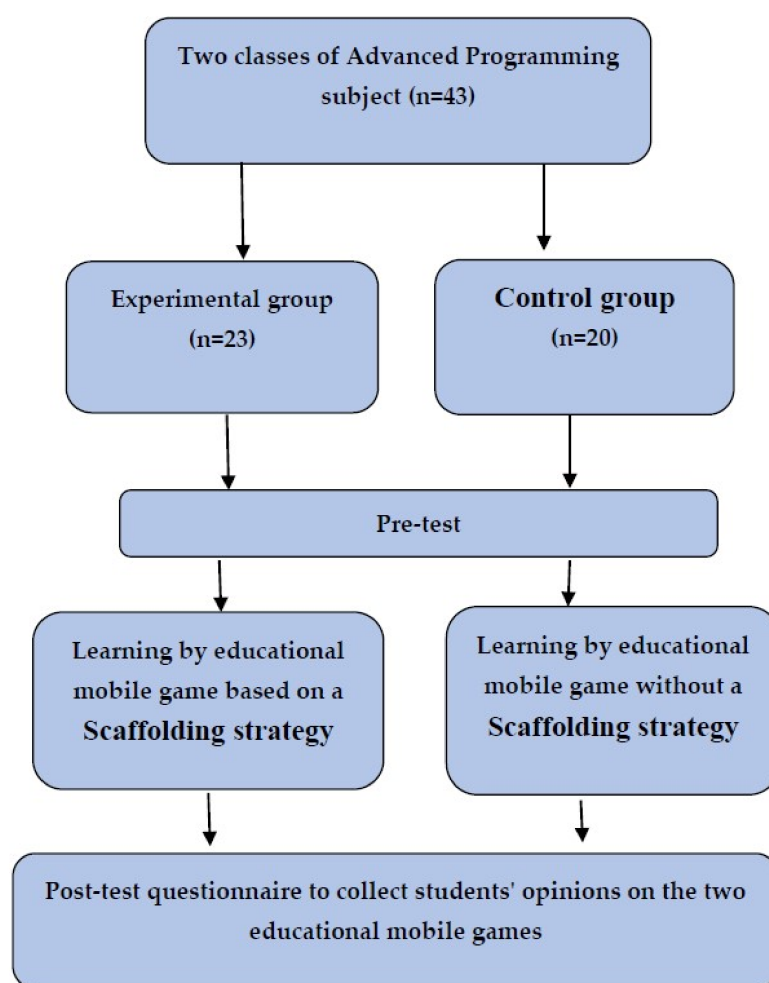


Figure 6. The experimental design procedure.

#### 5. Structural Model Analysis and Results

According to the results of Mann–Whitney U test on the subjects' prior experience of mobile games revealed that the mean and standard deviation were, respectively, 7.32 and 3.25 in the experimental group, and 7.62 and 3.11 in the control group. This indicated that there no significant difference existed between the experimental group and the control group ( $p = 0.83 > 0.05$ ). In addition, the results of Mann–Whitney U analysis on the students' breadth of vocabulary indicated that the mean and standard deviation values were, respectively, 13.21 and 5.21 in the experimental group, and 13.34 and 4.34 in the control group. The results indicated there is no significant difference between the two

groups ( $p = 0.86 > 0.05$ ). In general, these findings indicated that the participants in both groups had similar experience of mobile games and breadth of vocabulary.

This study employed structural equation modelling (SEM) to analyse the data collected for both groups, experimental group and control group. Based on that, two structural models were developed to test the hypotheses using path coefficients and  $R^2$  values where path coefficients serve as an indicator of the statistical significance of the hypotheses and  $R^2$  values indicate the models' ability to explain the variations in the dependent variables. Table 1 illustrates the results of path coefficients and  $R^2$  of the structural model for both the experimental group and control group. The results of the structural model by experimental group indicate that eight hypotheses (H1,H2,H3,H4,H5,H7,H8) were accepted, while two (H6 and H9) were rejected. These results also indicate that perceived enjoyment has significant positive effect on perceived usefulness, perceived ease of use, effectiveness and efficiency.

**Table 1.** Structural Model Analysis Results.

Hypotheses	Experimental Group (Mobile Game with Scaffolding Strategy)			Control Group (Mobile Game without Scaffolding Strategy)		
	( $\beta$ ) Value	T-Value	Results	( $\beta$ ) Value	T-Value	Results
H1:PEU—PEJ	0.66	1.62	Supported	0.42	1.12	Supported
H2:PEU—PU	0.33	1.45	Supported	0.080	0.11	Not Supported
H3:PEU—BI	0.45	1.54	Supported	0.031	0.01	Not Supported
H4:PU—BI	0.78	1.75	Supported	0.021	0.08	Not Supported
H5:PEJ—BI	0.92	1.85	Supported	0.38	1.41	Supported
H6:PEJ—EFF	0.84	1.79	Supported	0.22	1.30	Supported
H7:PEJ—EFC	0.71	1.72	Supported	0.011	0.06	Not Supported
H8:BI—UT	0.62	1.61	Supported	0.42	1.35	Supported
H9:EFF—UT	0.32	1.40	Supported	0.37	1.22	Supported
H10:EFC—UT	0.52	1.51	Supported	0.36	1.39	Supported

The results indicate that students' behavioural intention to use educational mobile games was influenced by perceived enjoyment, perceived usefulness, and perceived ease of use. In addition, the results show that students' utilization of educational mobile games was influenced directly by behavioural intention to use, effectiveness, and efficiency, and utilization was influenced by perceived enjoyment indirectly through effectiveness and efficiency.

## 6. Discussion

Several studies have indicated that educational mobile games may improve students' learning motivation and effectiveness when they are equipped with appropriate learning strategies. However, investigating the impact of learning strategies in students' utilization of educational mobile games has received little scholarly attention. Hence, this research proposed two learning game scenarios to fill this gap. In the first scenario, students were offered an educational mobile game with a learning strategy called the 'scaffolding strategy'; while in the second scenario, the same game was offered without the strategy. To achieve this objective, an experimental design with a research model was developed by combining TAM and TUT to examine the role of scaffolding learning strategy in students' utilization of educational mobile games. In this experimental study, 43 students from two classes participated in the two learning scenarios. The findings revealed that the introduction of a scaffolding learning strategy into educational mobile games has a significant and positive effect on students' utilization of educational mobile game, and thereby, will improve students' learning effectiveness and their efficiency.

Table 1 presents a comparative analysis between the results of the experimental group (educational mobile game with scaffolding strategy) and control group (without scaffolding strategy). The results showed that the effect of perceived ease of use on perceived enjoyment, perceived usefulness, and behavioural intention to use the mobile game varied in the two groups. Where perceived ease of use had a significant effect on perceived enjoyment, perceived usefulness, and behavioural intention to use in the experimental group, in the control group, it had a significant effect only on perceived usefulness. This implies that the perceived ease of use affected students' behavioural intention to use of educational mobile games significantly in the experimental group more than in the control group. The difference in the results might be explained by the introduction of the scaffolding strategy. In addition, the logical explanation for these results is that the scaffolding strategy makes the mobile game easier to play and learn, and therefore exerts a positive effect on the perceived usefulness of the game, enjoyment in playing the game, and behavioural intention to use the educational mobile game in the experimental group. While, in the control group, students were faced difficult situations due to the lack of a scaffolding strategy (i.e., tips and guidelines to accomplish the mission), thereby making the students tend to give up playing the game to learn. In contrast, the scaffolding strategy in the other group enabled the students to tackle the challenges in the stages of the game more easily, thereby increasing their motivation to learn using the educational mobile game. This can be seen in Figures 4 and 5.

The results also revealed that perceived usefulness had a significant and positive influence on behavioural intention to use in the experimental group, while in the control group; it had a non significant but positive influence on behavioural intention. The explanation for this result is that the mobile game with the scaffolding strategy improved the students' learning effectiveness through providing them timely tips, and thus enhanced the students' willingness to play. On the contrary, the control group did not have such a supporting mechanism, and this could be why the effect of perceived usefulness on the behavioural intention of this group was not as significant as that in the experimental one. This result is inconsistent with [53–57] they found that students' perceived usefulness had no significant and positive influence on their behavioural intention, which might be explained by their lack of interest in learning that led to their ignorance of the usefulness of the games.

The results showed that perceived enjoyment was the only factor that had a significant influence on students' behavioural intentions to use the mobile game, whether the scaffolding strategy was embedded in the mobile games or not. The possible explanation for such a result is that students preferred the educational mobile games as an entertainment tool that brought them fun and pleasure; and this served as the key factor that influenced their intention to use the mobile game. This result is consistent with a [58–61], who investigated the factors that influence individuals' acceptance of mobile learning games. His study showed that perceived enjoyment is the key factor that determines individuals' acceptance of mobile learning games.

The findings also showed that perceived enjoyment had a non significant influence on perceived effectiveness and perceived efficiency of educational mobile games in both groups. This explains that students in the experimental group and control group were interested in the entertainment more than learning, and thus perceived enjoyment is not a significant factor behind enhancing students' learning effectiveness and efficiency. This factor played a significant role in their acceptance of the mobile games. In other words, students did not care about the usefulness of the educational mobile game as a tool for enhancing their learning effectiveness and efficiency; they preferred the educational mobile games as entertainment tool.

Finally, the results revealed that predictive effectiveness and predictive efficiency had significant and positive influence on students' utilization of educational mobile games in the experimental group, while in the control group was insignificant. This implies that the predictive effectiveness and predictive efficiency affected students' utilization

of educational mobile games significantly in the experimental group more than in the control group. The difference in the results might be explained by the introduction of the scaffolding strategy. In addition, the logical explanation of these results is that the scaffolding strategy increased students' interest for learning through the mobile game in the experimental group. While students in the control group regarded the mobile game as an entertainment medium rather than a tool for learning due to the lack of a scaffolding strategy (i.e., tips and guidelines to learn), thereby making the students tend to play more than to learn. This result also supports the previous results of this study, which indicates that students' utilization was significantly and positively influenced by perceived enjoyment and perceived usefulness indirectly through the behavioural intention to use for the experimental group. This finding is consistent [62–64] who mentioned that the introduction of learning strategies in educational computer games might not only improve students' learning effectiveness but also reinforce their learning efficiency.

### *Implications of the Study*

This research has several implications for practitioners and researchers. The study findings indicated that students, who were exposed to the mobile game-based learning with the scaffolding strategy, experience a positive effect on learning skills and language aspects. This paper provides evidence that the use of mobile games could support and increase English language-learning outcomes. Hence, mobile game-based learning could achieve the goal of learning effectively. The results show that the learning motivations of students have significant impact on the learning achievement, and the learning achievements of students with mobile game-based learning are better than those who use the traditional face-to-face teaching. This study also found that students who use mobile games improve their motivation to complete learning homework. In this study, mobile games appear to be particularly effective in helping students improve their English knowledge and understanding. In addition, mobile games with the scaffolding strategy offer language practice to help learners to enhance their skills in reading, writing, speaking, and listening. They encourage students to interact and communicate. They create a meaningful context for language use. Mobile games are games that are developed to help students learn about specific subjects, reinforce development, and help them in improving learning skills through play. Mobile game-based learning plays a crucial role in learning and teaching by helping learners to learn, communicate, collaborate, and work in teams. Mobile games establish a dynamic that can allow students to enhance their skills and improve their learning using game strategies. In addition, mobile games improve the functioning of the brain.

## **7. Conclusions**

This study developed a model by combining TAM with TUT to examine the role of scaffolding learning strategy in students' acceptance of educational mobile games. Several findings of this research can be stated as follows: First, in the case of the educational mobile game with the scaffolding learning strategy, the students' perceived ease of use significantly influenced their perceived enjoyment, perceived usefulness, and behavioural intention to use; while in the case without the scaffolding learning strategy, the students' perceived ease of use did not influence their behavioural intention to use. Second, perceived enjoyment was the only important factor that affected the students' acceptance of the mobile games with or without the scaffolding learning strategy. Third, perceived usefulness had a significant and positive influence on behavioural intention to use in the experimental group, while in the control group it had a non significant but positive influence on behavioural intention. Fourth, perceived enjoyment had non significant influence on perceived effectiveness and perceived efficiency of educational mobile games in both groups. Finally, the predictive effectiveness and predictive efficiency had significant and positive influences on students' utilization of educational mobile games in the experimental group, while in the control group the effects were insignificant. In summary, these results show the important role of

the scaffolding learning strategy in enhancing students' acceptance of educational mobile games. The results of this study also clarify for designers and developers the important role of the scaffolding learning strategy in designing and developing educational mobile games, which therefore makes this study a practical reference for practitioners and researchers in facilitating the application and development of educational mobile games.

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**Conflicts of Interest:** The authors declare no conflict of interest.

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