Arab World English Journal

INTERNATIONAL PEER REVIEWED JOURNAL ISSN: 2229-9327

The Effects of Mobile Game-Based Learning on Saudi EFL Foundation Year Students' Vocabulary Acquisition

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Abstract
Mastering vocabulary can be a challenge as a great deal of information is delivered in intensive English courses. This study investigates the effects of mobile games on EFL students' vocabulary acquisition via the "Quizizz" application. A total of 56 female foundation year students from a Saudi Arabian university participated in this study. The purpose of the study was to explore the students' attitudes, cognitive load and motivation concerning vocabulary acquisition. The study employed a mixed-methods approach. Two groups underwent a pretest and posttest to compare mobile game-based learning to traditional teaching methods. To examine the effect of this strategy on EFL students' perceptions, both the control and experimental groups answered an online questionnaire. In a semi-structured interview, 10 participants from the experimental group expressed their perceptions towards mobile game-based learning. The study's findings demonstrated that the experimental group outperformed the control group in the posttest results. It is noteworthy that although learners of the control group practiced vocabulary via the conventional teaching method, they showed a high level of agreement towards implementing digital gaming for vocabulary learning, similar to the experimental group. Furthermore, the experimental group expressed their acceptance of this strategy as an effective way of facilitating, retaining, and alleviating cognitive load during vocabulary learning. EFL teachers are, therefore, recommended to integrate mobile game-based learning into their vocabulary lessons.
Keywords: Cognitive load, mobile-assisted language learning, mobile game-based learning, Quizizz application, vocabulary learning

Introduction

In the last decade, technology has become ubiquitous in all aspects of our lives, including education, work, and even entertainment. It has also been incorporated into the field of Computer Assisted Language Learning (CALL), which has been further melded with the field of Mobile Assisted Language Learning (MALL) as well (Hellmich, 2021). In recent years, researchers have used MALL as a powerful tool for supporting English language teaching and learning (Panagiotis & Krystalli, 2020). In the context of teaching English as a second language (ESL) or foreign language (EFL), the evolution of mobile learning (as a contemporary sub-field) takes learning both inside and outside the classroom (Lin & Chen 2017).

Word knowledge is perceived as the backbone of language learning (Moeller et al., 2009), meaning that without an adequate vocabulary repertoire, the four essential skills (reading, writing, listening, and speaking) cannot be mastered. Therefore, the first thing that comes to learners' minds when learning English is to use dictionaries, not grammar books (Schmitt, 2000). Consequently, many types of research have also been conducted on vocabulary learning through digital gaming in the Kingdom of Saudi Arabia (KSA), specifically in MALL, to enhance and facilitate second language acquisition (Alghamdi & Elyas, 2020; Al-Johali, 2019; Alharbi, 2020; Fageeh, 2013; Gamlo, 2019; Sanosi, 2018). The Saudi government's efforts would be satisfactory in incorporating technology into the education system, specifically in English language teaching (Saqlain et al., 2013). The use of digital gaming tools has expanded in education with the increasing involvement of mobile technology in the last few decades (Alshumaimeri, 2008).

English Language skills cannot be practical without learning vocabulary efficiently and practically through effective tools. Accordingly, if educators continue to teach using the traditional method, intensive English courses may hardly be assimilated by the long-term memory. The purpose of this research is to explore how mobile games can provide an enjoyable learning experience that can boost motivation and reduce cognitive load, resulting in better comprehension and achievement. Therefore, the present study investigates the effectiveness of mobile-assisted language learning, specifically Mobile Game-Based Learning (MGBL), regarding vocabulary learning among preparatory year students. The primary objective of the research is to examine the effects of MGBL on EFL female learners' cognitive load and motivation, specifically on vocabulary acquisition. Moreover, the study explores their attitudes towards utilizing MGBL, which offers a variety of gaming features. The investigation delimits its scope to EFL female foundation year students' vocabulary acquisition at King Abdulaziz University, Saudi Arabia. The perceptions of the participants are analyzed and discussed quantitatively and qualitatively.

The following research questions have been formulated to achieve the study's objectives:
1. How does mobile game-based learning affect female EFL students' vocabulary acquisition?
2. Are there any differences in perceptions between the control and experimental groups concerning attitudes, cognitive load, and motivation related to MGBL?
3. How do female EFL students in the experimental group perceive mobile game-based learning for vocabulary acquisition?

Literature Review

Internet ubiquity has made integrating technology more effective at revolutionizing language education. The field of CALL has gained broad attention in the research of English language teaching theoretically and empirically (Fageeh, 2013). According to Gamper and Knapp (2002), CALL is defined as "a research field which explores the use of computational methods and techniques as well as new media for language learning and teaching" (p. 331). With the advance of technology and the use of handheld devices, the field MALL has emerged, which "differs from CALL in its use of personal, portable devices that enable new ways of learning, emphasizing continuity or spontaneity of access across different contexts of use" (Kukulska-Hulme & Shields, 2008, p. 273). MALL and CALL were compared by Sari, Anwar, and Marifah (2022), who found MALL, using the Quizizz app, improved EFL learners' vocabulary knowledge after using it as an assessment tool. Lately, ESL/EFL teachers have gradually adopted new teaching methods and techniques, deviating from the formal/traditional teaching methods to get noticeably effective results. Recent studies in KSA have focused primarily on MALL for vocabulary acquisition (Alghamdi & Elyas, 2020; Alharbi, 2020; Gamlo, 2019; Sanosi, 2018). Accordingly, MALL has been integrated widely with games, referred to as mobile game-based learning, for getting a remarkable result with second language learners.

The Effect of Mobile Games on EFL Students' Vocabulary Acquisition

Due to the necessity of mastering vocabulary for competence in the target language, mobile learning games have been observed as a positive way to achieve tangible results with today's generation. Based on information gathered from the pretest and post-test results of the participants, studies on EFL learners in the KSA found that MGBL improved vocabulary acquisition when compared to conventional teaching and learning methods employed in the control groups (Alghamdi & Elyas, 2020; Alharbi, 2020; Fageeh, 2013; Sanosi, 2018).

By integrating the Quizizz platform with its gaming features, empirical studies on EFL learners found that the experimental groups who learned vocabulary via mobile games outscored their peers who used traditional teaching methods (BAL, 2018; Caroline & Grace, 2021; Huei, Yunus, & Hashim, 2021; Katemba & Sinuhaji, 2021). For example, Hui et al. (2021) noted a significant improvement in the vocabulary repertoire of EFL students who used the Quizizz app based on pretest and posttest results. Accordingly, the current study aims to employ the Quizizz application on the Saudi pre-intermediate level to examine its impact on their performance and perceptions.

EFL Students' Attitudes towards Mobile Games in Learning Vocabulary

The literature has witnessed an increased focus on MALL, with more than 345 mobile-related technologies available for use in English language teaching and learning (Burston, 2014, as cited in Alamer & Al Khateeb, 2021). Mobile games have become popular with the digital generation, which has prompted researchers to investigate how MALL can enhance second-language acquisition through its integration with games. As a result, gamified mobile apps have been integrated into English language teaching and learning due to their positive impact on students' attitudes and performance.

To examine the impact of mobile learning games on EFL low achievers, Gamlo's (2019) study on Saudi EFL students, who were at a low level in the intensive English courses, described

the MGBL as an exciting and memorable experience where they implied their willingness to continue using this strategy in learning English vocabulary. The willingness of A2-level students, who were regarded as low achievers, to learn vocabulary via mobile games was noticed when they were asked to comprehend and master 30 words weekly (Wang, 2017). Similarly, a study by Wichadee and Pattanapichet (2018) demonstrated the ease of use and enjoyment of the Kahoot app by showing that players could enhance their vocabulary skills faster and more efficiently when using the app than when using a conventional method.

The effectiveness of MGBL in facilitating the comprehension of vocabulary has been stated by many researchers (Dizon, 2016; Klimova & Polakova, 2020; Ozer & Kılıç, 2018). In a study in which Dizon (2016) developed Japanese ESL students' English vocabulary skills over ten weeks, students believed that learning with games facilitated their vocabulary acquisition. Besides, students in Ozer and Kılıç's (2018) study appreciated mobile learning because it made the educational process more effective and enjoyable by allowing them to work at their own pace. Due to this, mobile apps that focus on gaming characteristics have gained positive attitudes from EFL learners as tools for English vocabulary learning.

The Effect of Mobile Games on EFL Students' Cognitive Load

In today's digital era, many recent studies conducted on MALL and its role in enhancing one's cognitive learning system during the vocabulary learning process (Hwang, Hsu, & Hsieh, 2019; Ozer & Kılıç, 2018). Using digital gaming to learn vocabulary did not overburden students' cognitive systems, according to the questionnaire and experiment results (Ozer& Kılıç,2018). Researchers such as Zou, Huang, and Xie (2019) reviewed the effects of digital gaming on vocabulary learning in 21 research studies published in SSCI journals. They found the positive impact of mobile games on supporting both short- and long-term memory. Consequently, MGBL could enhance vocabulary retention without causing an overload during the learning process.

The Effect of Mobile Games on EFL Students' Motivation

A lack of motivation among EFL learners is an issue that researchers and educators try to overcome by integrating various strategies and techniques that could enhance enthusiasm, interest, and engagement during the learning process in the EFL context. Many researchers have examined how digital games are used to create a motivating learning environment for EFL learners (Elaish et al., 2019; Gamlo, 2019; Kohnke, 2020; Razali, Nasir, Ismail, Sari, & Salleh, 2020; Sun & Gao, 2020). In Razali et al.'s (2020) study, the findings indicated the significant impact of extrinsic motivation, such as rewards and points as strong motivational factors, compared to intrinsic motivation on EFL university students. However, intrinsic motivation was significant in some studies concerning students' desire to play based on their expected learning gains, such as Tsai, Cheng, Yeh, and Lin (2017). Competition, curiosity, and interaction, which are the essential factors in intrinsic motivation, were noticed in the utilization of digital gaming applications such as Kahoot, Quizlet, and Nearpod in both synchronous and asynchronous learning environments on EFL learners' English vocabulary (Karaaslan, Kılıç, Guven Yalcin, & Gullu, 2018).

Previous studies have emphasized the role of motivation generated via mobile games on EFL students' academic achievement. The perception of 70 Chinese first-year students was

examined, after a gaming intervention, to find that the influence of mobile game-based vocabulary learning on students' motivation and achievement was positive (Li, 2021). Video games were used as an experimental tool to teach vocabulary to English major students found that the experimental group acquired a large vocabulary within a short period (Calvo-Ferrer, 2017). They also felt the course was more appealing and helped them learn language effortlessly. Additionally, a study that employed three mobile games, including Quizizz, demonstrated the efficacy of mobile games in converting tedious English vocabulary lessons into fun and exciting experiences, thereby increasing students' self-motivation and mastery of the language (Aini & Ma'rifah, 2021).

Theoretical Frameworks

Cognitive Load Theory (CLT) was developed in the late 1980s by Sweller, which dealt with implementing instructional strategies to improve the human cognitive system's limited capacity (Van Merrienboer & Sweller, 2010). Cognitive load is defined by Ozer and Kılıç (2018) as the ability to absorb and retain information without exerting excessive effort on short-term memory. It consists of extraneous, intrinsic, and germane categories. These terms are described as; 1) extraneous cognitive load represents the extra effort imposed by students' minds that impedes their ability to learn, 2) intrinsic cognitive load indicates the level of complexity of the tasks to be accomplished, while 3) germane cognitive load illustrates the desired amount of effort learners put into learning (Lin & Yu, 2017). The capacity of the human working memory to process novel information is limited. Consequently, working memory should be used to construct cognitive schemata, where the information could be classified and stored as a coherent knowledge structure in the long-term memory (Sweller, Van Merriënboer, & Paas, 1998). Evaluating mobile games' efficacy in retaining vocabulary without causing cognitive overload is one of the areas that the current study aims to discuss.

Numerous theoretical perspectives related to the technology implications in the instructional field have been discussed to get a comprehensive idea of understanding users' adaptation to new technology. The Technology Acceptance Model (TAM), one of the most common technological theories, predicts an individual's intention to utilize new technology. Two primary factors influence users' acceptance of the latest technology; 1) perceived usefulness and 2) perceived ease of use (Davis, 1989), which are related to learners' attitudes towards the newly applied system. TAM is used to predict users' attitudes towards how specific technology systems could improve task performance (Surendran, 2012 as cited in Prayogi & Wulandari, 2021), based on two primary constructs: perceived usefulness and perceived ease of use. Therefore, the level of acceptance can be determined by the users' responses to the TAM constructs.

Based on the reviewed literature, this study aims to fill the gap in the literature on the vital role of MGBL for vocabulary acquisition at the tertiary level, specifically the intensive English courses taught in the foundation year in the Saudi Arabian educational system. It is worth noting that few studies have conducted an in-depth examination via interviews to discover the impact of MGBL on learners' attitudes, motivation, and cognitive load. Hence, the present study will provide academicians and researchers with a helpful guideline for learning vocabulary, thus improving EFL learners' proficiency.

Methods

The study was carried out by adopting an explanatory sequential model of mixed-methods research (QUAN-qual), i.e., quantitatively driven by a supplementary qualitative approach. According to Dornyei (2007), "The goal of mixed methods research is not to replace either of these approaches but rather to draw from the strength and minimize the weaknesses of both in single research studies" (p. 167)

Participants

The study was conducted with 56 female students, in the foundation year, at the A2- level (Art / Humanities track), which is regarded as the pre-intermediate level based on the Common European Framework of Reference for Languages (CEFR), during the academic year of 2021/2022. The students are a group of homogenous Arabic native speakers ranging from 17–21 years of age. Based on their voluntary participation in this study, the participants were categorized randomly into two symmetric groups of 28 learners each. The experimental group used the Quizizz application intervention as a mode of MALL, followed by the control group (who has been taught conventionally through the textbook) after conducting the proficiency pretest. The qualitative phase involved ten students from the experimental group participating in semi-structured interviews through the Zoom platform. Due to the COVID-19 pandemic, the experiment had been conducted at King Abdulaziz University (KAU), Kingdom of Saudi Arabia (KSA), using Blackboard Collaborate, i.e., virtual classes.

Research Instruments

In the quantitative phase, the data collection was conducted through two methods; a quasi-experimental approach with two groups (control and experimental) and a posttest questionnaire that aimed to compare the perceptions of both groups towards MGBL. A quasi-experimental design is a research design used to test an intervention and its influence on the dependent variables (Creswell, 2012). A 5-point Likert scale questionnaire, ranging from "Strongly disagree" to "Strongly agree," was employed to investigate the EFL foundation year students' perceptions of MALL. All participants, i.e., both groups, filled out the online questionnaire. Since the questionnaire items were generic, i.e., they did not address any specific app, the aim was to gauge learners' perceptions of the effectiveness of MGBL in acquiring the second language (L2) vocabulary. There were three variables included in the questionnaire: Attitudes, Cognitive load, and Motivation (15 items in total). The attitudes variable (5 items) was adapted from Uzunboylu et al. (2015), while the researcher theoretically created the cognitive load variable (four items). The motivation variable (six items) was adapted from the previous study conducted by Tsai et al. (2017) that included items nos. 10,11,12, and 14, while items 13 and 15 were adapted from Alamer (2021) (see Appendix A). The motivation and attitudes variables were modified after adaptation to meet the study requirements.

The qualitative phase of the study involved conducting semi-structured interviews with students about their experiences with MGBL in the EFL context. Semi-structured interviews "allow for an open response in the participants' own words rather than a 'yes or no' type answer" as it is "conversational and informal in tone" (Longhurst, 2003, p. 105). The interview questions were constructed based on this study's research questions and objectives. The interviewees used their mother tongue, the Arabic language, to facilitate the process of recounting the needed information.

An Overview of the Quizizz Application

The Quizizz application, an online formative assessment tool, is used widely for educational purposes due to its unique characteristics such as the leaderboard, memes, and activity reports that can be shared as Excel spreadsheets with the learners' parents in this study. Figure 1 represents the participants' rank on the leaderboard of this study during a vocabulary activity via the Quizizz platform. Educators can assign homework for additional practice via the Quizizz app, where students can respond at any time within the designated duration. The Quizizz app's features have made it a preferred option for educators, especially in the English language field, to interest and motivate learners for second language acquisition.

Figure 1. The leaderboard of Quizizz platform

Research Procedures

The researcher experimented on two A2-level classes via Blackboard Collaborate. The researcher taught the experimental group, while the course English lecturer taught the control group. The total duration was four weeks. In the first week, the researcher provided an introduction and details about the experiment and information using the Quizizz app. Besides, a pretest was conducted online via Google Forms on both groups (control and experimental) to measure the students' vocabulary size before experimenting. In the following weeks, the participants in each group practiced vocabulary weekly (up to twice per week). They learned about seven words in each class, adding to a combined total of 40 words. The target vocabulary list was derived from the course content. The experimental group used the Quizizz application to answer the vocabulary activities. On the other hand, the control group practiced vocabulary through class participation, i.e., the traditional teaching method. In the last week, a posttest with 25 multiple-choice questions was administered to gauge the vocabulary size for both groups via Google Forms after the intervention. A total score of 25 was calculated for each pretest and posttest, where each question was worth one point. The duration for each test was 30 minutes which was accomplished during class hours.

Besides, an online questionnaire was filled out by both the groups directly after the intervention. The questionnaire was translated into the students' native language, Arabic, and checked and proofread by an English-Arabic translator to avoid confusion and misunderstanding

of the survey items. The experimental group's data was collected via semi-structured interviews until the data reached a saturation point. Each interview lasted for about 20 minutes. The data was organized and prepared for analysis using NVivo software. All the raw data obtained from the interviewees was transcribed into English. As well as being a data analysis and interpretation process, the transcription helped turn the data into vivid pictures (Gillham, 2005). Concerning the confidentiality of the interviewees, the audio-recorder was used only after getting their approval to record their statements. The recording would ensure no significant points from them could be missed. The research confirmed that all the data was stored secretly behind pseudonyms/codes.

Validity and Reliability

The "content validity" was utilized to validate the vocabulary tests since the pretest items were obtained from the first five chapters. In contrast, the posttest items were derived from the rest of the coursebook's chapters. Therefore, content validity is used as evidence to gauge the instruments' validity by linking them to the target construct (Rusticus, 2014). For the questionnaire's validity, two experts in the English language field checked the items of each variable and made amendments to suit the study's aim and objectives. For reliability, on the other hand, a pilot study was conducted to check the items' reliability and internal consistency. The reliability coefficient of the pilot study was .97, according to the Cronbach's alpha test. For the semi-structured interviews, the validity of the interview questions was checked by two experts in the English language field. Besides, the "member checking" technique was used in this study for respondents' validation. It ensured accuracy and transferability, as well as credibility for the data since it could authorize the "triangulation of knowledge," especially in a study that adopted a "multiple data collection" method which "led to more valid interpretations" (Birt, Scott, Cavers, Campbell, & Walter, 2016, p. 1803).

Data Analysis

The quantitative data of the first and second research questions were analyzed using SPSS version 26. First, the mean differences in vocabulary acquisition were calculated between the pretest and posttest using paired samples *t*-tests, followed by finding the difference in the posttest scores using independent samples t-tests. Second, a duplicate copy of the same questionnaire was distributed using the online form to compare attitudes, cognitive load, and intrinsic and extrinsic motivation between the two groups using the independent samples *t*-test. The third research question was answered by thematic analysis of data gathered through semi-structured interviews. The third research question was answered by thematic analysis of data gathered through semi-structured interviews.

Results

A total of 56 students participated in this study. The researcher divided them into two equal groups: a) Control Group and b) Experimental Group, which is appropriate to the experimental nature of the study. The calculations suggested that most of the participants in both groups were 19 years of age; 12 (42.9%) in the control group and 13 (46.4%) in the experimental group. Furthermore, 21 (75%) of the experimental group participants used MGBL, compared to only 15 (53.6%) for the control group. Mobile game-based learning was used by 21 (75%) of the experimental group participants, compared with 15 (53.6%) for the control group.

The Vocabulary Tests for the Quasi-Experimental Approach

A paired-samples t-test was performed on both groups for answering research question one, as shown in Table 1. For the independent control group, the results showed a decrease in the tests' results of the participants. For instance, the mean pretest score ($M = 18.61, SD = 5.38$) decreased in the posttest to ($M = 15.43, SD = 5.63$), $t = 2.76, p = .010$. The correlation between the pretest and posttest was estimated at $r = .39$, with the difference of $d = 0.52$. In contrast, the experimental group's results showed a significant improvement in participants' performance. For instance, the mean pretest score ($M = 16.39, SD = 5.80$) increased in the posttest to ($M = 19.50, SD = 4.44$), $t = -2.39, p = .024$. The correlation was estimated at $r = .12$, with the difference of $d = 0.45$.

Table 1. *Paired-samples t-test results for the English vocabulary tests*

		Pretest		Posttest		r	t	p	d
	N	M	SD	M	SD				
Control Group	28	18.61	5.38	15.43	5.63	.39	2.76	.010	0.52
Experimental Group	28	16.39	5.80	19.50	4.44	.12	-2.39	.024	0.45

To determine whether there was any significant difference between both groups, an independent samples *t*-test was conducted to compare both the groups' posttest results, following the intervention as presented in Table 2. There was a significant difference in the scores between the 28 participants who received the MGBL intervention ($M = 19.50, SD = .4.44$), compared to the 28 participants in the control group ($M = 15.43, SD = 5.63$) who demonstrated better vocabulary learning, $t = 3.00, p = .004$. The large effect size was noted at $d = 0.8$, indicating a high level of practical significance.

Table 2. *Independent samples t-test results of the posttest*

	N	M	SD	t	p	d
Control Group	28	15.43	5.63	3.00	.004	0.8
Experimental Group	28	19.50	4.44			

The Posttest Questionnaire

To check the reliability of the variables included in the questionnaire, Cronbach's Alpha was used to assess the internal consistency of the questionnaire items. For instance, the value of α should be higher than 0.7 (Fraenkel & Wallen, 2003). In this case, the figures were as follows: attitudes = .97, cognitive load = .91, intrinsic motivation = .93, and extrinsic motivation = .78

Regarding the second research question, an independent samples *t*-test was used to compare the perceptions of the control and experimental groups for variables. In general, there was no significant difference between the perceptions of the two groups. As presented in Table 3, for attitudes ($t = 0.57, p = .570$), the means were not significantly different between the control ($M = 3.85, SD = 1.09$) and experimental groups ($M = 3.65, SD = 1.49$). For intrinsic motivation ($t = 0.04, p = .971$), the mean score for the control group ($M = 3.86, SD = 1.01$) was virtually the

same as that of the experimental group's (M =3.85, SD = 1.41). The magnitudes of the differences in the means of cognitive load (d = 0.06) and extrinsic motivation (d = 0.25) were very small.

Table 3. *Testing different perceptions of both groups by using independent samples t-test*

Variable	Control group (n = 28)		Experimental group (n = 28)				
	M	SD	M	SD	t	p	d
1. Attitudes	3.85	1.09	3.65	1.49	0.57	.570	0.15
2. Cognitive Load	3.52	1.11	3.60	1.39	0.21	.833	0.06
3. Intrinsic Motivation	3.86	1.01	3.85	1.41	0.04	.971	0.01
4. Extrinsic Motivation	2.75	1.25	3.07	1.26	0.96	.343	0.25

df = 54

Semi-Structured Interviews

Concerning the third research question aimed at the experimental group, the semi-structured interview, with its eight guiding questions, was used to gain further insights into participants' perceptions of the impact of MGBL on students' performance in acquiring English vocabulary. The elicitation of the interview questions was based on the study variables (attitudes, cognitive load, and motivation), i.e., the questionnaire items indirectly. Table 4 displays the three themes emerging from the interviewees' responses, namely, 1) acceptance of MGBL for L2 vocabulary learning, 2) effectiveness of MGBL in integrating the 'Quizizz' platform, and 3) MGBL and vocabulary retention.

Table 4. *Themes, codes, and segments of the experimental group interviews*

Themes	Codes	Segments
1. Acceptance of MGBL for L2 vocabulary learning	a) Active learning	● Increasing the interaction between classmates (9) ● Answering the online-game questions enthusiastically (7)
	b) Enjoyable learning environment	● Learning without getting bored (2) ● Having fun and learning at the same time (4)
	c) Ease of use	● The application was easy to be used in the virtual class (6)
2. Effectiveness of MGBL integrating 'Quizizz' platform	a) Promotion of critical thinking	● Thinking and trying to find out the correct answer (4) ● Ignoring irrelevant answers (2)
	b) Motivation improvement	● Results and levels of learners on the leaderboard (6) ● Memes (pictures) after each question (3)
	c) Facilitation of learning	● Knowing the correct answer immediately (4)
3. MGBL and vocabulary retention	a) Enhancement of long-term memory	● Improving comprehension instead of memorization (3) ● Similar to the actual test method (5)

The majority of the participants interviewed expressed a positive attitude towards mobile game-based learning. These positive points of their acceptance were in light of the following aspects:

active learning, enjoyable learning environment, and ease of use which were supported with extracts from the interviewees' responses.

With active learning, the participants mentioned that the used app increased the interaction between classmates. For example, one student said:

> Mobile game-based learning is enjoyable since it increases the interaction among learners, as all students have a chance to participate and evaluate the gained information at the same time while answering the online questions more than the traditional teaching method. (S2)

For its practicality, more than half of the interviewees stressed the seamless use of the Quizizz app in the virtual English class. Therefore, these aspects reflected the participants' acceptance and their positive attitudes towards integrating MGBL for vocabulary acquisition.

Regarding the interviewees' perceptions of MGBL's effectiveness in integrating the Quizizz platform, three points were identified: promoting critical thinking, motivation improvement, and facilitating learning. Promoting critical thinking was emphasized as a positive impact of mobile game-based learning in the EFL context. One of the participants stated her experience as follows:

> While I was trying to answer the vocabulary questions of the online game, I was thinking and trying to relate what I had already studied in the vocabulary lesson to find out the most related answer to each question of the game. (S6)

Additionally, half of the interviewees considered the similarity between the application-a feature that facilitated the recall of some of the vocabulary adopted by digital gaming and the actual test of asking questions. For example, one participant said: " MGBL helped me remember the vocabulary at the time of the test, as it is very similar to the real test method, which led to its usefulness in facilitating and remembering as well." (S10) MALL, Therefore, with its gaming features was highly appreciated by the study's participants.

Discussion
The Effect of Mobile Games on EFL Students' Vocabulary Acquisition
Based on the current study's findings, the mean scores of the female participants in the experimental group, who used mobile game-based learning for vocabulary acquisition, implied a significant improvement in their performance. This indicates that integrating digital gaming to facilitate second language vocabulary acquisition was tangible based on the results gained from the quasi-experimental approach. The study's results are consistent with those of other studies using the quasi-experimental design on EFL learners in the KSA (Alghamdi & Elyas, 2020; Alharbi, 2020; Fageeh, 2013; Sanosi, 2018), demonstrating that mobile learning games enhance vocabulary learning in EFL classrooms. For example, in Sanosi's (2018) study, the experimental group that underwent mobile game-based learning outperformed the other group that used traditional teaching methods. Accordingly, the present study found that technology increased the learning rates compared with the conventional way. Hence, this finding suggests that the applied treatment, namely the Quizizz app, stimulated the experimental group participants' performance compared to the control group. This study's results support previous studies that have found

MGBL, particularly the Quizizz app, enhanced EFL vocabulary learning (BAL, 2018; Caroline & Grace, 2021; Huei et al., 2021; Katemba & Sinuhaji, 2021).

The Effect of Mobile Games on EFL Students' Attitudes, Cognitive Load, and Motivation

Regarding female EFL learners' attitudes towards MGBL, this study suggests that female EFL learners at the pre-intermediate level hold positive attitudes towards MGBL as a strategy for learning English vocabulary. Despite the higher mean scores of the control group compared to the experimental group, the difference was not significant since both the groups expressed positive attitudes toward using MGBL to learn EFL vocabulary. A strong relationship between mobile game-based learning and learners' positive attitudes for EFL vocabulary acquisition has been reported in the literature (Dizon, 2016; Gamlo, 2019; Klimova & Polakova, 2020; Ozer & Kılıç, 2018; Wang, 2017; Wichadee & Pattanapichet, 2018). For example, Gamlo (2019) studied the attitudes of low-level Saudi A2-learners after integrating mobile games to enrich the students' English vocabulary learning, where they described the experience as enjoyable. They also expressed the intention of continuing to use the game in the future. Hence, the current results might be due to today's generation's captivation of mobile gadgets, which has made MGBL more appealing than traditional learning/teaching methods such as pencil and paper.

Concerning the impact of MGBL on EFL learners' cognitive load, the experimental group scored higher than the control group even though the difference was not significant. Henceforth, the applied mobile game effectively alleviated the cognitive load during English vocabulary learning. The findings in this investigation are compatible with other studies conducted on participants who used mobile games in English courses for vocabulary learning (Hwang et al., 2019; Ozer & Kılıç, 2018; Zou et al., 2019). To further support this premise, Zou et al. s' (2019) study found that digital game-based learning contributes to the development of long- and short-term memory in students learning English vocabulary. Hence, it seems possible that these results are due to the enthusiasm and engagement with the activities that MGBL could generate.

As for the learning motivation aspects, the current study's findings addressed the effect of MGBL on both the intrinsic and extrinsic motivation of EFL students for vocabulary learning. In general, digital gaming has been investigated for its potential to create a motivating learning environment for EFL learners using mobile technology (Elaish et al., 2019; Gamlo, 2019; Kohnke, 2020; Li, 2021). Despite no difference between the experimental and control groups in their intrinsic motivation, there was a high level of favorable agreement among participants of both groups regarding intrinsic motivation. The present study confirms previous findings showing learners' tendency toward intrinsic goals while learning vocabulary through mobile games, such as curiosity for learning new words and preference for challenging and interactional learning (Karaaslan et al., 2018; Tsai et al., 2017). A possible explanation for these results may shed light on learners' preference for technology that supports gaming features as an alternative to the conventional methods.

In contrast, extrinsic motivation was higher in the experimental than the control group, primarily driven by external factors, such as getting good grades, impressing people, and passing the final exam. In a similar vein, Razali et al. (2020), who used the Quizizz app, found that participants' interest in receiving rewards and points played a substantial role in motivating them extrinsically rather than intrinsically. A possible explanation could be related to the participants'

pre-intermediate level, indicating their limited ability to use language, which shifted their interest to simply getting points and passing the final test.

Insights on Mobile Games for Vocabulary Learning from Experimental Group

The interview data provided insights into the learners' views on the implementation of mobile game-based learning, where a positive correlation was found between all variables of the present study. Therefore, students' learning, especially vocabulary, seemed to benefit from the integration of mobile gaming through the Quizizz app. According to numerous studies, digital gaming increases learners' acceptance of learning English as a foreign language (Dananjaya & Kusumastuti, 2019; Klimova & Polakova, 2020; Ozer & Kılıç's, 2018). In the present study, students perceived MGBL as an active learning tool, which increased their enthusiasm through interaction with classmates. This result is consistent with the findings of an earlier study that showed digital games for vocabulary learning promoted social interaction among EFL learners (Dananjaya & Kusumastuti, 2019). Accordingly, their positive attitudes towards accepting the MGBL tool for vocabulary acquisition support the TAM that reflects the relationship between the two constructs: Perceived ease of use and perceived usefulness of the applied tools on learners' attitudes.

Another theme that emerged from the interview data was the effectiveness of the MGBL integrating the 'Quizizz' platform. The most notable aspects of the interviews related to promoting critical thinking, improving motivation, and facilitating learning. Based on a similar study using the Quizizz app, researchers found that mobile learning can motivate students by allowing them to track their progress on the leaderboard and see how many points they've gained (Razali et al., 2020). The app also seemed to be beneficial for the retention of English vocabulary. For instance, in the interview, various students pointed out that their ability to retain new words had improved when they learned through MGBL, indicating an enhancement of long-term memory. This finding is also supported by many previous studies (Hwang et al., 2019; Ozer & Kılıç, 2018; Zou et al., 2019) in which learners stated the role of MGBL in reducing the cognitive load in the EFL context. According to the given results, the tool implemented in this study had assisted learners by alleviating the cognitive load on their working memory. This improved the learners' comprehension as the load exerted was desirable for optimum knowledge acquisition. The phenomenon is called the 'germane category' in CLT.

Conclusion

This study investigated the impact of MGBL as a tool for vocabulary learning among pre-intermediate foundation year students in Saudi EFL virtual classrooms. Two groups, experimental and control, were created to assess the incremental improvement in their performance, employing pretest and posttest. According to the independent samples *t*-test of the posttest results, the experimental group outperformed the control group. Since both groups perceived MGBL positively for the utilized variables, the difference in their perceptions was not significant. The input may also be considered acceptable and non-stressful, i.e., without increasing the cognitive load on the student, if EFL learners are perceived as motivated. As for the study's limitations, it was geographically delimited to King Abdulaziz University and only included female participants. Additionally, the study focused on foundation-year students at the A2 level. In this regard, the study results may not represent all university students; hence, integrating a larger sample size could help to generalize the results to a bigger population. For

future research, a longitudinal experiment is needed to examine the effect of its implementation on knowledge retention. Additionally, the replication of the study would be required along with a significant sample of participants and a wider geographical area, i.e., selecting other universities in Saudi Arabia, to evaluate the app's efficacy on a larger scale.

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Appendices
Appendix A
Students' questionnaire

Demographic part

Q1. What is your age?
- ○ 18
- ○ 19
- ○ 20
- ○ 21 and more

Q2. Have you ever used mobile game-based learning?
- ○ Yes
- ○ No

Items	1	2	3	4	5
Attitudes					
1. I believe that MGBL facilitates English vocabulary learning.					
2. I believe that MGBL is interesting for vocabulary acquisition.					
3. I believe that mobile game-based learning enhances my willingness to learn new vocabulary					
4. I believe that MGBL is a means of improving English vocabulary.					
5. In general, I like using MGBL to learn new vocabulary.					
Cognitive Load					
6. MGBL encourages students to use high-level thinking skills.					
7. MGBL facilitates the process of vocabulary retention.					
8. MGBL puts less pressure on my memory.					
9. I had no difficulty in memorizing the vocabulary gained by MGBL.					
A. *Intrinsic goal orientation* (Motivation)					
10. I like playing challenging learning games in the classroom because they enable me to learn new things.					
11. I like mobile game-based learning because it raises my curiosity.					
12. If I have the chance, I will choose mobile game-based learning for vocabulary acquisition in the classroom.					
B. *Extrinsic goal orientation* (Motivation)					
13. I use mobile game-based learning only to get better marks in the English course.					
14. I use mobile games for learning English only to impress the people around me.					
15. I use mobile game-based learning only to pass the final exam of the English course.					