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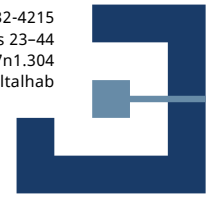

Castledown

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The impact of implementing augmented reality to enhance the vocabulary of young EFL learners

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This study seeks to contribute to the small, but growing area of research regarding technology potential in the field of vocabulary research. The study aims to determine the usefulness of augmented reality (AR) technology in EFL vocabulary learning. An experiment was conducted to examine young learners' motivation and vocabulary retention. The current study employed two instruments: a pre-post-delayed test and an interview. The participants (N=73) were primary school sixth-graders (11–12 years old) and were assigned into two groups, experimental (38) and control (35). The findings revealed that there were differences in the mean scores in favour of the experimental group. However, these differences were not statistically significant. Furthermore, seventeen students were interviewed regarding their perceptions of the used technology. The findings showed that AR results in better understanding and higher levels of motivation among students. The study also highlighted the role of technology in the domain of language learning.

Keywords: augmented reality, vocabulary, young learner

Introduction

Due the complexity of vocabulary knowledge, the wide range of lexical items, and their diversity, it is not easy to consider learning or acquiring vocabulary using one theory or method; this is supported by Schmitt's statement that "it is a common observation that there is currently no overall theory of vocabulary acquisition" (Schmitt, 2010, p. 97). However, some studies have

asserted theories on how vocabulary is acquired, for example, the parasitic model of vocabulary development (Hall, 2002), the DEVLEX model (Li, Farkas & MacWhinney, 2004), and computerized simulations of vocabulary (Meara, 2006). Although the employment of technology in vocabulary learning is still considered recent, computer simulations of vocabulary learning seem to be optimistic and promising (Schmitt, 2010).

Over the last two decades, technology has become a powerful tool for enhancing the learning experience. With the use of touch screen devices and the accessibility of various apps, digital technologies are making their way into the educational framework. Moreover, educators have started to examine the potential of apps that support second language learning and teaching. Recently, AR has gained attention in the educational domain. According to Hung, Chen & Huang (2017), AR facilitates the learning process, as it enables learner comprehension better than other teaching materials. The potential of AR to blend virtual and real worlds to create an enhanced reality offers new possibilities for teaching and learning (Bronack, 2011; Martin, Diaz, Sancristobal, Gil, Castro & Peire 2011). There has been some debate about the effectiveness of AR in relation to EFL students' motivations. Some studies indicate that AR has a positive impact on students' motivation (Kaufmann & Dünser, 2007; Liu, Tan & Chu, 2009); this could be attributed to the creativity of AR educational experiences, which leads participants to fully engage in the learning process (Yilmaz, Kucuk & Goktas, 2017). On the other hand, some studies point out that some participants have reported usability issues and rated AR difficult to use (Belcher, Billinghurst, Hayes & Stiles, 2003; Kaufmann & Dünser, 2007).

In the Saudi context, it is important to consider the 2030 vision which aims to develop teaching methods, materials, and strategies (Saudi Vision 2030, 2016). According to the Saudi Ministry of Education website, one of the major obstacles that faces education developers is the lack of creativity and motivation in the educational environment, which causes students to have a negative perception of education (Saudi Ministry of Education, 2017). This negative attitude toward education could be solved by providing students with technology. Therefore, the topic of augmented reality was chosen to determine the usefulness of this technology for the EFL field.

Literature review

Vocabulary learning

The role of vocabulary is considered absolutely vital in terms of EFL learners' ability to become language proficient. Regardless of the fact that reading, writing, listening, and speaking are the four basic skills that language learners need to master, it is nearly impossible to acquire those skills without a satisfactory amount of vocabulary. Wilkins (1972, p. 111–112) reflects that 'without grammar very little can be conveyed, without vocabulary nothing can be conveyed'. Learning a foreign language includes the memorization and practice of a sufficient amount of vocabulary. Teaching vocabulary might not only involve

implicit and explicit techniques, nor group based and individual activities. Teaching vocabulary comprises the process of word acquisition, pronunciation, and meaning (Nation, 2001). Also, it includes learning words' stylistic, morphological and syntactic properties (Barani, Mazandarani & Rezaie, 2010; Kalyuga, Mantai, & Marrone, 2013). Nation's (2001) stateed that EFL learners should know at least 5000 words in order to comprehend the meaning of an English text. In the domain of vocabulary, several teaching strategies and approaches have been examined to explore their effectiveness, for example; using L1 to L2 in teaching vocabulary, teaching vocabulary through reading, contextualized and decontextualized vocabulary teaching (Qian, 1996; Web, 2007; Sonbul & Schmitt,2009). In a Saudi EFL context, vocabulary is considered important, since Saudi culture is identified as an oral rather than literate culture (Taj, Ali, Sipra & Ahmad, 2017). In addition, reading is viewed as a foreign skill to Saudi learners, who appear to lack enthusiasm for reading whether in their first language (Arabic) or in English for EFL students (Morris & Gaffney, 2011).

Mobile Assisted Language Learning (MALL) and vocabulary

The use of computer assistance in the field of language learning has been established over the past two decades (Chapelle, 2010; Johnson, Perry, & Shamir, 2010; Dina & Ciornei, 2013). Lately, language learning applications has become the center of attention among educators. Mobile phones, computers, and tablets potential as communicational platforms could assist EFL learners to achieve language proficiency (Demouy & Kukulska-Hulme, 2010; Abdullah, Hussin, Asra, & Zakaria, 2013; Rahimi & Miri, 2014). Mobile phones applications such as: SMS, microblogging, and social networks could open new possibilities for EFL learners (Yang, 2013). In the domain of vocabulary learning, the use of multimedia has shown many encouraging results that emphasizes the importance of multimodal presentation in language learning. A study by Mustafa, Sain, and Razak (2012) examined the effect of the Internet gaming on vocabulary learning. The experimental group participated in online vocabulary activities, while the control group studied the same material on paper. The study revealed that the experimental group outperformed the control group. Similar results were reported by Taj, Ali, Sipra & Ahmad (2017) in a study that explored the effect of technology-enhanced language learning on the vocabulary acquisition of EFL learners in Saudi Arabia. Computers and mobile phones were employed as tools to learn vocabulary. The study was performed using vocabulary learning activities introduced through PCs, and students were provided with multiglossed vocabulary cards via the application WhatsApp on their mobile phones. The study concluded that the treatment group significantly outperformed the control group.

Likewise, ten studies were analyzed by Perez, Noortgate, and Desmet (2013), who obtained remarkable results by employing captioned videos in vocabulary learning. In the Saudi context, several studies have investigated computer assisted vocabulary learning (AbuSeileek, 2007; Ghafli & Hussain, 2011), the findings of which indicate positive results regarding online instruction

for vocabulary acquisition. These previous studies highlight the importance of technology in the field of language learning. On the other hand, some studies have claimed that young learners face difficulties while learning new vocabulary applications without social support (Bannard & Tomasello, 2012; Walter-Laager, Brandenberg, Tinguely, Schwarz, Pfiffner, & Moschner, 2017). Walter-Laager *et al.* (2017) found that vocabulary apps on interactive tablet computers could have positive effects on children's pronunciation and vocabulary. However, the positive effect was accrued more often for children who also had adult accompaniment or social support. This shows that teachers accompanying their students in their use of language apps might lead to better results.

The employment of (AR) in EFL

The technical definition of AR according to Milgram, Takemura, Utsumi & Kishino (1995:283) is: 'A form of virtual reality where the participant's head-mounted display is transparent, allowing a clear view of the real world'. However, other researchers point out that the consideration of a broad definition of AR might be more beneficial. According to Broll, Lindt, Herbst, Ohlenburg, Braun & Wetzel (2008), broad definitions of AR suggest that it could be formed and applied through various devices, whether it is a desktop computer, handheld device, or even touch screen tablet.

Students' high enthusiasm for engaging in AR experiences has been highlighted in several studies (Kaufmann & Dünser, 2007; Liu *et al.*, 2009; Yilmaz *et al.*, 2017) in which participants have a higher level of satisfaction and appear eager to repeat the AR experiment. Some researchers have suggested that there is a positive relationship between AR technology and student motivation. In vocabulary research, several studies have explored augmented reality effect on EFL learners (Zainuddin & Idrus, 2016; Ogawa, 2016; Richardson, 2016). He *et al.* (2014) examined the impact of augmented reality on the EFL vocabulary of pre-school children. They designed mobile-based software for EFL children where vocabulary is presented through virtual pictures and mixed with the meaning and pronunciation of the words. He *et al.*, (2014) carried out the experiment employing pre-post-tests accompanied by an interview with the teacher. They concluded that the augmented reality group outperformed the control group regarding the post test score and the level of motivation. It should be noted that some of these young participants were distracted by the use of a mobile during the experiment. In addition, the main limitation of selecting a pre-post-test for the previous study might be unfitting for pre-school EFL students due to their age abilities. While the previous study investigated the influence of augmented reality on preschool EFL learners, Solak and Cakır (2015) inspected augmented reality effect on the vocabulary of undergraduate EFL students in Turkey. The findings highlight the positive role of augmented reality on students' achievement and motivation. Similarly, Kaenchan (2018) investigated augmented reality potential effect on forty-eight EFL Thai students. He integrated augmented reality in their reading classroom. Students were requested to create vocabulary flashcards utilizing the new technology. The participants were observed,

interviewed, and given a semi-structured questionnaire to review their perspectives of the technology used. The study revealed that augmented reality had a positive effect regarding student motivation and engagement. Also, the study reported that augmented reality was helpful for promoting learning and that it supported the enhancement of students' vocabulary memorization.

In Saudi context, only one study was published regarding the use of AR in EFL. Alsowat (2016) carried out a study to examine the impact of augmented reality on Saudi EFL students' reading comprehension, self-efficacy, autonomy and attitudes. The researcher adopted the quasi-experimental approach by using pre-post-tests. Alsowat (2016) employed two applications during the study (Polyglocam and Aurazma). The study revealed that the experimental group outperformed the control group in the reading comprehension post-test. Furthermore, the augmented reality experimental group obtained positive results regarding the self-efficiency scale, motivation, and autonomy scale. Studies discussed previously thus demonstrate that augmented reality seem to support EFL students in achieving language proficiency within a supportive environment. Another study that highlights the impact of AR on student' motivation was performed by Yilmaz *et al.* (2017) investigated children's attitudes toward AR story books by conducting study with participants who aged from five to six years old. Yilmaz *et al.* (2017) revealed that the application of AR appears to be useful, and students' levels of motivation and engagement increased. Moreover, the young learners delivered strong story comprehension performances. Likewise, another study conducted by Liu *et al.* (2009) found that GPS-based games increased student motivation and creativity more than paper-based materials. These findings indicate that AR might increase student motivation and attainment. However, other studies claim that some AR users rate it more difficult to use than desktop-based alternatives (Kaufmann & Dünser, 2007). According to Kaufmann and Dünser (2007), some participants report usability issues in studies conducted using AR head-mounted systems. The students rated AR systems as less usable than PC versions, although they were motivated and engaged during the AR participation. Learners might be more motivated to explore new strategies if they are appropriately trained to use them (Schmitt, 1997). According to Nation and Webb (2011, p. 2), "the second most important job of the vocabulary teacher is to train learners in the use of vocabulary strategies, such as learning from word cards, guessing from context, learning word parts, and using a dictionary." In addition, vocabulary determination and social strategies might be beneficial in supporting student learning. As presented in Schmitt's (1997) study on vocabulary taxonomy, determination vocabulary strategies are used by learners to discover the meaning of new words without a teacher's assistance, while social vocabulary strategies include students' interactions to find out the meaning of the new vocabulary; this could be useful for EFL learners who wish to engage in more practice of the targeted language (Schmitt, 1997).

Rationale of the study and research questions

In Saudi context, Although English started to be taught in Saudi Arabia at intermediate and secondary schools in 1927, elementary schools started teaching English in 2004 (Al-Seghayer, 2011). Students start to learn English in public schools from the fourth grade (with two classes per week). At the intermediate level, students have four English classes per week, while at the secondary stage, the number of classes ranges from four to five depending on the school category (the Saudi Ministry of Education operates several different school systems, particularly for the secondary stage) (Al-Qahtani, 2016). Even though English language is considered an essential subject to be taught at Saudi schools, students' English proficiency is still assessed as poor (Al-Roomy, 2013; Al-Qahtani, 2016). In fact, according to IELTS data reports, Saudi participants have the lowest results worldwide regarding the reading section (IELTS, 2012; IELTS, 2014; Educational Testing Services, 2009, 2010, 2011, 2012, 2013). Several studies have been conducted to explore the causes behind the unsatisfactory level of Saudi English readers (Alzahrani, 2008; Al-Mansour, 2009; Nezami, 2012). One of the key factors was identified as the limited vocabulary of EFL Saudi learners (Nezami, 2012). Saudi EFL students' limited proficiency could be attributed to a number of aspects, such as insufficient exposure to English, teachers' poor training, lack of English practice, and the non-adaptable design of text books, which do not permit teachers to explore different teaching methods (Al-Sadan, 2000; Alzahrani, 2008; Al-Mansour, 2009; Al-Seghayer, 2011; Gawi, 2012; Altalhab, 2014). This suggests that EFL textbooks should be more flexible, allowing students to experience different scenarios and teaching strategies. Al-Qahtani (2016) conducted a study to identify the reasons behind Saudi EFL learners' poor reading abilities. He revealed that Saudi EFL students demonstrated poor reading skills in both L1 and L2. Moreover, the EFL students stated that the focus was on reading aloud instead of reading comprehension. Also, the EFL students had difficulties with unfamiliar topics due to their limited vocabulary. This suggests that reading topics should preferably be related to students' culture.

Similar views were expressed by Nezami (2012) who conducted a study to investigate the problems encountered by EFL readers. He pointed out that EFL readers suffer from limitation of vocabulary (knowing only 890 of the 5,000 most common English words). Moreover, he found that Saudi EFL readers had some difficulties recognizing the meaning of texts. He also found that students suffered low levels of motivation, and lack of interest in engaging with collaborative groups and discussions (Nezami, 2012). This emphasizes the need to present vocabulary to students through implementing technology, which could support and increase their levels of cognitive engagement and further motivation among students (He, Ren, Zhu, Cai & Chen, 2014; Solak & Cakır, 2015). Alsowat (2017) conducted a systematic analysis of studies regarding teaching English skills for Saudi EFL students that were published from 2007 to 2016. He found that most studies were focusing on university students, which indicates a limitation of elementary and preschool students' studies.

Furthermore, Alsowat (2017) revealed that (68.52%) of the studies gave prior attention to reading and writing skills neglecting other language aspects for example: speaking, listening, vocabulary and pronunciation. Hence, this study intends to investigate augmented reality effectiveness on EFL student's vocabulary gain and retention, cognitive ability, and motivation. The findings of the study could be valuable for both policy-makers, administrators to tailor their educational program accordingly.

Based on the literature review and the rationale of the study, the following questions need to be answered:

1. What is the impact of implementing AR on students' vocabulary memory?
2. How does AR affect students' motivation of learning English?

Method

Research design

This study is experimental, with the researcher utilizing a mixed method approach (qualitative and quantitative) by employing a pre-post test, and an interview to explore the impact of AR technology on the vocabulary of primary school EFL students.

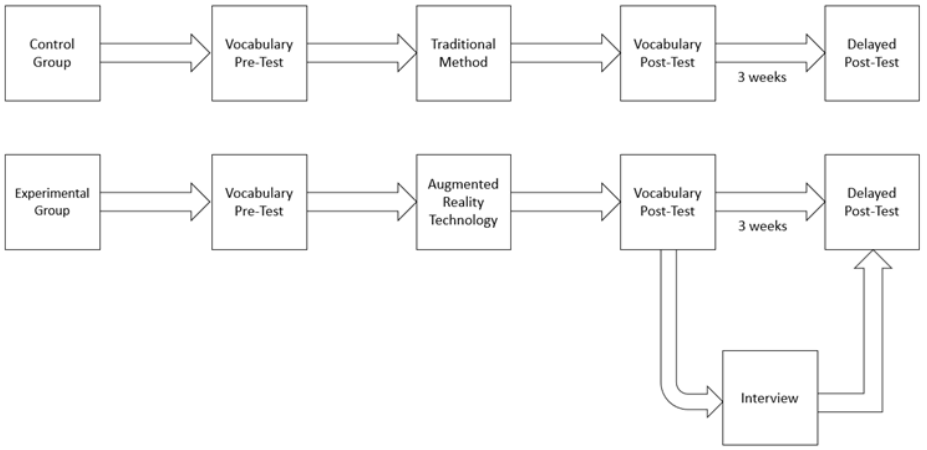

Figure 1: Research Design

Participants

In total, seventy-three Saudi female sixth-graders participated in the current study. At the time of the study, all participants belonged to the same age category (11–12 years old). In addition, all participants were native speakers of the Arabic language who started learning English at the age of nine, with two 45-minute classes per week. The sample contained two groups: the control group and the experimental group. Both groups were randomly chosen; the control group included (35) students, while the experimental group comprised (38) students. Initially, seventy-seven participants were involved in the study,

but the data of three participants were removed from the analysis since they were absent from the delayed post-test.

Research tools

The pre-/post- test. In our review of the literature, it appeared that there was a shortage of EFL primary school studies in Saudi Arabia, since most studies were concerned with university students. Hence, the current study aims to highlight the performance of primary EFL students and ask whether technology might assist in improving their language learning. The researcher designed the pre-post-test as words with associated images (e.g. swamp, hatchlings). Students were asked to match each word with its representative image. The pre-post-delayed tests were identical and comprised eight items (see Appendix 1). The level of the tested words was a beginners level. The words were chosen after the first researcher performed a pilot of the pre-post-test to a similar group sample that was not included in the experiment. The pilot was conducted to measure the level of students' vocabulary knowledge.

The interview. The interview that was employed during the experiment was a semi-structured interview and an open-ended type. The researcher's selection of open-ended questions was targeted to investigate and explore students' attitudes toward a traditional learning approach. The application of qualitative research appeared to be more useful when the researcher identified the need to draw on more clarification and explanations for the study questions (Muijs, 2004). The researchers investigated the participants' opinions and attitudes toward the implementation of technology in the domain of language learning, and whether it provided a supportive environment for EFL learning. The interview was conducted in Arabic, and the interview questions were simplified for the participants due to the immaturity of their expressive abilities. The interviews were conducted face-to-face and were recorded for data analysis purposes.

Procedure

An AR storybook series (Storybooks Alive, 2018) was selected and used simultaneously with a storybook app. The storybook was employed due to its suitability for the participants' ages and level (the participants' level was tested a week prior the experiment by performing a pilot). Also, the storybook contained situations and events that were related to the participants' real lives, which might provide them with a supportive environment for learning a foreign language. The length of the narration of the story is about four minutes, with the word count of sixty words. The targeted words (see Appendix 1) are supported by story animation, text and sounds. The story (Amos the alligator arrives at the airport) was about an alligator which had a flight to catch, then it was late, but managed to catch the flight at the end.

The storybook application could be uploaded onto either mobile phones or

tablets. The researcher chose to upload the storybook application (Storybooks Alive) onto tablets (iPads) to give the students a better vision and engagement experience. In addition, the storybook application does not need an Internet connection to function, which might be more practical for implementing the experiment. The experiment lasted for four weeks; one treatment session (pre-test, the story & post-test with the duration of forty-five minutes), and a delayed post-test three weeks later (only a delayed post- test with the duration of fifteen minutes). First, the first researcher went to the school a week prior to the experiment to apply a pilot of the pre-post-test to a similar group sample that was not included in the experiment. The implementation of the previous step was performed to ensure that the tested vocabulary was not familiar to the participants. Also, the researcher contacted the teacher to ensure that the participants would not have chances to be subjected the target words during the three-week interval. A week later, on the experiment day, both groups were given a pre-test. The control group was taught using a traditional approach (teacher-centered) employing two strategies: teaching vocabulary through reading and guessing the meaning of the new words. First, the teacher started to introduce the participants to the story using the method of teaching vocabulary through reading. Then, the teacher asked the students to underline the most difficult words. After that, teacher started to ask students to guess the meaning of the new words. After identifying all targeted vocabulary, the teacher asked the students to pronounce the new words orally, which was followed by asking them to write the words down as well. Finally, after the experiment, the participants were given a post-test to examine their performance and to later compare it with the performance of the experimental group.

On the other hand, the experimental group was taught using a student-centered approach and included AR technology through the application of the following steps: first, students were trained to use a tablet accompanied with the storybook application. Then, they were divided into seven groups, with each group including 5–6 participants, and each group provided with one storybook and one tablet (iPad). After that, the teacher asked the students to explore the storybook by employing the iPad. The participants started to point out the application camera on the storybook and the storybook started to come alive, with certain elements beginning to appear and move on the tablet screen. After finishing the story, the teacher asked the students about the meaning of the targeted vocabulary and whether they had understood the story. After finishing the experiment, seventeen participants were selected randomly and interviewed to measure their motivation toward AR and to explore their opinions towards using technology in EFL learning.

Three weeks after the experiment, both groups were given a delayed post-test to measure their vocabulary retention, as well as to compare the effect of the conventional approach with the AR technology.

Data analysis

The data collected from the present study were both quantitative and qualitative. The quantitative data were obtained from the participant' scores from both the post and the delayed post-tests. To ensure the validity of the tests, the researcher piloted the instrument a week prior to the experiment on a similar group sample. The test scores were statistically analysed with the software program SPSS. The SPSS program provided a descriptive analysis of the participants' scores to produce a numeric review of both the participants' groups. On the other hand, the qualitative data were collected from interviews that were conducted with seventeen participants of the experimental group after the experiment. The interview transcripts were translated from Arabic into English, and all interviews were transcribed and revised. The interviews were analysed by adopting the thematic approach of coding to increase the reliability of the analysis (Strauss & Corbin, 2008).

Results

Pre-test results

A T independent samples test was used to identify the statistical differences between the means of the pre-test score of both groups (control and experimental). It is evident from Table 1 that there are no statistical differences between the pre-test results of the experimental and control groups by their values (t = 0.875, df =71, p = 0.382). This indicates that both groups had equivalent linguistic knowledge before the implementation of the AR experiment.

Table 1. T test independent samples results of the pre-test

Groups	N	Mean	Std. deviation	Std. error mean	T-test	df	Sig.
Control group	35	3.11	1.859	0.314	0.875	71	0.382
Experimental group	38	2.71	2.065	0.335			

Post-test results

A T independent sample test was used to identify the mean differences of the post-tests between both groups (control and experimental). The results revealed that there were differences between the means of both groups (see Table 2). The experimental group managed to obtain a higher mean score of 5.00, while the control group mean result was 4.86. However, these differences were not statistically significant with a value of t = −0.274, df = 71, p = 0.785. This means that both groups had similar vocabulary gains following the implementation of the experiment.

Table 2. T independent samples test results (post-test)

Groups	N	Mean	Std. deviation	Std. error mean	T-test	df	Sig.
Control group	35	4.86	2.277	0.385	−0.274	71	0.785
Experimental group	38	5.00	2.181	0.354			

The delayed post-test

A (T independent samples test) was used to identify the vocabulary retention differences of the delayed post-test scores of the two groups (control and experimental). The results revealed that there were differences between the means of both groups, with the experimental group yielding a higher mean score (4.03) than the control group (3.77) (see Table 3). However, these differences were not statistically significant by the value of (t = 0.642, df = 71, p = −0.467). This indicates that both groups had similar vocabulary retention in the delayed post-test results.

Table 3. Mean vocabulary gains of the delayed post-test

Groups	N	Mean	Std. deviation	Std. error mean	T-test	df	Sig.
Control group	35	3.77	2.045	0.346	0.642	71	−0.467
Experimental group	38	4.03	2.563	0.416			

Analyzing the qualitative data

Qualitative data were imported from students' interviews. Seventeen students from the experimental group were interviewed to identify their perceptions to the employment of AR technology in the field of vocabulary. In order to increase the reliability of the analysis, the researcher adopted a thematic approach in coding.

Table 4. Student answers on questions 1, 2, & 3 of the interview.

Question number	Question	% of students with positive perspective	% of students with negative perspective
1	Were you satisfied with the experience of learning vocabulary using AR technology?	94.1%	5.9%
2	Did you understand the meaning of the words without the need for the teacher's clarification?	35.2%	64.8%
3	Did you have a positive attitude (excitement-anticipation-enjoyment) toward AR, or was it a negative attitude (confusion-fear-no operating knowledge)?	94.1%	5.9%

Answering the first question, sixteen of the participants interviewed (94.1%) agreed that they liked the experience of learning vocabulary via AR technology. This indicates that the majority of the students were satisfied with the experiment. One of the participants stated, *"We are the generation of (iPads), we prefer to learn by technology, it is much better than books."* Another student expressed, *"It was an enjoyable experience, where it did not feel like a lesson, it was rather an entertaining game."* As shown in Table 4, the results of the interview also revealed that only one student (5.9%) expressed that she did not like the experiment due to the distraction that was caused by using a tablet. The second question shows that eleven participants (64.8%) had difficulties understanding the meaning of the new words, while six participants (35.2%) expressed that they understood the meaning of the new words without the need for teacher assistance. This indicates that using technology in the classroom might be more satisfactory with the support of a teacher. Moreover, sixteen students (94.1%) expressed that they had positive attitudes toward using AR in vocabulary learning (see Table 4). This result indicates that AR had a significant positive impact on students' motivation. One of the participants commented that *"the narration of the story was smooth and intriguing, as it helped me to understand the meaning of the new words easily."* Another perceived benefit was explained by another participant with her positive perception of the new technology: *"the animated interactive moving objects helped me to understand the meaning of the new words, besides the native accent of the narrator is better than the teacher's accent."* Only one participant viewed the experiment as "negative" because she did not like to share the tablet with other students; instead she suggested that students should bring their own devices from home to school.

Table 5. Student answers on question 4

Question number	Question	AR technology	Traditional approach
4	What do you prefer: learning by AR technology, or by the traditional approach?	47.1%	52.9%

The results of the fourth question indicated that student responses were varied, as nine of the students favored the traditional approach due to their "familiarity with it," while eight participants preferred AR because they reported it to be more "intriguing" and "engaging" (see Table 5). When a participant was asked why she chose AR, she replied, *"The best thing is that we can move around while we experience it, it is much better than sitting still all day."*

Table 6: An example of the thematic approach in coding the interview

Themes	Example	Code
The satisfaction with augmented reality learning experience	*It was an entertaining social learning experience.*	satisfactory
	I was distracted by the chaos and disturbance that my classmates caused during the experiment.	unsatisfactory
The impact of augmented reality on students' cognitive ability	*The narration of the story was smooth and intriguing, as it helped me to understand the meaning of the new words easily.*	effective
	I did not understand the meaning of the new vocabulary; the teacher understands my language needs better than the tablet.	ineffective
Features of traditional vocabulary learning	*I prefer the traditional approach, because when I need clarification the teacher provides it.*	advantages
	The traditional approach is dull, sometimes I lose focus because I'm bored.	disadvantages
Features of augmented reality vocabulary learning	*I liked the idea of tablet group learning, everyone was excited.*	advantages
	I would rather bring my own tablet from home, I did not like to share the tablets among groups.	disadvantages

Discussion

The impact of AR on students' vocabulary

Based on the results of pre, post and delayed tests, and the interview, many findings emerged regarding the impact of AR technology on students' vocabulary, and motivation, as well as their attitude toward the used technology. The findings show some differences between the means of the tests of both groups (control and experimental) in favor the experimental group. However, the differences between both groups were not statistically significant. The previous finding resonates with a study by Alemi, Sarab & Lari (2012), which

also revealed that there were no significant differences between the post-test results of a treatment group and control group. Such a result could be contributed to several factors. During the interview, some students were unsatisfied with the use of AR technology, referring to some of the negative elements that lead to this perception as 'lack of technical knowledge', 'distraction', and 'chaos'.

Although most of the existing literature studies support the huge impact that AR holds on students' cognitive ability (Liu & Tsai, 2013; Ogawa, 2016; Richardson, 2016). Yet, the current study found that 64.7% of participants stated that they did not understand the meaning of the new vocabulary and needed the teacher's assistance. One participant pointed out *"I prefer the traditional approach, because when I need clarification the teacher provides it."* Another participant argued that *"I did not understand the meaning of the new words, the teacher understands my language needs better than the tablets."* This finding suggests that students can benefit from their teacher's direction while using the tablets, which is in agreement with a study by Walter-Laager *et al.* (2017) suggesting that teachers accompanying their students while using language apps might lead to better results, especially for preschool and primary students. However, it could be argued that students should not completely rely on their teacher's assistance, it might be better to train them to use determination and social vocabulary strategies (presented through Schmitt's (1997) vocabulary taxonomy). Determination vocabulary strategies are usually used to discover the meaning of new words, while social vocabulary strategies include students interacting to find out the meaning of the new words (Schmitt, 1997). Therefore, it can be suggested that training students in determination and social vocabulary strategies can provide better vocabulary learning gains.

On the other hand, some participants stated that using AR supported them in understanding the meaning of the new vocabulary without the need for a teacher's assistance. One of the participants commented that *"the narration of the story was smooth and intriguing, as it helped me to understand the meaning of the new words easily."* Another perceived benefit was explained by another participant with her positive perception of the new technology: *"the animated interactive moving objects helped me to understand the meaning of the new words, besides the native accent of the narrator is better than the teacher's accent."* These findings revealed that AR seems to help facilitate the learning process, which has been found in other studies (Hung *et al.*, 2017; Kaenchan, 2018). The above findings provide an answer to the first research question, which aimed to investigate the impact of AR on students' vocabulary.

The impact of AR on student motivation

Overall, AR technology seems to have a positive impact on student motivation during the experiment. According to the study findings, 94.1% of the participants were satisfied with learning vocabulary through AR technology. This satisfaction rate could be attributed to number of factors. The "entertainment," "gamification," "social interaction," and "mobility" factors could all be considered key factors to the positive attitudes held by the participants towards AR

technology. Students reported that the technology was "intriguing" and "different," and that this led them to consider the experiment as an encouraging learning experience. This finding is also supported by other studies (Kaufmann & Dünser, 2007; Liu *et al.*, 2009; He *et al.*, 2014; Yilmaz *et al.*, 2017), indicating that AR caused higher levels of student motivation and autonomy. Another perceived feature of the used technology was clarified by a participant: *"It was an enjoyable experience, where it did not feel like a lesson, it was rather an entertaining game."* The previous reference to the new technology as a "game" is no longer dismissed, since many studies have recently started to explore the concept of "gamification," which merges education with games and entertainment (Mawer & Stanley, 2011; Reinhardt & Sykes, 2014). Another perceived benefit of augmented realty technology is the mobility factor. When a participant was asked about the best feature of the used technology, she replied, *"The best thing is that we can move around while we experience it, it is much better than sitting still all day."* This indicates that students need a creative and entertaining learning environment to raise their motivation, as reported by a study by He Ren, Zhu, Cai & Chen (2014). Another encouraging finding was revealed with 94.1% of participants considering AR technology as positive, with only one student perceiving it as negative. She explained the reason behind her negative outlook: *"I would rather to bring my own tablet from home, I did not like to share tablets among groups";* this may be ameliorated with the BYOD (bring your own device) policy, as this policy allows students to bring their own devices from home to school to guarantee that personal technology is available to support teaching and learning (Philip & Garcia, 2015; Selwyn, Nemorin, Bulfin & Johnson, 2017).

The Saudi Ministry of Education website mentions that one of the major obstacles that faces education developers is changing the typically conventional and negative perception of education (Saudi Ministry of Education, 2017), and the BYOD policy might help to change this. However, despite the previous claim, other participants believed that sharing the tablets among groups was a "fun" and "encouraging" experience; in fact, most of the participants seemed to enjoy the social aspect of language learning. The majority of students (94.1%) were motivated by the experience of sharing the tablets among the groups. It could also be suggested that the social side of language learning could help to raise EFL oral interaction, thus leading to a more successful vocabulary gain. This finding is in line with the findings of other studies (Bannard & Tomasello, 2012; Walter-Laager *et al.*, 2017), which appear to confirm the importance of social support while using technology in learning. Nevertheless, a few participants rated the experiment as negative. A number of factors contributed to these negative perceptions, with "lack of technical knowledge," "distraction by the tablets," and "chaos" reported by some participants. Indeed, one participant argued, *"I was annoyed by the chaos and disturbance that my classmates caused during the experiment, which distracted me from learning the new words."* Another participant complained that *"it took me some time to get to know how to operate the app, as I do not have enough technical knowledge as my friends."* The former perceptions resonate with those of other studies (e.g. Kaufmann &

Dünser, 2007), which reported some usability issues, as well as the problem of not taking individual differences among students into consideration. This indicates that technology developers should keep individual differences between learners in mind when designing software. Also, it suggests that learners might be more motivated to explore new strategies if they are appropriately trained to use the technology.

Conclusion

The current study presented the employment of augmented reality technology using the (Story Books Alive) application in Saudi primary schools. The research focused on the augmented reality effect on students' vocabulary, and their motivation. The findings showed that there were differences between the means of the tests of both groups (control and experimental) in favour the experimental group. However, these differences were not statistically significant. Also, the findings indicated that augmented reality resulted in better understanding and higher levels of motivation among students. Student satisfaction was contributed to a number of factors like: 'entertainment', 'animated interactive objects', 'social interaction', and the 'mobility' feature, as reported by the participants. Nevertheless, a few students were unsatisfied with the used technology, referring to some of the factors that contributed to this perception as 'lack of technical knowledge', 'distraction', and 'disturbance'. This study provides future researchers with the opportunity to further investigate the use of technology in vocabulary learning.

Limitations

Some students reported that they lacked technical knowledge; hence, the importance of giving students appropriate training prior to employing technical lessons should be noted. Also, a few students complained that they needed more tablets, and that the numbers of the tablets were not enough, since four to five students were assigned to use one tablet. Therefore, it is suggested that students be provided with more tablets or to apply the BYOD policy. Some of the participants reported that they were distracted by the chaos disturbances from their classmates during the experiment. Thus, it would be advisable to maintain a calmer environment in future studies. Another complain was raised by Some students that the application did not give students enough time to figure out the meaning of the new vocabulary. Hence, application designers should keep in mind the need to provide the application user with sufficient time to answer. Furthermore, a few participants reported that they preferred to hear the new words more than once. This highlights the importance of repetition in vocabulary learning. Therefore, application designers ought to design applications with repeat features to allow students to hear words more than once.

Recommendations for improving teaching and learning vocabulary

Although this study was conducted in a Saudi context, the following recommendations are applicable to the wider global context based on the findings discussed. The study shows that vocabulary learning through AR is influenced by several factors that contribute to the creation of an effective environment for learning vocabulary. The role of those factors such as teaching techniques, vocabulary strategies, dividing students into groups, students' English proficiency levels, and students' beliefs and attitudes that take place in the classroom should be considered in the creation of a successful vocabulary environment. Also, the findings indicate that the "animated interactive objects" of AR technology assisted the students in understanding the meaning of the new vocabulary in addition to increasing their level of motivation. Therefore, syllabus designers should consider implementing technology within EFL textbooks. Another issue was derived from the findings of the study which showed that students fully depend on their teacher to explain the meaning of new words. Thus, students should be trained to use vocabulary strategies explicitly. It is advisable that further research should consider applying AR technology to other language skills such as writing, listening, and speaking, which could enrich the field of CALL and MALL studies. As students reported that they enjoyed group learning in this study, teachers should assign students into groups, as this can help start conversations and discussions among students, as well as assist them in the practice of social vocabulary strategies. This would also help students gain vocabulary and motivation. In addition, EFL language policy makers should consider applying the BOYD (bring your own device) policy, which could help to increase autonomy and motivation among students. According to the findings of the current study, it is recommended that effective digital learning should be integrated in language learning in schools and universities. Also, in order to choose the appropriate strategies and tasks, teachers should be taught and trained in how to use the relevant applications and tablets and use them in teaching. Some participants reported lacking motivation and autonomy due to the traditional methods of teaching. Hence, teachers, syllabus designers, and EFL language policy makers should customize textbooks so that they are suitable, engaging, related and authentic to students' real lives, and adaptable for technology use. Finally, the educational domain has recently started to include the term "gamification," which combines learning with entertainment. It is advisable for researchers to conduct studies that explore the potential of gamification, since it may be more suitable for young language learners and could provide them with an effective language learning environment.

References

Abdullah, M. R. T.L., Hussin, Z., Asra, B., & Zakaria, A. R. (2013). MLearning scaffolding model for undergraduate English language learning: bridging formal and informal learning. *TOJET: The Turkish online journal of educational technology*, *12*(2), 217–233 .

AbuSeileek, A. F. (2007). Cooperative vs. individual learning of oral skills in a CALL environment. *Computer Assisted Language Learning*, *20*(5), 493–514.

Alemi, M., Sarab, M. R. A., & Lari, Z. (2012). Successful learning of academic word list via MALL: Mobile assisted language learning. *International Education Studies*, *5*(6), 99–109.

Al-Mansour, N. (2009). Bilingualism and the need for early EFL education in the Kingdom of Saudi Arabia. *King Saud University Languages & Translation Journal*, 21, 1–12.

Al-Qahtani, A. A. (2016). Why do Saudi EFL readers exhibit poor reading abilities? *English Language and Literature Studies*, *6*(1), 1–15.

Al-Roomy, M. (2013). *An action research study of collaborative strategic reading in English with Saudi medical students*. Unpublished Doctoral Thesis, University of Sussex, Sussex.

Al-Sadan, I. A. (2000). Educational assessment in Saudi Arabian schools. *Assessment in Education: Principles, Policy & Practice*, *7*(1), 143–155.

Al-Seghayer, K. (2011). *English teaching in Saudi Arabia: Status, issues, and challenges*. Riyadh: Hala Print CO.

Alsowat, H. H. (2016). Breaking down the classroom walls: Augmented reality effect on EFL reading comprehension, self-efficacy, autonomy and attitudes. *Studies in English Language Teaching*, *5*(1), 1–23.

Alsowat, H. H. (2017). A systematic review of research on teaching English language skills for Saudi EFL students. *Advances in Language and Literary Studies*, *8*(5), 30–45.

Altalhab, S. (2014). *Teaching and learning vocabulary through reading at Saudi universities*. Unpublished Doctoral Thesis, University of Strathclyde, Glasgow.

Al-Zahrani, M. (2008). Saudi secondary school male students' attitudes towards English: An exploratory study. *King Saud University, Language and translation Journal*, *20*, 25–39.

Bannard, C., & Tomasello, M. (2012). Can we dissociate contingency learning from social learning in word acquisition by 24-month-olds? *PloS one*, (11), 1–7.

Barani, G., Mazandarani, O., & Rezaie, S. H. S. (2010). The effect of application of picture into picture audio-visual aids on vocabulary learning of young Iranian ELF learners. *Procedia-Social and Behavioral Sciences*, *2*(2), 5362–5369.

Belcher, D., Billinghurst, M., Hayes, S. E., & Stiles, R. (2003). Using augmented reality for visualizing complex graphs in three dimensions*:* Mixed and Augmented Reality, Proceedings. *Papers in The Second IEEE and ACM International Symposium.* pp. 84–93.

Broll, W., Lindt, I., Herbst, I., Ohlenburg, J., Braun, A. K., & Wetzel, R. (2008). Toward Next-Gen Mobile AR Games. *IEEE Computer Graphics and Applications*, *4*(28), 40–48.

Bronack, S. C. (2011). The role of immersive media in online education. *The Journal of Continuing Higher Education*, *59*(2), 113–117.

Chapelle, C. A. (2010). The spread of computer-assisted language learning. *Language Teaching*, *43*(1), 66–74.

Demouy, V., & Kukulska-Hulme, A. (2010). On the spot: Using mobile devices for listening and speaking practice on a French language programme. *Open Learning: The Journal of Open, Distance and e-Learning*, *25*(3), 217–232.

Dina, A. T., & Ciornei, S. I. (2013). The advantages and disadvantages of computer assisted language learning and teaching for foreign languages. *Procedia-Social and Behavioral Sciences*, *76*, 248–252.

Educational Testing Services. (2009, 2010, 2011, 2012, 2013). *Test and score data summary for TOEFL Internet-based and paper-based tests.* Retrieved August 5, 2018, from: http://www.ets.org

Gawi, E. M. K. (2012). The effects of age factor on learning English: A case study of learning English in Saudi schools. *English Language Teaching*, *5*(1), 127–139.

Ghafli, A., & Hussain, M. (2011). *The effect of mediated glosses on vocabulary retention and reading comprehension with English language learners in Saudi Arabia*. Unpublished Doctoral Thesis, University of Kansas, Kansas.

Hall, C. J. (2002). The automatic cognate form assumption: Evidence for the parasitic model of vocabulary development. *IRAL*, *40*(2), 69–88.

He, J., Ren, J., Zhu, G., Cai, S., & Chen, G. (2014). Mobile-based AR application helps to promote EFL children's vocabulary study. Advanced Learning Technologies 14th International Conference. pp. 431–433.

Hung, Y. H., Chen, C. H., & Huang, S. W. (2017). Applying augmented reality to enhance learning: a study of different teaching materials. *Journal of Computer Assisted Learning*, *33*(3), 252–266.

IELTS. (2012). *Test taker performance 2012*. Retrieved August 20, 2018, from http://www.ielts.org/researchers/analysis-of-test-data/test-taker-performance-2012.aspx

IELTS. (2014). *Analysis of test data: Percentile ranks 2012*. Retrieved August 20, 2018, from http://www.ielts.org/researchers/analysis_of_test_data/percentile_ranks_2012.aspx

Johnson, E. P., Perry, J., & Shamir, H. (2010). Variability in reading ability gains as a function of computer-assisted instruction method of presentation. *Computers & Education*, *55*(1), 209–217.

Kaenchan, P. (2018). *Examining Thai students' experiences of augmented reality technology in a university language education classroom.* Unpublished Doctoral Thesis, University of Boston, Boston.

Kalyuga, M., Mantai, L., & Marrone, M. (2013). Efficient vocabulary learning through online activities. *Procedia-Social and Behavioral Sciences*, *83*(4), 35–38.

Kaufmann, H., & Dünser, A. (2007). Summary of usability evaluations of an educational augmented reality application. *Papers in International conference on virtual reality*. pp. 660–669.

Li, P., Farkas, I. & MacWhinney, B. (2004). Early lexical development in a self-organizing neural networks. *Neural Networks, 17*(8–9), 1345–1362.

Liu, P. H. E., & Tsai, M. K. (2013). Using augmented-reality-based mobile learning material in EFL English composition: An exploratory case study. *British Journal of Educational Technology*, *1*(44), 1–4.

Liu, T. Y., Tan, T. H., & Chu, Y. L. (2009). Outdoor natural science learning with an RFID-supported immersive ubiquitous learning environment. *Journal of Educational Technology & Society*, *12*(4), 161–175.

Martin, S., Diaz, G., Sancristobal, E., Gil, R., Castro, M., & Peire, J. (2011). New technology trends in education: Seven years of forecasts and convergence. *Computers & Education*, *57*(3), 1893–1906.

Mawer, K., & Stanley, G. (2011). *Digital play: Computer games and language aims*. London: Delta Publishing.

Meara, P. (2006). Emergent properties of multilingual lexicons. *Applied Linguistics*, *27*(4), 620–644.

Milgram, P., Takemura, H., Utsumi, A., & Kishino, F. (1995). Augmented reality: A class of displays on the reality-virtuality continuum. *Telemanipulator and telepresence technologies*, *International Society for Optics and Photonics*, 235, 282–293.

Montero Perez, M., Van Den Noortgate, W., & Desmet, P. (2013). Captioned video for L2 listening and vocabulary learning: A meta-analysis. *System*, *41*(3), 720–739.

Morris, D., & Gaffney, M. (2011). Building reading fluency in a learning-disabled middle school reader. *Journal of Adolescent & Adult Literacy*, *54*(5), 331–341.

Muijs, D. (2004). Designing non-experimental studies. *Qualitative research in education with SPSS*, 21(3), 30–55.

Mustafa, H. R., Sain, N., & Razak, N. Z. A. (2012). Using Internet for learning vocabulary among second language learners in a suburban school. *Procedia - Social and Behavioral Sciences*, *66(1)*, 425–431.

Nation, I. S. P., & Nation, P. (2001). *Learning vocabulary in another language*. Cambridge: Cambridge University Press.

Nation, I. S., & Webb, S. A. (2011). *Researching and analysing vocabulary*. Boston, MA: Heinle Cengage Learning.

Nezami, S. R. A. (2012). A Critical study of comprehension strategies and general problems in reading skill faced by Arab EFL learners with special reference to Najran University in Saudi Arabia. *International Journal of Social Sciences & Education*, *2*(3), 306–316.

Ogawa, T. A. (2016). Vocabul-AR-y: Action research project of Aurasma to support vocabulary. *LTCE, 14*(7), 4–22.

Philip, T. M., & Garcia, A. (2015). Schooling mobile phones: Assumptions about proximal benefits, the challenges of shifting meanings, and the politics of teaching. *Educational Policy*, *29*(4), 676–707.

Qian, D. D. (1996). ESL vocabulary acquisition: Contextualization and decontextualization. *Canadian Modern Language Review*, *53*(1), 120–142.

Rahimi, M., & Miri, S. S. (2014). The impact of mobile dictionary use on language learning. *Procedia-Social and Behavioral Sciences*, *98(4)*, 1469–1474.

Reinhardt, J., & Sykes, J. (2014). Special issue commentary: Digital game and play activity in L2 teaching and learning. *Language Learning & Technology*, *18*(2), 2–8.

Richardson, D. (2016). Exploring the potential of a location based augmented reality game for language learning. *International Journal of Game-Based Learning (IJGBL), 6*(3), 34–49.

Saudi Ministry of Education (2017). *Saudi Vision: Kingdom of Saudi Arabia*. Retrieved October 3, 2018, from https://www.moe.gov.sa/ar/Pages/vision2030.aspx

Schmitt, N. (2010). *Researching vocabulary: A vocabulary research manual*. New York: Springer.

Schmitt, N., & McCarthy, M. (1997). *Vocabulary: Description, acquisition and pedagogy*. Cambridge: Cambridge University Press.

Selwyn, N., Nemorin, S., Bulfin, S., & Johnson, N. F. (2017). Left to their own devices: the everyday realities of one-to-one classrooms. *Oxford Review of Education*, *43*(3), 289–310.

Solak, E., & Cakir, R. (2015). Exploring the effect of materials designed with augmented reality on language learners' vocabulary learning. *Journal of Educators Online*, *12*(2), 50–72.

Sonbul, S., & Schmitt, N. (2009). Direct teaching of vocabulary after reading: Is it worth the effort? *ELT journal*, *64*(3), 253–260.

Story books alive (2018). *Amos augmented reality storybook*. Retrieved September 7, 2018, from https://alivestudiosco.com/storybooksalive/

Strauss, A. 8c Corbin, J. (1998). *Basics of qualitative research: Techniques and procedures for developing grounded theory.* Thousand Oaks: Sage Publishing.

Taj, I. H., Ali, F., Sipra, M. A., & Ahmad, W. (2017). Effect of technology enhanced language learning on vocabulary acquisition of EFL learners. *International Journal of Applied Linguistics and English Literature*, *6*(3), 262–272.

Walter-Laager, C., Brandenberg, K., Tinguely, L., Schwarz, J., Pfiffner, M. R., & Moschner, B. (2017). Media-assisted language learning for young children: Effects of a word-learning app on the vocabulary acquisition of two-year-olds. *British Journal of Educational Technology*, *48*(4), 1062–1072.

Webb, S. (2007). Learning word pairs and glossed sentences: The effects of a single context on vocabulary knowledge. *Language teaching research*, *11*(1), 63–81.

Wilkins, D. A. (1972). *Linguistics in language Teaching*. London: Edward Arnold.

Yang, J. (2013). Mobile assisted language learning: Review of the recent applications of emerging mobile technologies. *English Language Teaching*, *6*(7), 19–25.

Yilmaz, R. M., Kucuk, S., & Goktas, Y. (2017). Are augmented reality picture books magic or real for preschool children aged five to six? *British Journal of Educational Technology*, *48*(3), 824–841.

Zainuddin, N., & Idrus, R. M. (2016). The use of augmented reality enhanced flashcards for Arabic vocabulary acquisition. *Papers in Learning and Technology Conference*. pp. 1–5.

Appendix 1

Pre, post and delayed-test sample

EXPERIMENTAL GROUP DELAYED POST-TEST

Name: _____ Class:_____

Match the words in column (A) with the correct picture in column (B):

A	B
1 - Alligator	(__) 
2 - Lake	(__) 
3 - Swamp	(__) 
4 - Frog	(__) 
5 - Airport	(__) 
6 - Turtle	(__) 
7 - Hatchlings	(__) 
8 – Land	(__)