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Using Mobile Augmented Reality Applications to Develop EFL Vocabulary Learning of Primary Stage Pupils and their Interest in Learning it

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Abstract

The purpose of this study was to develop primary stage pupils' EFL vocabulary learning through using augmented reality applications treatment proposed by the researcher. A pre-post vocabulary test was developed. The experiment lasted for two months in a governmental distinguished language school, Dakahlia Governorate. The study adopted the quasi-experimental design using two independent groups design. Two intact classes were selected randomly to represent the experimental and the control groups (N=60). The study results revealed that the mean score of the experimental group was significantly higher than that of the control group on the vocabulary learning posttest. Finally, it was recommended that further research should be conducted related to using augmented reality applications for developing the vocabulary level of other EFL learners at other schools' levels and for developing different EFL skills.

Keywords: Augmented reality applications, Mobile learning, EFL Vocabulary Learning, Interest in Learning, Egypt

Introduction and overview

Vocabulary is one of the important language elements since it is impossible to communicate effectively without an adequate amount of vocabulary. When one acquires language vocabulary, he/she can convey feelings or messages, whether orally or in a written form. Mastering vocabulary for students who learn English as a foreign language enables them to actively participate in their society through speaking, listening and writing. In fact, vocabulary is a language element that links the four language skills together.

Barreira et al, (2012) found that students who are learning a language through augmented reality (AR) technology gaming comprehend more and achieve superior progress than those who learn language by conventional means. The audio and video accessories associated with the technology helped to promote vocabulary. So, integrating Augmented Reality (AR) in EFL classrooms for teaching vocabulary is expected to help young learners become more effective and interested in the learning process. Therefore, this study will investigate the possible effect of using augmented

reality applications on primary stage pupils' vocabulary learning and interest in learning it.

Types of Vocabulary

Some experts divide vocabulary into two types: active and passive vocabulary. The first type of vocabulary refers to the one that the students have been taught and that they are expected to be able to use. The second type refers to the words which the students will recognize when they meet them, but which they will probably not be able to pronounce. Other experts divide vocabulary into receptive vocabulary and productive vocabulary. Receptive vocabulary items are words which learners recognize when they are used in context, but which they cannot produce. It is the vocabulary that learners recognize when they see or meet in reading text but do not use it in speaking and writing. Productive vocabulary items are the words which the learners understand and can pronounce correctly and use constructively in speaking and writing. This kind of vocabulary involves what is needed for receptive vocabulary plus the ability to speak or write using it at the appropriate time. Therefore, productive vocabulary can be addressed as an active process, because the learners can produce the words to express their thoughts to others (Alqahtani, 2015).

Teaching vocabulary for second language learners

Teachers should be concerned that teaching EFL vocabulary is something new and different from student's native language. They also have to take into account that teaching English for young learners is different from adults. The teachers have to know the characteristics of his\her learners. They moreover need to prepare good techniques and suitable material in order to gain the target of effective language teaching (Alqahtani, 2015).

The teacher has an essential role in helping students to improve their vocabulary (Sofi, 2019). Traditional vocabulary instruction for many teachers involves having students look words up in the dictionary, write definitions, and use words in sentences. Word lists, teacher explanation, discussion, memorization, vocabulary books, and quizzes often are used in an effort to help students learn new words. But these methods ignore what research and theory tell us about word learning and sound vocabulary instruction (Mohammad, 2018).

Nowadays, there is more freedom in choosing the methods to be used during English classes. Teaching new vocabulary should begin by presenting the new items in context and then the learners should be given the opportunity of dealing with words out of context. It is important to

provide learners with strategies for inferring the meaning of unknown vocabulary from the context in which occurs instead of getting them to memorize long lists of words or look up unknown words in a dictionary (Sofi, 2019).

The instructor is critical in helping students develop their vocabulary. For a long time, English teachers use teaching methods such as Direct Process and Audio Linguicism, which stressed the primary importance of teaching grammatical structures. In classes where the accent was on grammar, the new vocabulary was restricted and only applicable to the grammar constructs taught. A substantial change happened at the beginning of the 1970s: direct Process and Audio linguicism lost emphasis to the Communicative Technique, which stressed teaching vocabulary. Students learned different vocabularies and speech practices. Words were incorporated in those classes, and students were advised to speak as soon as possible. Today, the number of approaches to use in English class is more available (Rashid, et al. 2022).

Vocabulary learning and teaching

Vocabulary is one aspect of language that cannot be tolerated and must be learnt well to understand the language easily. Learners with adequate vocabulary competence have the ability to speak, write, read, and listen well. However, it is also one of the most difficult challenges for English language learners. Vocabulary knowledge includes the ability to know a word and its meaning upon seeing it and to know how to use it in appropriate context (Ibhar & Said, 2018).

Second language learning depends largely on vocabulary, as the building blocks from which learners start their second language acquisition. Therefore, its significance lies deeply within the first stages of the acquisition of any language (Ramos, 2015). Vocabulary is the most important words to be learned in the language. Without vocabulary, learners cannot speak, write, read, or understand what is being said in the listening and speaking process. If they lack vocabulary, it may hinder them to understand words. (Katemba, 2021). Students would not comprehend others' ideas or communicate their own ideas if they did not have a broad vocabulary (Rashid, et al. 2022).

Vocabulary constitutes one of most crucial skills which are important for teaching and learning a foreign language. It constitutes the basis for the development of all the other skills: reading comprehension, listening comprehension, speaking, writing, spelling and pronunciation.

Vocabulary is the chief instrument for the students in their attempt to use English effectively. (Sofi, 2019).

Importance of learning vocabulary

Vocabulary knowledge is often considered as an important tool for second language learners because a limited vocabulary in a second language hinders successful communication. The acquisition of vocabulary is essential for successful second language use and plays an important role in the formation of complete spoken and written texts. In English as a second language (ESL) and English as a foreign language (EFL), learning vocabulary items plays a vital role in all language skills. The acquisition of an adequate vocabulary is essential for successful second language use because without an extensive vocabulary, learners will be unable to use the structures and functions for comprehensible communication. Vocabulary has been acknowledged as second language learners' greatest single source of problems. The endless vocabulary system is perceived to be a cause of difficulty by learners. Another possible problem is that vocabulary does not have rules the learners may follow to acquire and develop their knowledge. (Alqahtani, 2015).

Vocabulary learning and technology

In second language learning process, vocabulary teaching and learning is a very complicated and challenging process. Second language learners do their best to find out the vocabulary learning technique that is the most beneficial for them. However, memorizing the new vocabulary item is their first approach in vocabulary learning. Clearly, beginners prefer to learn items separately by using a list of word items to memorize. On the other hand, advanced learners attempt to acquire words in their context.

Presenting new words without paying attention to the learner's background knowledge is one of the limitations in teaching vocabulary items. Accordingly, computers have provided diversity of activities and better opportunities for learners and teachers to master this limitation. The significant impact of computer-assisted instruction on developing reading comprehension skills and learning lexical items has been reported in numerous studies. As for vocabulary instruction through technology, many practitioners have claimed that vocabulary has been one of the most commonly taught language areas through technology in recent years. The rapid remarkable advancements in computer technologies have been affecting all aspects of language learning in general and vocabulary component in particular for more than two decades.

Technology can be employed to help students and teachers learn and teach second language vocabulary items more effective. Technology can be used to increase the quality of input, to provide useful corrective feedback and train students in the use of technological advances that are fundamental skills in learning another language vocabulary items. Some examples about mixing technology and education in the classroom are having computers to access the internet, using mp3 players and etc. Computer-assisted and online vocabulary learning contexts have proved to be of great help to EFL learners (Hajebi, 2018).

Mobile learning

(Brown,2001) stated that mobile learning is a broad field that includes a great number of devices and applications such as mobile phones, PDAs, Smartphones, GPS tools, laptop computers, MP3 or MP4 players, video tapes, multimedia players, e-game tools, e-books e-organizers, CDs and DVDs. Such devices are considered among the list of mobile tools. Mobile devices can be effective to a great extent in educational purposes. When the concept of mobile learning (ML) appeared in education, some scholars developed it to be more related to language education. Accordingly, the concept of ML was available in the field of education since the year 2000. Since then, scholars are investigating the merits of using these technologies. The increasing development of ML nowadays strengthen the idea of using ML inside classrooms. It can be used as a substitution to traditional materials.

Nature of augmented reality

The goal of augmented reality systems is to combine the interactive real world with an interactive computer-generated world in such a way that they appear as one environment. As the user moves around the real object, the virtual (i.e. computer generated) one reacts as it is completely integrated with the real world. Furthermore, the virtual object may move but still the movements are registered with respect to the real world (Sharma, 2014).

Augmented Reality is a technology that utilizes computer vision methods to combine computer-generated virtual objects/ environments with real objects/environments, to enhance or annotate what can be discerned by the human user. AR is a technology with a possibility to transform two dimensional pictures into three-dimensional computer graphics, showing spatial forms and AR is considered as a medium, combining aspects from ubiquitous computing, tangible computing, and social computing (Ivanova & Ivanov, 2011). AR is the integration of digital information with live video or the user's environment in real time. Basically, AR takes an existing

picture and blends new information into it. Very often AR is regarded as a type of "virtual reality where the Head Mounted Display (HMD) is transparent" (Sharma, 2014). Augmented reality (AR) can be regarded as a technology that combines the real world with virtual objects and it provides interaction between real and virtual objects (Meryem &Goktas, 2018).

Augmented reality and education

Several advantages to integrate AR technology in education are identified during the examination of AR implementation in educational practices. Utilizing AR for learning stimulates creative thinking among students، enhances their comprehension in concrete subject domain and increase the understanding of spatial spaces. In several unattractive science subjects AR technology can stand as a motivation tool for conduction of students' explorations and as a supportive tool of theory learning in an interesting and enjoyable way. AR proposes a safe environment for students to practice skills and conduct experiments.

The key benefits of AR technology are summarized in: excels at conveying spatial and temporal concepts; multiple objects can be placed in relative context to one another or relative to objects in the real world; maximizes impact, creates contextual awareness, enhances engagement, and facilitates interaction; heightens understanding with kinesthetic learners; provides a high degree of engaging, self-paced interaction, and maintains interest; improves communication, learning retention, and interaction with others; includes both professionally built content and an AR content building tool suite. (Ivanova, Ivanov, 2011).

Augmented reality and learning vocabulary

Tsai (2020) stated that AR can be used as a teaching tool, which allows learners to smoothly interact with virtual objects in virtual and real environments. Besides, learners' using AR as a teaching tool will lead to new types of teaching and learning. AR can help learners immerse themselves in the characteristics of the learning content, rather than merely learning being static memorization of information.

Yuen, Yaoyuneyong, and Erik (2011) proposed that Augmented Reality can provide learners with a new type of learning tool. Benefits from applying AR to education include: 1) Interaction: students are able to operate it easily, as well as have discussions about it; visual and audio stimulation can arouse school children's curiosity and increase their learning motivation. 2) Sensory feedback: the 3D real-time model presented in front of school children helps them enter the space formed by virtual objects and the real environment as a way of immersion. 3) Spatial association: the

spatial association between each virtual object, each real object, and the environment can be easily identified. 4) Learning novelty: owing to AR's novel way of presenting knowledge and its simple and intuitional interaction, AR can also act like multimedia, which can make learning fun for students and trigger their learning motivation and interest (Tsai, 2020).

Problems associated with applying augmented reality in education

Even though AR provides an important contribution to education, there are still some problems that need to be overcome. The most important problem in this context is the difficulty of applying and producing content for AR applications. Especially, as developing 3D objects requires technical knowledge, many students and teachers are prejudiced about using AR. Besides, another problem that makes this technology hard to apply effectively in education results from external factors like lighting, output and display quality that affects the applications negatively. On the other hand, there are some problems related to students and learning processes. Students that use AR may face a huge amount of knowledge at same time. This situation results in high levels of cognitive load. Furthermore, students that use AR applications may have to use several devices. This issue requires students to have spatial orientation ability, problem-solving ability and technology interference skills. (Meryem & Goktas, 2018).

Involving students in creating AR projects is likely to engage students more in the learning process. AR can be used as a teaching tool, which allows learners to smoothly interact with virtual objects in virtual and real environments. Teaching with Augmented Reality is thought to be helpful in promoting the learning of English as a foreign language in elementary schools.

Background of the problem

Primary stage pupils at Governmental Distinguished Language School (GDLS) had a weakness in their vocabulary learning. Moreover, a pilot study was conducted a pilot study to determine pupils' current level in vocabulary learning. A vocabulary test (See appendix A) was administered to third year primary pupils at a governmental distinguished language school, Dakahlia Governorate. Results of the pilot study are presented in table (1).

Table (1) Pupils' Scores on the Vocabulary Test (N=15)

Test	*Max Mark*	*Mean (x)*	*SD*	*Percentage %*
Vocabulary	25	10.5	4.9	42

Results in table (1) indicated that the pupils' vocabulary learning tends to be weak (X = 10.5). Although the mean score of 10.5 out of 25 was not a high mark, it indicated that pupils had hardly passed the vocabulary learning test. This means that they had a weakness in their vocabulary. Therefore, there is a need to develop their vocabulary learning.

Statement of the problem

Based on the previous review of literature, the researcher's experience as a teacher of English and the results of the pilot study, it became crystal clear that third grade primary stage pupils at governmental distinguished language school had a weakness in their vocabulary learning. Therefore, the study aimed to investigate the possible effectiveness of using mobile augmented reality applications in developing third grade primary stage pupils' EFL vocabulary learning.

Questions of the study

The study attempted to answer the following main question: "To what extent can using mobile augmented reality applications help develop EFL vocabulary learning of third grade primary stage pupils?''

Purpose

The present study aimed at:

1. Identifying the features of mobile augmented reality applications that can be employed in this study.
2. Investigating the effectiveness of using mobile augmented reality applications in developing EFL vocabulary learning of the third-grade primary stage pupils.

Significance

It is hoped that the present study would contribute in:

1. Providing empirical evidence to the value of incorporating and adopting mobile augmented reality applications in learning vocabulary.
2. Directing the attention of EFL teachers and curriculum designers towards the modern mobile AR applications that could help learners to develop their vocabulary learning skills.
3. Raising the awareness of EFL teachers of the importance of employing mobile augmented reality applications in language teaching.
4. Providing EFL primary teachers on how to use modern mobile AR applications to develop their vocabulary learning skills.

Delimitations

The present study was delimited to;

1. Two classes from the third-grade primary stage pupils at a governmental distinguished language school, Dakahlia governorate.

2. One term from the academic year 2023/2024 as the duration of the experiment.
3. Three units from the 3rd grade primary pupils' text book (Connect 3) that are taught at the first term.
4. Some mobile AR applications (e.g., Animal 4D, Virtuali-TEE, AR-Animals, Mr Body, Animal 4D Safari, etc…) appropriate for developing pupils' EFL vocabulary learning.

Hypotheses

The present study attempted to verify the following hypotheses:

1. There is a statistically significant difference at 0.05 level between the mean score of both the control and experimental group pupils on the post administration of the EFL vocabulary learning test in favor of the experimental group.
2. There is a statistically significant difference at the 0.05 level between the mean score of the experimental group pupils on the pre and post administration of the EFL vocabulary learning test in favor of the post one.

Methodology

Participants

Participants of the study were selected from third year primary stage pupils in a governmental distinguished language school, Dakahlia Governorate. Two intact classes were selected; one represented the experimental group and the other was the control group. Each class consisted of 40 pupils, thus the total number of the pupils participated in the study is fifty (N=60). Their age ranged from 8 to 9 years.

Design

The study adopted the quasi-experimental design by using two groups; experimental and control. The control group used the regular way of teaching and the experimental group employs the mobile AR applications. A pre-post administration of the Vocabulary Learning test was administered on both experimental and control groups in order to determine the effectiveness of using these applications on the experimental group. The adopted the quasi-experimental design (See figure 1) in this study (pre-post test) was as follows:

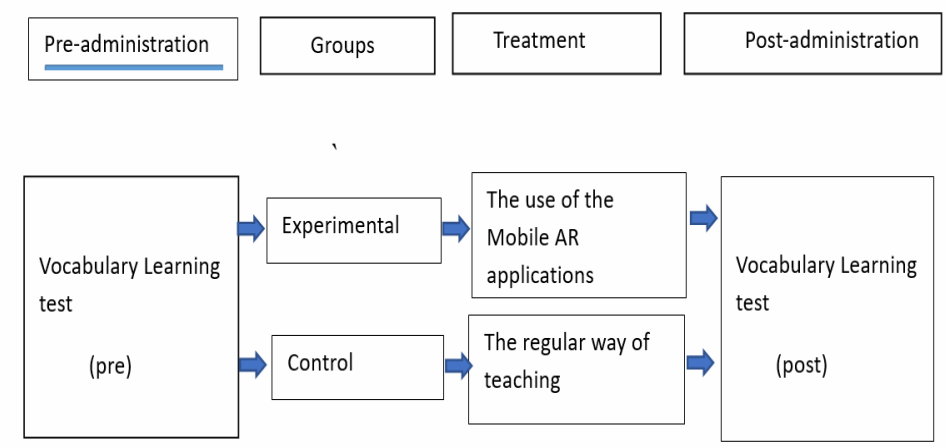

Figure (1) Design of the study

Instruments

The following instruments and materials were prepared:

1. A Vocabulary Learning test was used as pre-posttest to measure pupils' level in vocabulary learning before and after the experimental treatment.
2. An Interest in Learning scale was used as pre-post scale to measure pupils' interest in learning before and after the experimental treatment.
3. A Teacher's Guide to the AR applications experimental treatment.

Definition of terms

Vocabulary learning

Vocabulary learning is the process of acquiring the building blocks in second language acquisition (Ramos, 2015). Weiser (2013) also regarded vocabulary learning as "a process of acquiring new words to use in daily life, and more specifically, the basis for learning any language.

For the purposes of this study, vocabulary learning can be considered as the process of widening students' vocabulary to learn the meaning of new words and concepts in various contexts and across all academic content areas by using some mobile AR applications (e.g., Animal 4D, Virtuali-TEE, AR-Animals, Mr Body, Animal 4D Safari, etc…).

Interest in Learning

According to Hidi and Renninger (2006) interest is a feeling of wanting to learn more about something or to be involved in something. Interest is viewed as a powerful motivational process that energizes learning, …. and it is essential to academic success. Interest is both a psychological state of attention and affect toward a particular object or topic, and an enduring predisposition to reengage over time(PMC,2016).

For the purpose of this study, interest can be regarded as "a feeling of wanting to learn more of the English vocabulary."

Augmented Reality (AR)

Caudell and Mizell (1992) define AR as an enabling technology used to 'augment' the visual field of the user with information necessary in the performance of the current task. Yuen, Yaoyuneyong and Erik (2011) described AR as "a kind of technology that enhances the real world through content produced by the computer". For the purpose of this study, augmented reality is regarded as "a digital technique that allows learners to combine both virtual objects such as: videos, images and 3D animation with the physical world and interact with them through using some downloaded mobile applications to develop their speaking performance."

Mobile Augmented Reality Application

Caudell and Mizell (1992) define AR as an enabling technology used to 'augment' the visual field of the user with information necessary in the performance of the current task. Yuen, Yaoyuneyong and Erik (2011) described AR as "a kind of technology that enhances the real world through content produced by the computer".

For the purpose of this study, augmented reality is regarded as "a digital technique that allows learners to combine both virtual objects such as: videos, images and 3D animation with the physical world and interact with them through using some downloaded mobile applications to develop their speaking performance."

Statistical Analysis and Results

The results of the research are discussed in the light of the statistical analysis of the study instrument. A discussion of the results is provided after each statistical analysis as well as a discussion of the overall results.

Establishing the homogeneity of the groups

To establish the homogeneity of both the experimental and control groups, a pre *(t) test* was administered. Table (2) shows the results of the a pre *(t)* test.

Table (2) t- test value between mean score of both the experimental and the control groups in pre vocabulary test

Test	*The group*	*No.*	*Mean*	*SD.*	*T.*	*DF.*	*Sig.*
Vocabulary	Experimental	30	4.5714	.91670	1.8	68	Not significant
	Control	30	4.2286	.64561	1.4	68	Not

The statistics in Table (2) indicate that the independent t-test value of the overall vocabulary pre-test was 1.95, and it was non-significant.

There are no significant differences at the level of 0.05 between the mean score of the experimental and control groups in the pre- administration of the vocabulary test, which means that the two groups were homogeneous. Consequently, results in the table verify the equivalence between the control and the experimental group pupils.

Results and Statistical methods

Results of the study were attained through testing the research hypotheses. To validate the hypotheses of the study, the responses of the participants were analyzed and processed statistically using the SPSS program; the researcher applied the following tests:

1- The T-test for comparing means of the two independent groups in the pre and post administration of each instrument of the study.
2- The Eta Square (η2) for determining the effect size of the independent variable on the dependent one.

Testing the Hypotheses

Testing the First Hypothesis

The first hypothesis stated that: "***There is a statistically significant difference at 0.05 level between the mean score of both the control and experimental group pupils on the post administration of the EFL vocabulary learning test in favor of the experimental group***".

The t-test for independent samples was used to test the first hypothesis. The following table shows results concerning the first hypothesis which addressed the differences between the mean scores of the control group and those of the experimental group of vocabulary on the post administration of the vocabulary learning test.

Table (3) Results of t- test of the control and experimental group on the post- administration of the vocabulary learning test.

	Groups	*N*	*Mean*	*Std. Deviation*	*T Value*	*Df*	*Sig*
Vocabulary	Experimental	30	27.23	2.635	20.774	58	0.05
	Control	30	13.27	2.572			

Table (3) shows that the mean scores of the experimental group pupils in vocabulary and in the total increased and became higher than those of the control group. The table also illustrates that the estimated t- value is significant at 0.05 level. This indicates that there are statistically significant differences between the experimental and control groups in vocabulary on the post- administration of the test. These significant differences are in favor of the experimental group. In other words, results in table (2) provides evidence that the experimental group outperformed the control group as the

total mean score of the control group is (13.27) while the total mean score of the experimental group is (27.23). So, it can be concluded that the score of the experimental group is much better and greater than that of the control group and that the level of pupils in vocabulary got better due to using Mobile AR applications.

Testing the Second Hypothesis

The second hypothesis stated that: "There is a statistically significant difference at the 0.05 level between the mean score of the experimental group pupils on the pre and post administration of the EFL vocabulary learning test in favor of the post one". The t-test for paired dependent samples was used to test the second hypothesis, which addressed the difference between the experimental group pre & post administration of the vocabulary learning test in order to investigate if there was any statistically significant difference between the mean scores of the experimental group pupils on vocabulary learning pre and posttest because of the administration of the experimental treatment. Following are the results of the t-test comparing the mean score of the pupils in the experimental group on the pre/post overall vocabulary learning test.

Table (4) Comparing the vocabulary level of the experimental group on the pre & post- administration of the vocabulary learning test

Vocabulary	*Measurement*	*N*	*Mean*	*Std.*	*T*	*df*	*Sig*
Total	Pre	30	6.2	2.387	31.12	29	0.01
	Post		27.23	2.635			

Results in Table (4) indicate that the total mean score of the pupils on the pre-total vocabulary learning test was (6.2), while their total mean score on the post vocabulary learning test was (27.23). These results indicated that the high mean was obtained for the post-test results. So, it can also be noticed that t- value for the overall vocabulary learning test was 31.12. Results in the above table illustrate that the estimated t- value is significant at 0.05 level. Thus, the results of the t-test verified the second hypothesis. This reflects that there are statistically significant differences between the mean scores of the pre-post administration of the vocabulary learning test. These significant differences are in favor of the posttest.

Estimating the effect size (η2):

Eta Square (η2) was used in order to estimate the effect size of the experimental treatment. Table (5) shows the results and illustrates the effect size of the proposed program concerning the difference between the pre-post application of the test on the experimental group.

Table (5): Value of (η2) and the effect of the experimental treatment on the vocabulary level

	N	*Mean*	*Std. Deviation*	*Sig*	*(η2)*
Vocabulary	30	27.23	2.635	0.01	0.954

Table (5) illustrates the effect size of the proposed program on the academic achievement of the experimental group pupils in vocabulary. Results indicate that the effect size is high in the two domains. It is obvious from the previous table that the effect of the treatment on the development of vocabulary was significant, as indicated by the obtained total test percentage.

Results in table (4) and the effect size results shown in table (5) prove that the statistical differences between the pre-post administration of the vocabulary learning test are in favor of the post administration. In addition, the size of these differences fosters and supports the positive effect of the treatment on promoting the pupils' vocabulary. Therefore, the second hypothesis of the study is proved and accepted.

Discussion of the results

The previous results clarify that there is a remarkable and noticeable enhancement in the experimental group pupils' vocabulary on the post administration of the vocabulary learning test. This improvement is due to the use of the mobile augmented reality applications (AR) to the experimental group. Mobile Augmented reality applications which are featured with animations, images, voices, music and colorful models are very catchy and attractive for the pupils as they encourage them to take part in the treatment in order to enhance their vocabulary. This enables pupils to broaden their horizon and enrich their capacity to gain a good repertoire of vocabulary. By the end of the study administration, almost every pupil participated in the treatment with clear joy and a spirit of creativity and revamp.

The results might be due to the following reasons:

1- The mobile augmented reality applications that were carefully selected by the researcher had so many features in common with games that the pupils are mesmerized with and that attracts them towards getting involved into them and taking part in activities to try the applications.

2- The mobile augmented reality applications depend mainly on the idea of making videos and images that increased pupils' interest and provided pupils with opportunity for active participation to make and share their own videos and images. These videos and images helped

them to understand the lessons and met their needs to act, talk freely and communicate in English thinking that they become famous like other celebrities and youtubers.

3- The variety of Mobile AR applications pushed the pupils to sway from one application to another to explore more about these applications to the extent that a large number of pupils began to use other different mobile applications such as, AR solar system, AR viewer, AR animal, ARloopa, Augment, Cospaces, Earth 3D, Egypt AR, Moment, Mr.body, Objectiveviewer Unite AR, Vrtuali-tee, Animal4D, Assemble AR to create unique and professional videos.
4- The Mobile AR applications also provide the pupils with a great chance to engage in conversations, to prepare a talk, a dialogue and share with the classmates.

Through the statistical analysis, the results of the present study disclosed that:

1- The mean score of the experimental group was significantly higher than the mean score of the control group on the vocabulary learning posttest.
2- The mean score of the experimental group on the post- vocabulary learning test was significantly higher than their mean score on the pre-test.
3- There was a statistically significant difference between the mean score of the experimental group pupils and those of the control group pupils on the vocabulary post -test in favor of the experimental group pupils.
4- There was a statistically significant difference between the mean score of the experimental group pupils on the pre and post administrations of the vocabulary learning test in favor of the post-one.

Conclusions

The current study concluded the following points:

- The present study affirmed the importance of using the mobile AR applications in improving EFL learners' vocabulary. These results came in line with a lot of former research studies (previously mentioned).
- The experimental group performance improved at the end of the treatment, and it was much higher than that of the control group.
- The mean score of the experimental group was higher than that of the control group on the vocabulary learning test.

- The present study accentuated the possibility of integrating learning strategies within mobile augmented reality applications to enhance EFL students' vocabulary.
- The study results revealed that vocabulary mastery levels are positively impacted by the mobile augmented reality applications and consequently pupils' proficiency to find appropriate responses to situations indicates improvement.
- The recent research manifested that the mobile augmented reality applications enable pupils to learn English in an active and enthusiastic atmosphere, make the vocabulary lessons pleasurable, foster their interest in learning by doing through acting, present lifelike experiences for pupils, create a creative environment in which all pupils can take part in the vocabulary lessons and activities.
- The results also revealed that using mobile AR applications builds up and accelerates and develops pupils' learning of vocabulary.

Recommendations of the Study

In the light of the results and conclusions of the current study, the following recommendations were suggested:

- The mobile AR applications support teaching English vocabulary with different technologies for creating a better learning environment so it is recommended to be used by EFL teachers as a framework for developing vocabulary.
- The proposed program is recommended to be integrated in the vocabulary lessons and it should receive more attention from the curriculum designers.
- New techniques for enhancing vocabulary should be explored and exploited, so that language learners will easily make their way to their proficiency goals.
- Learners ought to adopt technology when learning English in order to improve their levels in all academic fields.
- Vocabulary should receive more attention by curriculum designers so as to be enhanced especially at the primary stage.

Suggestions for Further Research

The following suggestions are recommended to be considered for further research:

- Using this proposed treatment in developing the vocabulary level of other EFL learners at other schools' levels (e.g. preparatory and secondary stages).
- Using this treatment with different set of EFL skills (e.g. reading, writing, listening and speaking) and with different participants.
- Using the mobile AR applications treatment to enhance the learning of disabled pupils' EFL Skills (e.g. reading and writing skills).

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