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Mobile Assisted Language Learning: Investigating Receptive and Productive Vocabulary Knowledge of Iranian Intermediate EFL Learners

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ABSTRACT

This study investigated the impact of mobile-assisted language learning on mastering receptive and productive vocabulary knowledge by Iranian EFL learners. The sample of this study included 140 male and female learners from Andisheh Language Institute, Langroud, Iran. Following a Quick Placement Test, 100 intermediate learners were randomly divided into two groups of 50 to conduct the research. Then the treatment began, the experimental group received Beelinguapp as an educational app, whereas the control group used paper word cards. Finally, learners in both groups were given a posttest of Collocation Achievement Tests (CAT) and Vocabulary Knowledge Scale (VKS) to see if there were any differences in receptive and productive vocabulary knowledge between the experimental and control groups. The data were statistically analyzed using Paired sample t-test, independent sample t-test, ANCOVA, Wilcoxon signed, and Mann Whitney tests. The findings revealed that there is a significant difference between the experimental group and the control group in terms of receptive vocabulary knowledge in the post-test. That is, the participants in the experimental group outperformed those in the control group in receptive vocabulary knowledge. It was also observed that there is no difference between using mobile applications and paper word cards in terms of productive vocabulary knowledge. Pedagogical implications for integrating technology tools in enhancing learners' vocabulary knowledge are discussed.

KEYWORDS: Beelinguapp; MALL; Productive Vocabulary Knowledge; Receptive Vocabulary Knowledge

INTRODUCTION

The rapid development of new technologies with new possibilities provides new opportunities to tackle the challenge of L2 vocabulary learning. Learners can develop their vocabulary through computer and mobile devices using language learning applications, online communication tools, and games. The benefit of technology-supported vocabulary learning is based on the availability of practice and the use of media to support in or out of context meaning-making through utilizing videos, pictures, and audio. However, researchers noted that the possibilities have raised challenges for teachers and learners (Golonka, Bowles, Frank, Richardson, & Freynik, 2014; Ma, 2017; Yu & Trainin, 2022). The challenge is to find ways to choose suitable vocabulary learning apps, to transform them into effective tasks for learners, to meet the different needs of learners, and develop self-regulated strategies. In the ast decade, the trend of mobile-based technologies, specifically mobile phones, in teaching-learning contexts based on technological developments in information and communication technologies (ICT) has provided a special perspective for different planning of the learning process and enhancing the learning experience of students. This, in turn, has led to a vast expansion of research in the field of mobile learning to understand the prerequisites for integrating mobile technologies in foreign language teaching and learning (Chen, Chen, & Yang, 2019; Namaziandost, Alekasir, Saberi Dehkordi, & Ahmad Tilwani, 2021; Wrigglesworth, 2020).

Mobile technology developments are quickly expanding the field of learning in non-formal education areas by rendering universal and instance-oriented access to privileged digital resources. Mobile learning technology requires mobile devices to improve learning and academic performance by having the opportunity to learn

remotely at all times in compliance with students' comforts (heon et al., 2012). Mobile devices are mostly used in developed countries, particularly for language learning purposes. Specifically, Mobile-Assisted Language Learning (MALL) implies mobile phones in the learning and teaching of languages. Vocabulary is the foundation of language mastery because it forms the building blocks of meaning. Extensive vocabulary can make speaking, listening, reading, and writing more fluent and accurate (Webb & Nation, 2017; Yu & Trainin, 2022). This is the key to successful communication. Vocabulary learning is not just remembering a list of words, it is a complex process. For example, the learning load of second language (L2) vocabulary can come from different forms of resources, which include language systems of learners first language (L1) learners, similarities between L1 and L2 learners, vocabulary teaching methods, and learners' experience of words (Webb & Nation, 2017). Therefore, L2 learners often struggle to learn and remember vocabulary because vocabulary knowledge is not easily generalized.

Considering the Iranian EFL context, the teaching of English vocabulary items may not have seen unique methods for teaching English vocabulary. More precisely, the teaching methods that are intended to improve the vocabulary knowledge of Iranian learners are not related to the use of technology-based instruction, particularly teachers in Iran still follow the traditional methods of teaching vocabulary (Mansouri & Mashhadi Heidar, 2019; Namaziandost, Alekasir, Saberi Dehkordi, & Ahmad Tilwani, 2021; Namaziandost, Rezvani, & Polemikou, 2020). As a result, this is the reason why the researchers proposed the idea of investigating the effect of technology-mediated instruction on the learning of English vocabulary items of Iranian EFL learners. Consequently, considering the need to fill the research gap felt in relation to the role of technology-mediated instruction in improving students' vocabulary knowledge in the Iranian context, this research was conducted with the aim of investigating whether the use of mobile-assisted language learning has a significant impact on the improvement of Iranian learners' vocabulary knowledge.

The importance of this research is that few studies have been done in Iran in the field of using technology to teach English vocabulary (Alavinia & Qoitassi, 2013; Namaziandost, Alekasir, Saberi Dehkordi, & Ahmad Tilwani, 2021; Zakian, 2022). The researchers intended to carry out this study and draw more attention to the significance of integrating technology with traditional teaching methods. In addition, having technology-mediated instruction integrated with traditional teaching-learning contexts can be effective for teaching foreign languages. Therefore, to clarify the effectiveness of using Mall in Iran, the researchers believe that this study can be an attempt to pave the way for more related research in order to have a better insight into the use of everyday technologies in learning contexts. The main aim of this research is to find out how EFL learners learn receptive and productive vocabulary knowledge with their mobile devices. Thus, the following research questions were addressed in the study:

1- Are mobile applications effective in improving Iranian intermediate EFL learners' receptive vocabulary knowledge?

2- Are mobile applications effective in improving Iranian intermediate EFL learners' productive vocabulary knowledge?

LITERATURE REVIEW

THEORETICAL FRAMEWORK

According to Yu and Trainin (2022), the penetration of digital technology into education has provided new opportunities for language teaching and learning. It has also created challenges for both teachers and learners. The main challenge is to understand what digital applications will improve current practices. According to dual coding theory, people encode information through two pathways: visual and verbal. The verbal pathway encodes linguistic information in all its forms, while the visual pathway encodes images. When the inputs of the two paths overlap, encoding and retrieval are improved. Referential connections between two codes allow operations like imagining words to reinforce input and accurately retrieval information (Clark & Paivio, 1991). Multimedia instruction addresses individualized learning needs by providing opportunities for students to be exposed to language in a variety of ways, which accelerates learning and increases vocabulary retention. Based on dual coding theory, using technology can increase retrieval by combining images, sounds, and print to facilitate vocabulary learning (Moeller et al., 2009). Gathering cumulative results is important to understand how multiple studies inform theories that explain potential advantages and limitations of technology-assisted vocabulary learning. There is a moderator that can affect the relationship between two variables. As some studies have shown, technology-assisted vocabulary learning is more effective than traditional vocabulary learning, and the kind of instruction (receptive/productive) may be a moderator that impacts the outcome (Yu & Trainin, 2022).

RECEPTIVE AND PRODUCTIVE VOCABULARY KNOWLEDGE

Vocabulary knowledge is classified into receptive vocabulary knowledge and productive vocabulary knowledge. Receptive vocabulary knowledge is the knowledge to understand a word in listening and reading, whereas productive vocabulary knowledge is the knowledge to produce a word when one speaks and writes (Nation, 1990; Schmitt, 2014). Nation (2001) stated that one type of assessment cannot measure all aspects of learners' word knowledge. Many researchers in technology-assisted vocabulary learning studies have adopted various assessments to measure aspects of vocabulary knowledge. For example, multiple-choice tests assess recognition vocabulary knowledge and sentence translation tests and mixed-type tests assess production vocabulary knowledge. It is significant to know what aspects of vocabulary knowledge can be best achieved through technology. Therefore, multiple-choice tests that assess vocabulary knowledge of recognition will produce higher effect sizes than productive measures (Yu & Trainin, 2022). There are several studies such as Ahmad, Sudweeks, and Armarego (2015), Dizon and Tang (2017), Anjaniputra and Salsabila (2018), Fathi, Alipour, and Saeedian (2018), Kukulska-Hulme (2018), Lin and Lin (2019), Okumuş, Konca, and Demiröz (2020), Li and Hafner (2022), and Yu and Trainin (2022) reporting favorable results for using mobile devices in vocabulary learning.

MOBILE ASSISTED VOCABULARY LEARNING

The benefits of mobile learning have been described by numerous researchers (Kukulska-Hulme, 2018; Kukulska-Hulme & Traxler, 2013; Passey, 2010; Traxler, 2010). These are particularly relevant in higher education settings, where students are required to undertake considerable out-of-class learning, and for independent, self-regulated vocabulary learning using personal mobile devices. One of the most frequently-cited benefits is the ubiquity of learning, whereby learners can take advantage of the portability, mobility, and flexibility of their devices to access learning materials and learn in a variety of different spaces and locations at a variety of different times (Lai & Zheng, 2018). This creates opportunities for students to make productive use of fragmented time or dead time, between classes or when commuting that enables vocabulary learning to be undertaken in bite-size chunks of time more frequently (Wu, 2015).

Another benefit is that because smartphones are now very affordable due to significant reductions in their retail price over the last decade, mobile learning is now very accessible and most learners now possess their own device (Godwin-Jones, 2017). This personal ownership enables greater freedom and autonomy for students to access learning materials without the need of a teacher (Ahmad, Sudweeks, & Armarego, 2015). There is also the potential for greater personalization of learning because students can navigate their own pathway through the materials without being forced to use them in a certain way. They can change the settings in both language learning applications and on their mobile device (Kukulska-Hulme, 2012). This sense of control overlaps very strongly with the concept of self-regulation since learners have to be able to plan, manage and control their use of the device, the digital learning tools, as well as the actual learning content.

It has also been argued that mobile learning better enables seamless learning that links together and encompasses both formal learning within the classroom, and informal and formal learning outside the classroom across myriad devices, in a variety of physical and temporal arenas. In other words, it allows learners to more easily extend their studies beyond the traditional or virtual classroom (Kukulska-Hulme, 2018; Li & Hafner, 2022). This is particularly true when online digital tools are available in a variety of different formats, including web-based interfaces that can be accessed on laptops, and mobile applications that learners can use on smartphones and tablets (Wong & Looi, 2011).

PREVIOUS STUDIES

Over the past years, an increasing number of studies have examined the different capabilities of mobile devices for vocabulary learning and teaching (Li & Hafner, 2022; Lin & Lin, 2019; Yu & Trainin, 2022; Zakian, 2022). This growing body of knowledge points to the facilitative role of mobile technologies in addressing vocabulary learning component of language teaching programs (Zhang et al., 2011). In this regard, studies have investigated learning outcomes from a wide range of mobile technologies, including text messages (Derakhshan & Kaivanpanah, 2011), context aware applications (Chen & Li, 2010), game-based learning environments (Cho & Castañeda, 2019), digital flashcards (Başoğlu & Akdemir, 2010; Fathi et al., 2018; Nakata, 2020), and dedicated applications for vocabulary learning (Wu, 2015).

Deng and Shao (2011) used a mobile application called Remword to investigate students' attitudes towards use of mobile applications in vocabulary building. They found that some benefits of applications such as autonomy, flexibility, and low costs of internet access helped students learn vocabulary in a self-directed way.

Moreover, Wu (2014) investigated the impact of smartphones on ESL students to learn English vocabulary. This researcher-developed application presented each word in a graphic diagram with seven features which are spelling, pronunciation, meaning in the Chinese language, synonym, antonym, part of speech, and using it in example sentences. The researchers carried out this research with the help of 50 participants who were equally divided into an experimental group and a control group. The results of this study indicated that the learners receiving treatment in the experimental group outperformed those in the control group. In addition, Wu (2015) conducted an experimental study with college students. He used a Java application (Word Learning) for vocabulary learning. The findings revealed that the experimental group outperformed the control group significantly in the posttest. In another study, Wang (2017) designed an Android application that presented 720 lexical items of the most frequent English words to university students in Taiwan. The results showed that the app gave students more opportunities for learning English and allowed them to learn every day although particular learning gains were not highlighted.

Anjaniputra and Salsabila (2018) used Quizlet with a class of 30 students at a university in Indonesia and interviewed a small number of students. The findings suggest that Quizlet provided students with an enjoyable learning experience due to the variety of activities and the fact that they felt like playing and learning at the same time. Secondly, Quizlet helped generate learner persistence in vocabulary learning mainly due to the competitive element of the tool. In a more recent study, Lin and Lin (2019) examined the effectiveness of Mobile-Assisted Vocabulary Learning (MAVL). Lin and Lin's (2019) overall findings show that there was an overall positive and large effect size (ES = 0.94) from mobile vocabulary learning. In another recent study, Muthumaniraja (2020) used Quizlet Live with 20 Japanese university students for vocabulary review sessions. Findings obtained from this study indicated that 100% of the students said that it motivated them and helped them to enjoy vocabulary learning. It also led to increased collaboration with classmates. Finally, Okumuş et al. (2020) carried out a study to examine the effect of using mobile phone on EFL students' vocabulary learning in Turkey. Using a quasi-experimental design, researchers implemented a mobile application in the experimental group for 14 weeks. Findings revealed that using mobile phones had a significant impact on students' vocabulary retention.

Despite the positive findings, Zhang et al. (2011) found that there were some problems that students reported. One of these problems was related to the nature of technology. Another problem was that the students felt deconcentrated or distracted as they received continuous messages at the specific period of the day. The participants in the study of Fujimoto (2012) have expressed negative feelings about using mobile devices for educational purposes due to screen size, cost of mobile devices, and limited functions of mobile devices. Furthermore, Hsu (2013) found that learners think that not all linguistic skills can be developed only through mobile devices. Additionally, Nami (2020) concluded that all language skills cannot be practiced equally via mobile applications.

In addition, Cojocnean (2016) conducted a survey and found that the vast majority of participants revealed neutral attitudes towards using mobile assisted learning tools in their vocabulary learning. In the follow-up focus groups with 43 participants, a lot of students represented a low usage of digital tools in their vocabulary learning. This was due to many reasons, like the lack of a culture pertinent to the use of digital tools in the language classroom and a lack of teacher guidance. Finally, Titova and Samoylenko (2017) carried out a research on the effect of mobile-testing system PeLe on developing language skills in the context of mobile-assisted language learning. The results of the study revealed that language classes with PeLe support led to an increase in language skills. Qualitative data analysis also emphasized the positive impact of mobile formative assessment on learners' motivation and collaboration skills.

Some studies have been conducted on the effect of mobile-assisted language learning on learners' vocabulary knowledge in Iran. Alavinia and Qoitassi (2013) investigated the effect of using MALL-operated vocabulary instruction techniques on vocabulary acquisition. The researchers chose 40 elementary learners studying at the Iran Language Institute, Iran. They used a variety of instruments including questionnaires, interviews, and a multiple-choice vocabulary test. The findings represented that treatment through the application of mobile-assisted vocabulary learning had been effective in improving learners' vocabulary learning. Pirasteh and Mirzaiean (2015) investigated the effect of SMS on learners' learning phrasal verbs. 75 students were selected for this study. They were assigned randomly into two experimental and control groups. Participants in control group received 25 phrasal verbs in a booklet and those in experimental group received 25 phrasal verbs via SMS. The results of this study represented that the experimental group outperformed the control group.

In another study, Fathi, Alipour, and Saeedian (2018) examined the impact of using mobile application (app) of Memrise on the learners' vocabulary learning. Fifty nine EFL learners participated in this quasi-experimental research. They were randomly assigned to experimental (N=33) and control (N=26) groups. During a 13-week semester, students in the experimental group used Memrise app to learn new vocabulary items, while those in the control group learned new words traditionally without using any technology or software. The findings showed that Memrise helped students improve their L2 vocabulary learning more than the control group.

In additiona, the findings of previous studies also show that mobile assisted vocabulary learning has significant potential in promoting intentional vocabulary, which is the main source of vocabulary learning for EFL learners (Zakian, 2022). Furthermore, Aliakbari and Mardani (2022) investigated the effect of mobile learning on EFL learners' speaking skill. Sixty students were assigned to two groups. One group participated in face-to-face classes, and the other took part in mobile learning classes through WhatsApp. The results indicated that the majority of students were satisfied with mobile learning classes, students in mobile learning classes performed better than the students in face-to-face classes, and mobile learning classes played a significant role in enhancing students' motivation to take part in class discussions.

METHODOLOGY

RESEARCH DESIGN

The design of the present study was quasi-experimental in which two non-equivalent groups were exposed to two different types of treatment. Generally, in this type of design, experimental and control groups are used. The experimental group(s) is given the specific treatment but the control group does not receive it. However, the experimental and control groups undergo take the same tests in the form of pre-test and post-test. MALL served as the independent variable of the study, and receptive and productive vocabulary knowledge as the dependent variables.

PARTICIPANTS

The participants of this study included 100 male/female (40 male & 60 female) Iranian intermediate EFL learners studying English at a private language institute, namely Andisheh Language Institute, Langroud, Iran who were selected to participate in the study based on convenience sampling in the form of two intact classes. The participants' age ranged from 17 to 25. In order to make sure of homogeneity, they were selected out of a pool of 140 based on their results on a Quick Placement Test (QPT) and were randomly divided into two groups of 50 students each. After that, the experimental group received treatment. In this study, the researchers used Beelinguapp as a educational app for the experimental group, whereas the control group used the traditional method to improve their vocabulary knowledge.

MATERIALS AND PROCEDURE

The following instructional and testing materials were used to answer the current study research questions.

MATERIALS AND PROCEDURE FOR THE PROFICIENCY TEST OF THE STUDY

Prior to beginning treatment, participants were required to take a placement test, QPT, to ensure that they were homogeneous in terms of their overall ability in language skills. The questions were adapted from Fischer's "Oxford University Press and University of Cambridge Local Examinations Syndicate" (2001). The QPT is made up of 60 multiple-choice questions. Reliability of the test was reported as .80 and its validity was confirmed through factor analysis (Wistner, Hideki, & Mariko, 2013). Following the administration of the QPT, 100 learners with an average total score of 30-39 were chosen as intermediate level learners. The time allocated for answering the questions was 30 minutes. The participant's level of language proficiency was determined using this measure. It should be highlighted that because QPT is a validated standard test, it does not need to be standardized again.

Material(s) and Procedure for the Pretest and Posttest of the Study

Two already validated equivalent Collocation Achievement Tests (CATs), originally developed by Salimi, Tavakoli, and Ketabi (2011) in a Ph.D. thesis and taken from Zare Behtash and Etehadi (2016) were used as the instruments in the present study to evaluate the receptive vocabulary knowledge of the participants. One of the tests was used as the pre-test and the other one as the immediate and delayed post-test. Each test consisted of 30 fill in the blank items in the form a sentence in which one word was omitted and there was a word or phrase in bold type. The missing word together with the bold type word or phrase constituted a collocation. A Persian equivalent of the collocation in question was also provided at the end of each sentence as a clue. Reliability and

validity of the tests have been confirmed by Salimi, Tavakoli, and Ketabi (2011). For the purpose of this study, Cronbach's Alpha reliabilities of the tests were .76 and .81.

The Vocabulary Knowledge Scale (VKS) was used to evaluate the productive vocabulary knowledge of the participants. It was developed by Paribakht and Wesche (1993). The purpose of this scale was to measure the enhancement of vocabulary through extensive reading. The test was a 5-point scale report and performance items are used to obtain demonstrated and self-perceived knowledge of specific vocabulary words usually in written form. The scale ratings ranged from entire unfamiliarity, little recognition of the word, little idea of its meaning and to the ability to actually use the word in context with grammatical and semantic accuracy. The scale basically measures the progressive degrees of vocabulary knowledge. Level I tell what learners do not know whereas next three levels, II, III, and IV measure the vocabulary recognition. The levels measure the actual use of word in a sentence which is called productive vocabulary.

The participants were given target words lists and explained how to demonstrate their level of knowledge for each, and for self-report levels IV and V, to show this knowledge. VKS scoring allows categories I and II to give scores 1 and 2 for self-reported word knowledge but needs a display of knowledge for higher scores. Score 2 was given to categories III, IV and V for incorrect responses in the self-report. For correctly identifying synonyms or meanings score 3 was awarded for categories III and IV. If words had been used in the right context but with wrong grammar then Score 4 was given. Score 5 was given where the vocabulary word was used correctly grammatically and semantically.

Paribakht and Wesche (1993) determined the reliability of the VKS through testing and retesting of a word list (contained N=32) to 93 different participants with 6 different proficiency levels. The VKS sheet with thirty vocabulary words was given to the participants at the start of the study. They had to put a tick in front of the option they think is right. There were five options in front of each word. This scale helped the researchers to find out the vocabulary level of the participants before starting the treatment procedure. To establish learner's overall vocabulary size after the completion of the treatment procedure, VKS was used once again where participants had to tick the options given in front of the vocabulary words which were counted or measured later according to the scale. Finally, these two scales were compared to find out the enhancement participants' vocabulary.

Material(s) and Procedure for the Treatment of the Study

As it was mentioned before, the researchers used Beelinguapp as an educational app for the experimental group, whereas the control group used the traditional method (given paper word cards) to improve their vocabulary knowledge. Beelinguapp is a language-learning mobile application. It works by showing a text to the user in two languages simultaneously, allowing the users to use their native language as a reference. It works also as an audio book, users listen to a recording of a voice reading a text while at the same time a karaoke style animation moves through the text in both languages. The app offers different kinds of texts across 12 languages; with additional languages in development. Beelinguapp app is available on Android and IOS.

This mobile app worked under two concepts it called "Side by Side Reading" and "Karaoke Reading." The "Side by Side Reading" showed the user a text in a split screen in two languages side by side, the idea being that the user read a text in the language being practiced but can always use their native language as a reference. "Karaoke Reading" meant that the audio will be playing while the user is reading and a karaoke-style animation will be shown in both the learning and reference languages. Figure 1 illustrates some pictures form the app.

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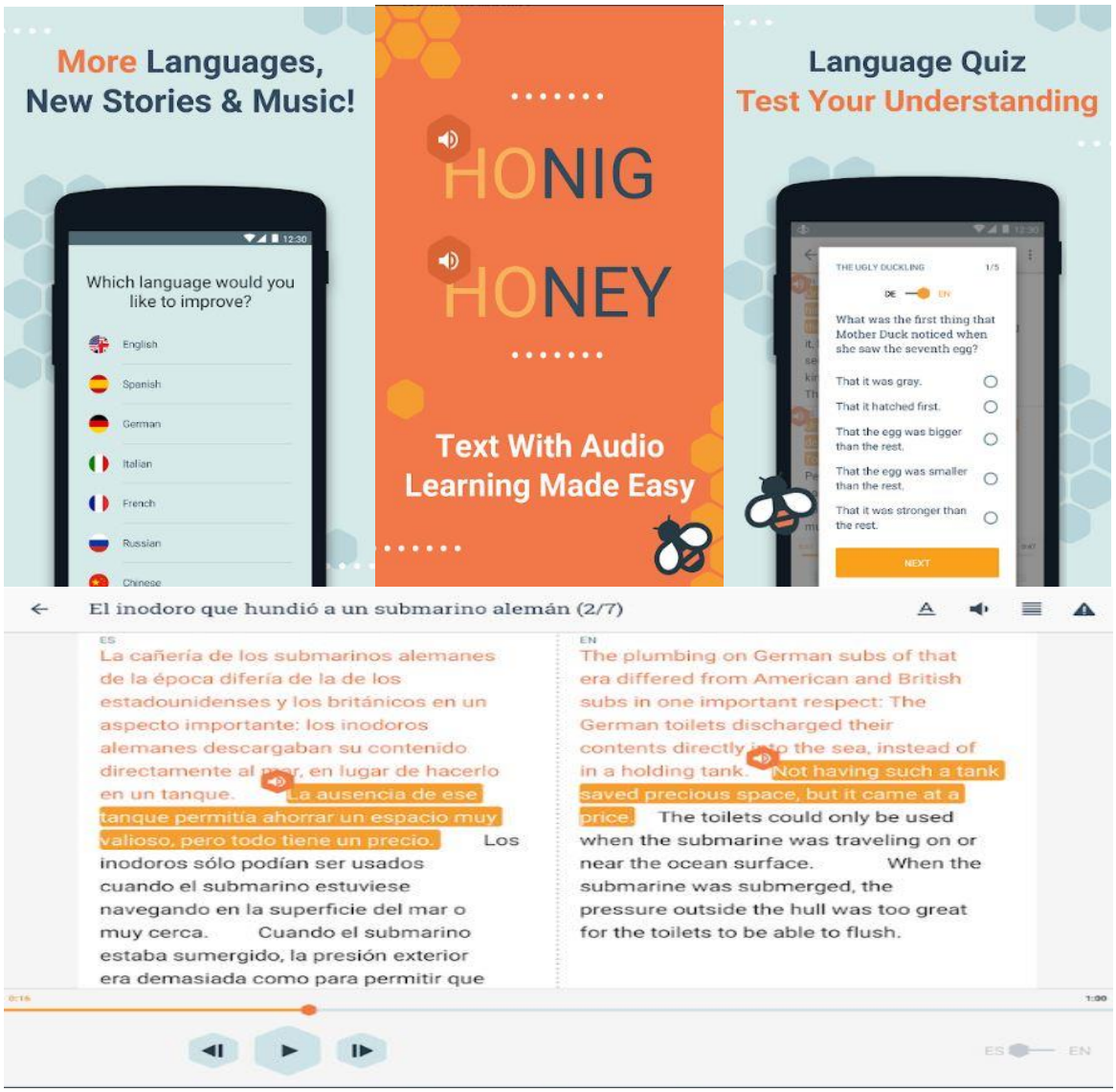

Figure 1 *Pictures of Beelinguapp used by the experimental group*

The whole study took for four weeks, each week for two sessions, and each session for 30 minutes in which the researchers focussed just on vocabulry knowledge of the participants. There were also two sessions for administration of the pretest and the posttest.

Data Analysis

In order to provide an answer to the research questions, the collected data of the current study were examined using SSPS 25 program. Both descriptive and inferential statistical tests were calculated. Before analyzing the data, firstly the normality of scales was tested in order to decide which test would be used. Paired sample t-test, independent sample t-test, and ANCOVA were used for analysing the data on CAT but Wilcoxon signed and Man Whitney u tests were used for the data obtained through VKS.

FINDINGS

The current study data were mainly quantitative in nature, and they were subjected to a variety of statistical analyses using the SPSS software. The descriptive statistics of the study are measured first, followed by the inferential statistics.

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Descriptive Analysis of the Data

The descriptive statistics were used to display and describe the data, as well as to calculate statistical results analytically. To ensure a homogeneous sample, 140 EFL learners were chosen, and 100 learners with QPT exam scores ranging from 30-39 were chosen for the main study. These 100 students were divided into two groups: experimental and control. Table 1 shows the result of the QPT.

Table 1
Statistics for the Results of QPT

N	**Valid**	140
	Missing	0
Mean		34.73
Median		34.00
Mode		32
Std. Deviation		5.937
Variance		35.250
Skewness		.929
Std. Error of Skewness		.205
Kurtosis		.935
Std. Error of Kurtosis		.407
Range		28
Minimum		24
Maximum		52
Sum		4862
Mean		34.73

Table 1 displayed the group statistics and numerical information for the QPT scores that were used to select a homogeneous sample of participants from a pool of 140 EFL learners. The QPT included measures of central tendency such as mean, median, and mode, as well as measures of dispersion such as range, variance, and standard deviation, as well as measures of distribution. The QPT scores were obtained from 140 respondents, with a mean of (34.73) and standard deviation of (5.937). Following that, both groups took a pretest of CAT and VKS to see if there were any early differences in their level of receptive and productive vocabulary knowledge. The pretest results were entered into the SPSS datasheets. The findings of the pretest are summarized in Table 2. Figure 2 depicts the differences in pretest means between the experimental and control groups.

Table 2
Descriptive Statistics of the Pretest Scores

Test	Groups	N	Minimum	Maximum	Mean	Std. Deviation	Variance
CAT	Control	50	14	23	17.04	2.407	5.794
	Experimental	50	13	22	17.14	2.268	5.143
VKS	Control	50	36	65	48.34	7.436	55.290
	Experimental	50	32	65	47.48	8.024	64.377
Valid N (listwise)		50					

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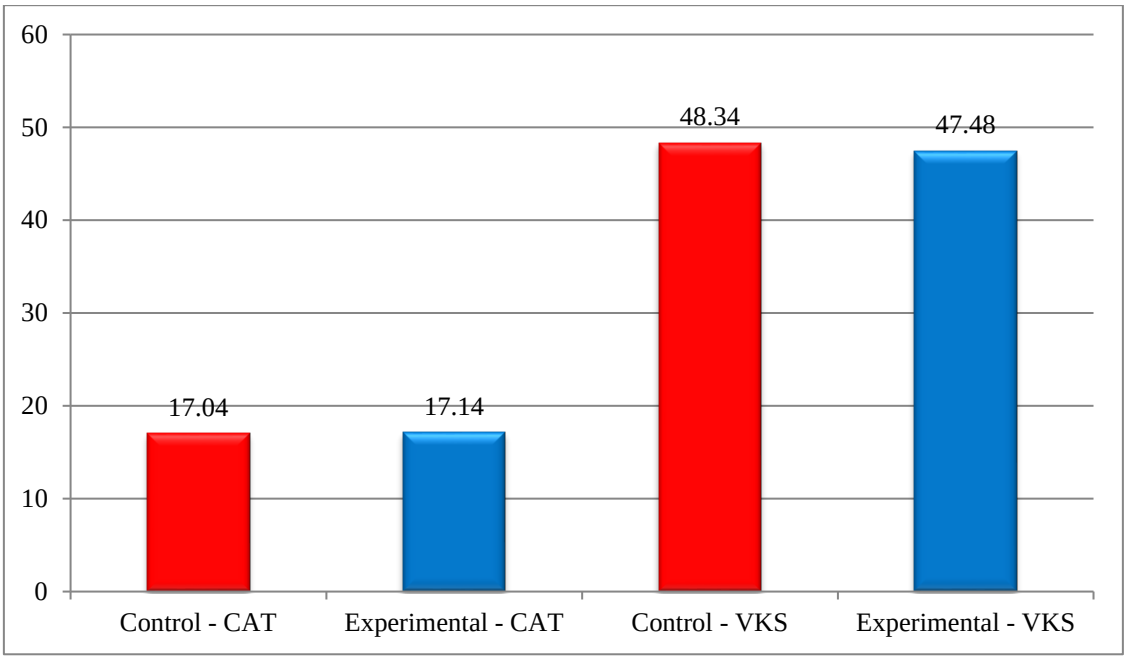

Figure 2 *The means plot for the pretest means of the study groups*

As shown in Table 2, the experimental and control groups' scores in both tests were very close to each other. Furthermore, it can be seen that the participants' performance on the tests was uninspiring. Finally, at the end of the study, the participants took the posttest. The posttest results were entered into the SPSS data view tab. The posttest data are shown in Table 3. Figure 3 shows the differences in the means of the posttest scores between the experimental and control groups.

Table 3
Descriptive Statistics of the Posttest Scores

Test	Groups	N	Minimum	Maximum	Mean	Std. Deviation	Variance
CAT	Control	50	15	25	17.90	2.605	6.786
	Experimental	50	20	28	24.06	1.942	3.772
VKS	Control	50	35	72	52.94	8.837	78.098
	Experimental	50	40	80	62.30	9.709	94.255
Valid N (listwise)		50					

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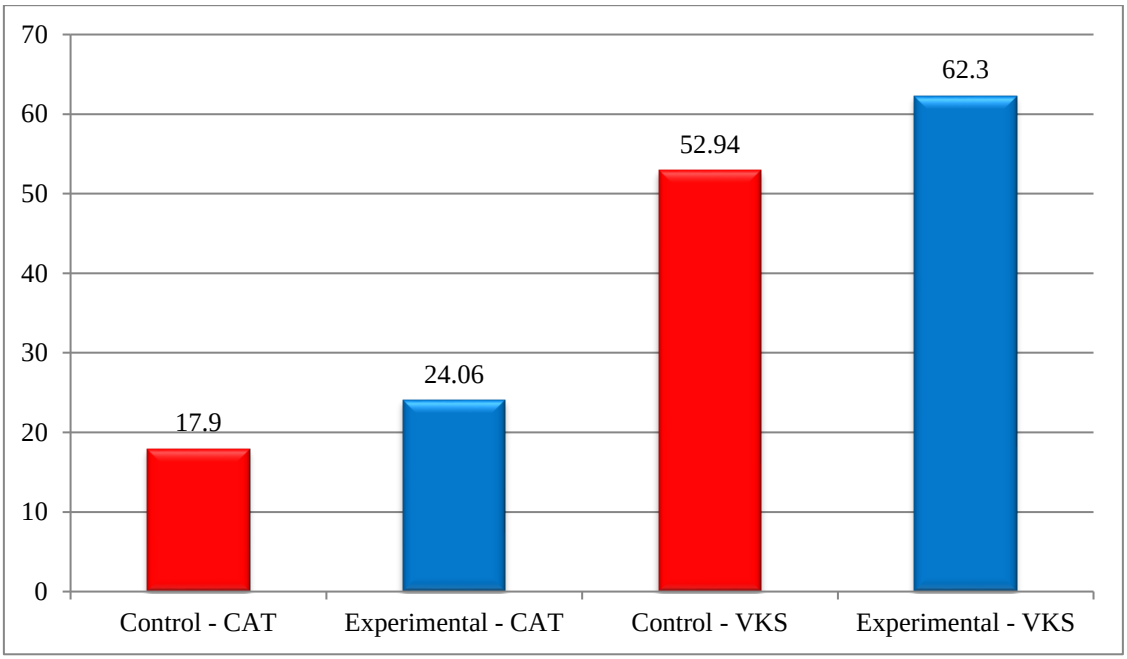

Figure 3 The means plot for the posttest means of the study groups

As shown in Table 3, the experimental group's mean score in both CAT and VKS tests were higher than the control group in the posttest. It means that learners who used mobile-assisted vocabulary learning approach to learn receptive and productive vocabulary knowledge had better scores than the control group, and as a result, they performed better on the posttest.

Inferential Analysis of the Data

Before running the specific tests chosen to answer the research questions, the assumption of normality for the dependent variables (i.e., CAT and VKS test scores) was examined. To test the assumption of normality, the Shapiro-Wilks test, which is typically tested at (α=.01) level of significance was used. The Shapiro-Wilks test is a statistical test of the hypothesis that sample data have been drawn from a normally distributed population (Pallant, 2010). The Sig. (p) values were compared to the alpha level of the significance for the statistic and the decision was made as to reject ($p < \alpha$) or retain ($p > \alpha$) the null hypothesis.

Table 4
Tests of Normality for the Pretest and the Posttest Scores of CAT and VKS

	Groups	Shapiro-Wilk		
		Statistic	df	Sig.
Pretest	Control - CAT	.901	50	.301
	Experimental - CAT	.933	50	.207
	Control - VKS	.846	50	.196
	Experimental - VKS	.943	50	.118
Posttest	Control - CAT	.955	50	.153
	Experimental - CAT	.972	50	.283
	Control - VKS	.974	50	.336
	Experimental - VKS	.973	50	.302

The findings of the Shapiro-Wilks test for the pretest scores showed that the value of (p) for the control group (CAT) equaled (p = .301), for the experimental group (CAT) came to (p = .207), for the control group (VKS) equaled (p = .196), and for the experimental group (VKS) equaled (p = .118). When it comes to the posttest scores, the values of (p) for the control group (CAT) equaled (p = .153), for the experimental group (CAT) came to (p = .283), for the control group (VKS) equaled (p = .336), and for the experimental group (VKS) amounted to (p =

.302). Given the aforementioned (p) values for the Shapiro-Wilks test and using (α = .01), it was concluded that each of the levels of the dependent variables (CAT and VKS test scores) were normally distributed. Therefore, the assumption of normality had been met for these samples.

After examining the normality assumption, to answer the first research question of the study, the results of CAT was evaluated by using paired sample t-test, independent sample t-test, and ANCOVA. First of all, an independent-samples t-test was used to determine whether there is a statistically significant difference between the pretest scores of CAT for the control and experimental groups. The results of the independent-samples t-test for the pretest scores of both groups are shown in Table 5 below.

Table 5
Results of the Independent-samples T-test Reported for the Pretest Scores of CAT

		Levene's Test		**t-test for Equality of Means**						
		F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**	**95% Confidence Interval of the Difference**	
									Lower	**Upper**
Pretest scores	Equal variances assumed	.027	.871	-.214	98	.831	-.100	.468	-1.028	.828
	Equal variances not assumed			-.214	97.654	.831	-.100	.468	-1.028	.828

As shown in Table 5, the two-tailed sig of the test is "0.831," which is much higher than the assumed p value of "0.05," implying that there is no significant difference between the groups. As a result, by considering that there was no significant difference between the two groups, each group received specific treatment to learn receptive vocabulary knowledge. Then, another independent-samples t-test was conducted between the posttest scores of CAT for the control and experimental groups to demonstrate the differences between them at the end of the process. Table 6 shows the outcome of the independent-samples t-test.

Table 6
Results of the Independent-samples T-test Reported for the Posttest Scores of CAT

		Levene's Test		**t-test for Equality of Means**						
		F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**	**95% Confidence Interval of the Difference**	
									Lower	**Upper**
Prosttest scores	Equal variances assumed	.455	.502	-4.792	98	.000	-2.360	.492	-3.337	-1.383
	Equal variances not assumed			-4.792	96.625	.000	-2.360	.492	-3.337	-1.383

As revealed in Table 6, the two-tailed sig of the test is "0.000," which is significantly less than the predetermined p value of 0.05. As a result, it is possible to conclude that there is a significant difference between the groups. In another sense, the value of T is "-4.792," which is less than the critical value (-.1.96). As a result, the study null hypothesis is rejected, and it is possible to conclude that the treatment was effective. Following that, Paired-samples t-tests were run between the pretest and posttest scores of both groups in an attempt to measure the amount of progress they made over the course of the study. Table 7 represents the results of the tests.

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Table 7
Results of the Paired-samples T-test Reported for the Experimental and Control Groups

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Control group	-.860	1.107	.157	-1.175	-.545	-5.495	49	.000
Pair 2	Experimental group	-6.920	2.069	.293	-7.508	-6.332	-23.654	49	.000

As depicted in Table 7, the two-tailed sig reported for statistical significance of the mean difference of the two groups of experimental and control are lower than the predetermined amount of p value, which is 0.05. As a result, it is possible to argue that there is a statistically significant difference in the participants' level of receptive vocabulary knowledge before and after the tests in both groups separately. The implication is that both groups made significant progress over the course of the study, though the experimental group gained more than the control group.

Finally, the data collected in the first phase of the study were inferentially analyzed using a one-way analysis of covariance (one-way ANCOVA) for answering the first reseach question. According to Tabachnick and Fidell (2013), this statistical technique assumes a lack of univariate and multivariate outliers, normality of subgroups' distributions, homogeneity of variances, reliable measurement of the covariate prior to the treatments, and linearity and homogeneity of regression slopes. Preliminary checks showed that all these requirements were met and no meddlesome violations were observed. Table 8 shows the results of the tests of between-subjects effects.

Table 8
Resulsts of the Tests of between-subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	442.848[a]	2	221.424	73.932	.000	.604
Intercept	69.647	1	69.647	23.255	.000	.193
Pretest of CAT	303.608	1	303.608	101.372	.000	.511
Groups	130.439	1	130.439	43.553	.000	.310
Error	290.512	97	2.995			
Total	37138.000	100				
Corrected Total	733.360	99				

a. R Squared = .604 (Adjusted R Squared = .596)

The results of "Sig." column in the group row provides the statistical significance value (i.e., p-value) of whether there are statistically significant differences in treatment (i.e., the dependent variable) between the groups (i.e., the independent variable) when adjusted for treatment (i.e., the covariate). As it was shown in Table 8, there is a statistically significant difference between adjusted means ($p < .0005$). It should also be noted that the significant F-value associated with the covariate (pretest) ($F = 73.932$, $p < .05$, partial $\eta 2 = .604$) indicated that the pretest was correctly chosen as a covariate, i.e. it had a significant role in this model and could explain about 60.4 percent of the variation in the posttest scores. Now, post-hoc comparison tests were employed in order to compare the groups two by two to locate the exact place of the differences that is illustrated in Table 9.

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Table 9
Pairwise Comparisons for Posttest Scores by Study Groups

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
A	B	-2.285*	.346	.000	-2.972	-1.598
B	A	2.285*	.346	.000	1.598	2.972

The pairwise comparisons indicated that Group B that received MALL vocabulary teaching (adjusted M = 24.06) significantly outperformed Group A (adjusted M = 17.90) on the posttest of CAT (Mean Difference = 2.285, p < .05). Thus, it can be cocluded that the use of mobile applications are effective in improving Iranian intermediate EFL learners' receptive vocabulary knowledge. For evaluating the results of the data obtained through VKS, Wilcoxon signed and Mann-Whitney U tests were used. The Mann-Whitney U test is used to compare differences between two independent groups when the dependent variable is either ordinal or continuous, but not normally distributed. When choosing to analyze data using a Mann-Whitney U test, part of the process includes ensuring that the data to be analyzed can actually be analyzed using a Mann-Whitney U test. The results of Mann-Whitney test is shown in Table 10.

Table 10
Results of the Mann-Whitney Test

	Groups	N	Mean Rank	Sum of Ranks
Posttest of VKS	1	50	37.81	1890.50
	2	50	63.19	3159.50
	Total	100		

The results of the above table indicated which group can be considered as having the higher level of productive vocabulary knowledge, overall; namely, the group with the highest mean rank. In this case, the experimental group had the highest productive vocabulary knowledge scores. Then, to show the actual significance value of the test, Test Statistics table is evaluated. It provides the test statistic, U statistic, as well as the asymptotic significance (2-tailed) p-value. The results of the test statistics are revealed in Table 11.

Table 11
The Results of Test Statistics

	Posttest of VKS
Mann-Whitney U	615.500
Wilcoxon W	1890.500
Z	-4.383
Asymp. Sig. (2-tailed)	.000
a. Grouping Variable: Groups	

From the above table, it can be concluded that productive vocabulary knowledge scores of the experimental group was statistically significantly higher than the control group (U = 615.5, *p* = .000). Finally, the results of Wilcoxon Signed-Rank Test are shown in Table 12. This test is used to compare two sets of scores that come from the same participants. It is used to investigate any change in scores from one time point to another.

Table 12
Results of Wilcoxon Signed-Rank Test

	Control – Pretest Control - Posttest	Experimental – Pretest Experimental - Posttest
Z	-4.252	-6.157
Asymp. Sig. (2-tailed)	.000	.000

A Wilcoxon signed-rank test showed that a 4 week, twice weekly treatment course elicited a statistically significant change in productive vocabulary knowledge scores of the control (Z = -4.252, p = 0.000), and the experimental (Z = -6.157, p = 0.000) groups. As a result, the treatment procedure for both groups resulted in a statistically significant difference in posttest scores.

Results of Hypotheses Testing

The results of the study hypotheses testing are presented and described in this section. The study results were used to support or reject the study hypotheses in order to provide a detailed analysis. Participants in the experimental and control groups took the pretest of CAT and VKS at the beginning of the procedure and the posttest at the end. An independent-samples t-test was performed in SPSS25 to determine whether there was a statistically significant difference in the pretest scores of CAT for the experimental and control groups. The results demonstrated that the two-tailed sig is greater than 0.05. This measure shows that there is no statistically significant difference between the performance of two groups on the pretest of CAT. An independent-samples t-test was used once more to see if there was a statistically significant difference between the results of the experimental and control groups on the posttest. As a result, the two-tailed sig was less than 0.05, indicating that there is a statistically significant difference between the posttest of CAT of the two groups. The first null hypothesis of the study was rejected based on these findings. To evaluate the second hypothesis of the study, the results of Mann-Whitney test and Wilcoxon Signed-Rank test were measured. The results of these two tests revealed that mobile applications can be served as effective tools in improving Iranian intermediate EFL learners' productive vocabulary knowledge. Thus, the second null hypothesis of the study was also rejected based on the findings of this study.

DISCUSSION

The purpose of this study was to determine whether mobile-assisted language learning (MALL) can help Iranian intermediate EFL learners improve their vocabulary learning ability. In recent decades, mobile-assisted language learning (MALL) has garnered substantial interest in Iranian EFL learners due to its pragmatic and functional applications. Such increased use of mobile technologies provides learners with abundant opportunities to interact, using language to meet everyday communication needs, and engage in different cultural experiences. Mobile devices have also been found to be significantly beneficial for establishing, organising, and personalising appropriate goals for learning as well as customising protocol designs for teaching (Li & Hafner, 2022).

On the other hand, knowing a word involves different aspects of vocabulary knowledge. One way of distinguishing various types of vocabulary knowledge is the receptive– productive dimension, which can help to estimate the level of mastery of comprehension and production of lexis (Schmitt, 2014). Kowledge of both receptive and productive vocabulary is essential for language ability. Both of them were improved through Beelinguapp and then measured through CAT and VKS. Based on the descriptive statistics of the study, the improvement of the two groups on total scores of both tests supported the findings of earlier studies that both paper word cards and mobile apps can provide an opportunity for effective vocabulary learning (Başoğlu & Akdemir, 2010; Dizon & Tang, 2017). Improvements observed are largely due to the effects of tratment procedure, in effect a type of learning activity that involves the process of recalling vocabulary-related information (e.g. form, meaning) previously encountered. The results are consistent with the finding of (Karpicke & Roediger, 2008) that retrieval of material significantly increases L2 vocabulary knowledge.

Both the mobile app and word cards presented the target items first, then required recall of the meanings and collocations afterwards. The process helped the students retrieve the items from their memory and gain access to new learning materials or correct their errors with feedback immediately and repeatedly, thus producing successful retention of vocabulary. The results further support previous research, which suggested that digital word cards provide a greater boost regarding learning outcomes when compared to physical word cards (Başoğlu & Akdemir, 2010).

Although the expanding rehearsal strategy, also known as the spaced repetition technique, can optimise learning with both tools, most learners in the control group were observed in the classroom to be unable to utilise the word cards to their best advantage effectively. The control group participants were directed to sort the cards into separate decks during the experiment, with the most difficult vocabulary items placed at the beginning of the sequence, as this would have helped the participants encounter the most difficult vocabulary items with more frequency. However, sorting the word cards by difficulty would have required the students to accurately evaluate their vocabulary knowledge levels using significant metacognitive abilities (Nakata, 2020). Alternatively, the

higher gains within the experimental group could have occurred because the mobile app with spacing algorithms afforded automatic assessment and analysis, relieving the experimental group participants from the burden of complex self-evaluation.

The findings of CAT showed that the use of mobile application affected receptive vocabulary knowledge of language learners positively. On the other hand, use of paper word cards did not have a significant effect on receptive vocabulary knowledge of the learners. Thus, when the groups were compared, it was seen that the participants of the experimental group were more successful than the control group in the posttests. This finding was parallel with other research studies that use different features and tools of mobile technology such as SMS, mobile applications, and other mobile systems generated by researchers. Studies of Alavinia and Qoitassi (2013), Liu and Chen (2015), Başoğlu and Akdemir (2010), Rahimi and Miri (2014), Wu (2015), Zhang et al. (2011), Lu (2008), Saran et al. (2012), Fathi, Alipour, and Saeedian (2018), and Zakian (2022) also showed that experimental groups using mobile technologies got higher scores in the posttest than control groups who studied vocabulary based on paper.

This was in line with the depth of processing theory (Craik & Lockhart, 1972), which states that the deeper level of cognitive analysis of the stimuli leads to more elaborate, stronger, and longer memory retention. The mobile app helped the users to retrieve the target word in the form of word-related collocation, and it also provided collocational exercises for revision, whereas gains in productive knowledge for the paper word cards group had to depend on the users' autonomy to direct their attention to the collocational information. It appears that productive knowledge was processed in more depth with the mobile app than the paper word cards.

The scores of the two groups indicated that the participants in the experimental group outperformed those in the control group in receptive vocabulary knowledge which confirms the findings in some previous studies (e.g. Başoğlu & Akdemir, 2010), but contradicts the findings in others (e.g. Nikoopour & Kazemi 2014). It was concluded that using mobile technologies was an effective way of learning vocabulary receptively. The studies of Zhang et al. (2011), Lu (2008), and Saran et al. (2012) showed that mobile technology was effective in learning vocabulary and in retention of these words. On the other hand, in the study of Alemi et al. (2012), experimental group using mobile technology achieved higher scores in the delayed test than control group while there was no significant difference between two groups in terms of posttest scores.

The outcomes of the present study also confirm those of Pirasteh and Mirzaeian (2015) who explored the efficacy of a subset of MALL, SMS on learning phrasal verbs among university students in Iran. In addition, the findings are in line with the study by Heidari-shahreza (2014) who studied the development of productive knowledge of vocabulary through implicit exposure. The results revealed that there were significant differences between lexicalized and non-lexicalized target words in the productive knowledge of associations. Titova and Samoylenko (2017) also found that immediate feedback which was given through PeLE (a mobile-testing system) was quite supportive and encouraging in terms of learning. The participants using mobile applications achieved higher scores in their posttest. On the other hand, control group using papers did not show improvement in their posttest.

CONCLUSION

This study aimed to determine the impact of mobile phone applications on the vocabulary learning of Iranian intermediate EFL learners and showed that there is a significant difference between the experimental group and the control group in terms of receptive vocabulary knowledge. However, this impact was not observed in retention test. The findings suggest some starting points for the development of future mobile assisted language learning apps. First, auditory presentation plays a crucial role in verbal information retention. The app in this study exposed the learners to native speaker pronunciation instructions when showing the form of the target word. Here, the multimodal, visual, and auditory presentation contributes to more successful recall of pronunciation. Future apps could follow this multimodal design, as it may benefit learners' phonological knowledge.

Furthermore, picture and video presentations could be incorporated into the design of mobile vocabulary learning apps. The temporal contiguity principle (Mayer, 2002) suggests that displaying pictures simultaneously with the corresponding words may help students achieve better learning results. Visual information provides learners with opportunities to construct the meaning of the words in a contextualised learning environment, reinforcing the connection between form and meaning. One of the educational conclusions of this study was to upgrade and promote the learner's attitude towards learning a second language through MALL. Therefore, it is effective to EFL learners to use their phones for learning a second language. After making several analyses, it was

found that traditional learning and acquisition of receptive and productive knowledge of vocabulary via MALL were not similar in learning because the group that took instruction through MALL outperformed the other group that received learning in traditional way.

When learners utilized digital instruments to be connected, they were capable to internalize context in order to learn. This connection and exchange of information can help learners develop the ability to create new knowledge at any point in time. The quick progress of technology affected many changes both in knowledge generally and learning a language particularly. Intermediate to advanced EFL learners often exhibit a greater need to learn vocabulary in a more comprehensive manner, particularly for academic purposes (e.g. listening to lectures, writing academic essays). Mobile-assisted vocabulary learning and assessment tasks are usually limited to the basic meaning of the word. Webb (2009) found that paired-associate learning improves learners' multiple vocabulary knowledge constructs. The application used in this study focuses on the knowledge of single form–meaning mapping and collocational use, but other word components (e.g. phonological knowledge, polysemous meaning) should also be incorporated by future apps.

By comparing the learning effects of receptive and productive word knowledge from a mobile app and paper word cards, this study adds to the ongoing research into mobile-assisted vocabulary learning and teaching. While most previous research on mobile-assisted vocabulary learning has focused only on the dimension of receptive knowledge, this study, in contrast, investigated both receptive and productive vocabulary knowledge. The study demonstrated that both mobile- and paper-based word cards tools benefited vocabulary learning. The results also suggest that additional encounters, a deeper level of analysis, and the effective practice of vocabulary usage could promote greater gains in productive knowledge with the app than with the physical word cards.

At the same time, there was some limited evidence that the receptive knowledge was strengthened better with the app. It is a common belief that vocabulary knowledge gradually shifts from receptive knowledge to productive knowledge on a developmental continuum. Therefore, attention and time on productive knowledge in the mobile-based vocabulary learning and recycling process make for a sensible pedagogical target. It seems necessary that future investigations are needed to explore the significance of mastering receptive and productive vocabulary knowledge for Iranian EFL learners. The teachers should pay more attention to teaching English vocabulary and attempt to extract the learner's consideration to learning them and assist students to learn them more efficiently.

Limitations of the Study

As with any research procedure, the present study had a number of problems by which the effect on the issue of generalizability of the results can be limited. One of the limitations of the study is that it did not administer a delayed test at an interval of longer than one week. Nakata (2017) recently found that the benefits of repeated retrievals facilitate L2 vocabulary learning continuously four weeks after the treatment. The population from whom the participants of the study were selected were intermediate learners, as well as a small range of age participated in the investigation. Because this study was carried out in one institute, a larger sample of participants could not be participated in the study. The last limitation of this study is learners' personal situation during the pre-test and posttest or in the process of treatment which can not be evaluated.

Suggestions for further Research

Smartphones, iPads, iPods, and laptops have all become commonplace in our daily lives. By changing how these devices are used to learn the language, self-regulated learning can be developed. Based on the study limitations, the following recommendations on vocabulary knowledge ability will be suggested:

- Future research could look into how mobile apps can be investigated from the standpoint of self-access learning. Students choose what they will learn, how they will learn it, and how they will evaluate their own progress. Students can use online resources to determine when and where they want to learn through self-access learning.
- Future studies should aim to test more target words if possible and assess whether the positive effects of both paper- and mobile-based word cards learning could be retained over a longer time span.
- Future research could use a larger sample size and different measurement instruments to explore how these factors affect vocabulary acquisition.
- Since the participants in this study were intermediate level learners, future research can be done on the other levels of proficiency.
- The additional surveys are necessary to investigate the consequences of the other social networks and

MALL tools on the learning and development of a second language.

- To determine whether mobile learning or e-learning is more effective, future studies at lower and higher levels could compare mobile-based and computer-based vocabulary tools.

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