Computer Assisted Language Learning Electronic Journal CALL (-EJ), 23(3), 314-333, 2023

The Effects of Mobile-Assisted Versus Paper-and-Pencil Concept Mapping on EFL Learners' Vocabulary Learning

Ardalan Kaveh (kaveh.ardalan1395@gmail.com)
Department of Foreign Languages, Shiraz Branch, Islamic Azad University, Shiraz, Iran

Ehsan Hadipourfard (e.ehadipour@gmail.com)
Department of Foreign Languages, Shiraz Branch, Islamic Azad University, Shiraz, Iran

Mohammad Bavali (mbvl57@gmail.com)
Department of Foreign Languages, Shiraz Branch, Islamic Azad University, Shiraz, Iran

Abstract

Teaching second language (L2) vocabulary plays an important role in both EFL and ESL contexts. The current study was conducted to investigate the effects of mobile-assisted versus paper-and-pencil concept mapping on EFL learners' vocabulary learning. To fulfill this objective, 90 Iranian EFL intermediate students were assigned into two experimental and one control groups, each involving 30 learners. The learners in one experimental condition were asked to draw concept maps a number of highlighted words in a text using mind mapping application after discussing the texts. The learners in the second experimental condition were also asked to draw concept maps of the same highlighted words through paper-and-pencil. Both experimental conditions received assistance on how to draw concept maps. The participants of the control group were provided with the same highlighted words without the opportunity for drawing concept maps. Vocabulary pre-test, post-test, and delayed post-test were administered to examine students' vocabulary improvement as a result of the treatment sessions. The findings of the study revealed that both mobile-assisted and paper-and-pencil concept mapping were effective for EFL learners' vocabulary acquisition meanwhile the mobile-assisted concept mapping condition proved more effective than the paper-and-pencil concept mapping for L2 vocabulary learning.

Keywords: vocabulary learning, concept mapping, mobile-assisted language learning (MALL), ubiquitous learning (U-learning), computer assisted language learning (CALL)

Introduction

Vocabulary learning has been regarded as one of the most important elements in English as a foreign language (EFL) context, and many instructors have focused on improving students' vocabulary learning. It plays a central role in language learning process and lack of vocabulary knowledge blocks language comprehension and also production (Nation, 2001; Nouri & Zerhouni,

2018). As Adamson (1993) and Collier (1989) stated, learners' success in an academic setting and language proficiency depends on their knowledge of vocabulary. EFL learners who have limited vocabulary knowledge usually face some difficulties in their communication (Al-khasawneh, 2019).

A substantial body of research has indicated that vocabulary learning is a significant component of language learning and helps people communicate effectively (e.g., Abraham, 2008; Hu & Nassaji, 2016; Pellicer-Sanchez, 2020; Rassaei, 2018; Tadayonifar et al., 2021). There are many techniques for teaching second language (L2) vocabulary. However, there are still some learners who have difficulty learning L2 vocabulary (Liu, 2016; Schmitt, 2010). It seems that due to a lack of vocabulary learning techniques, many EFL learners experience difficulties which may result in frustration. Accordingly, investigating other innovative techniques for teaching L2 vocabulary merits further attention.

One technique that particularly deserves further attention for language learning is mobile-mediated concept mapping. As a kind of technology-mediated concept mapping, it is different from the traditional or paper-and-pencil concept mapping in several ways. For instance, mobile-mediated concept mapping can be employed online or offline, that is synchronously or asynchronously. Moreover, mobile-mediated concept mapping can be used without the limitation of time and location and therefore can be helpful and effective for some specific instructional settings and purposes, including distance education.

Guastello et al. (2000) defined concept mapping a graphic organizer which is used to indicate the connection or relationship among the concepts or ideas. A number of previous studies provided evidence regarding the usefulness and effectiveness of concept mapping on L2 development (e.g., Kazemi & Moradi, 2019; Machida & Dalsky, 2014; Naderifar, 2018; Rassaei, 2019). However, to the best of the researchers' knowledge, few studies have compared the effects of mobile-mediated versus paper-based concept mapping on EFL learners' vocabulary learning.

Therefore, the goal of this study is twofold. The first goal of the present research is to study the effects of mobile-mediated concept mapping on EFL learners' vocabulary learning. The second aim of the study is to find out if EFL learners benefit from the mobile-mediated and paper-and-pencil concept mapping equally or differently.

Literature Review

Concept Mapping

Concept mapping is known as a diagram that indicates important ideas or concepts in a text along with connections among those ideas (Rassaei, 2019). They are used to help learners enhance their logical thinking and can be especially useful when maps are made in group settings (Haugwitz et al., 2010; Kwon & Cifuentes, 2009; Ritchhart et al., 2009). As Novak and Canas (2006) stated, concept maps involve some various shapes which are really appropriate for arranging and showing the connections among the ideas or concepts in a hierarchical order. In other words, they include different shapes, such as triangles, circles, boxes and etc. to show the connections among the ideas hierarchically which may lead to meaningful learning.

Concept mapping has its origin in Ausubel's assimilation theory which suggests that meaningful learning takes place as a result of relating new information and existing one. The notion of concept mapping was first developed by Novak at Cornell University to enhance students' understanding (Richardson & Fox, 2005). Several researchers (e.g., Liu et al., 2010; Nesbit & Adescope, 2006) state that concept maps are really beneficial for students because they enable them to review or recall information. Moreover, instructors can use concept maps with the aim of eliminating learners' misconceptions in various areas of education (Asiksoy, 2019).

Dunston (1991) and Readence et al. (1989) claimed that concept mapping technique as a visual organizer is effective for learners' understanding. Islim (2018) also stated that when learners are required to prepare concept maps, especially on a non-familiar topic, they are forced to relate previous information with existing one which results in meaningful learning better. Further, relating concepts or ideas to meaningful paths allows learners to make a coherent structure knowledge (Islim, 2018). Generally, concept mapping as a metacognitive technique can be useful to be employed in different fields such as education to increase learners' planning process.

One important characteristic that distinguishes concept mapping from other educational techniques is using the minimum of words. That is, since concept mapping provides learners with visual representation of concepts and interrelationship, it assists learners in learning subject matters much better in a more efficient manner (Chang et al., 2017; Erdem et al., 2009). According to Haugwitz et al. (2010), concept maps can be employed both individually and collaboratively to assess learning and also determine learners' misconceptions.

Several previous studies examined the effects of traditional paper and pencil concept mapping on L2 development (e.g., Kazemi & Moradi, 2019; Kaveh & Rassaei, 2016; Machida & Dalsky, 2014; Rassaei, 2019). All these studies showed that traditional classroom concept mapping is beneficial for improving L2 development. However, the results of the previous studies provided no evidence regarding the effectiveness of mobile-mediated concept mapping compared to traditional paper and pencil concept mapping and its influence on EFL learners' vocabulary learning. It seems that little is known on the effects of mobile-mediated versus paper-based concept mapping on EFL learners' vocabulary learning. Therefore, the present study aims to investigate the effects of mobile-mediated versus paper-based concept mapping on EFL learners' vocabulary learning to add more evidence to the present review of literature.

Vocabulary Learning and Concept Mapping

Vocabulary learning is a major part of L2 development and its importance has long been emphasized in second language acquisition. According to Rubin and Thompson (1994), "one cannot speak, understand, read or write a foreign language without knowing a lot of words, so vocabulary learning is at the heart of mastering a foreign language" (p. 79). Liu (2016) claimed that learners who are lack of vocabulary knowledge are usually faced with some big challenges and cannot communicate very well. Viera (2017) also stated that vocabulary is more important than grammar in language learning because the inappropriate use of vocabulary knowledge influences the whole communication while the grammatical errors just result in ungrammatical utterances.

Ghalebi et al. (2020) claimed that learners who do not know much vocabulary become reluctant to cope with language skills, especially reading and listening. As Harmer (1994) stated, "If language structures make up the skeleton of language, then it is vocabulary that provides the vital organs and the flesh" (p. 153). A number of previous studies (e.g., August et al., 2005; Kaveh & Rassaei, 2016; Harris et al., 2011) revealed that learning vocabulary is essential for both variation in the process of reading such as grammatical processing, schemata construction and overall academic progress.

Yaccob et al. (2019) claimed that EFL learners who know much vocabulary will not experience difficulties or barriers in forming their linguistic skills. In fact, learners who know more vocabulary are able to increase their language skills as well as thinking abilities (Schmitt, 2002). Knowledge of vocabulary contributes to learning four language skills, especially reading (Al-Khasawneh, 2019). Laufer (1997) stated that without comprehending the text's vocabulary, no EFL learner is able to understand the text even in his/her native language which indicates the primary role of vocabulary, particularly in reading comprehension.

Dilek and Yurk (2013) stated that the more words people know, the better they can express their ideas and also communicate with others. In other words, people cannot communicate effectively without knowing enough words. Successful learners always use disciplines and techniques to learn vocabulary (McCarthy, 1990). Cook (2013) remarked that vocabulary development usually occurs in contexts where learners are provided with opportunities to retrieve, recall, and employ the target vocabulary items across various settings. Kayi-Aydar (2018) also claimed that the nature of vocabulary development is multi-faceted, meaning vocabulary development consists of the knowledge not only meanings, but also grammatical properties, spelling, pronunciation, morphological options, connotations, and semantic association of the words. Based on the above review, it can be stated that vocabulary is an essential element of language learning and it should be taken into consideration in second language (L2) classrooms.

With regard to vocabulary learning and concept mapping, some studies have examined the effects of concept mapping on EFL learners' vocabulary learning. For example, Kaveh and Rassaei (2016) investigated the effect of concept mapping on Iranian EFL learners' vocabulary learning and strategy use. The results of the study showed that concept mapping was effective for EFL learners' vocabulary learning and strategy use. Zahedi and Abdi (2012) also examined the effect of semantic mapping strategy on EFL learners' vocabulary learning. The outcome revealed that semantic mapping was beneficial for students' vocabulary knowledge. In another study, Dilek and Yurk (2012) conducted a study on using semantic mapping technique in vocabulary teaching at pre-intermediate level. The findings indicated that concept mapping promoted learners' vocabulary knowledge. Thaledon (2020) examined the use of semantic mapping to improve vocabulary comprehension. The results revealed that concept mapping was useful for the experimental group's participants.

Technology-Mediated Concept Mapping

With the emergence of technology in various areas of education, several studies have been done to investigate how different kinds of technology could help EFL learners enhance their language skills (e.g., Bashori et al., 2021; Beyranvand & Rahmatollahi, 2021; Hermagustiana &

Rusmawaty, 2017; Kilickaya & Seferoglu, 2013; Taj et al., 2017; Zaini & Mazdayasna, 2014). Among all the technological devices available to both learners and teachers, mobile-assisted language learning (MALL) has received much attention in recent years. Kukulska-Hulme (2018) defined MALL as the use of smartphones in language classrooms. Klopfer et al. (2012) stated that mobile phones have some distinctive features, including ubiquity, cost-effectiveness, accessibility, multimedia capabilities, interactivity, internet connectivity, and portability which distinguish them from other technological tools.

McQuiggan (2012) claimed that mobile learning (M-learning) is effective for learners because it helps them deal with the subject matters better and do their assignments without the limitation of time and place. Further, instructors can use mobile phones to improve their instructional process (Hashim et al., 2017). Regarding technology-mediated concept mapping, several studies have investigated the effects of computer-mediated concept mapping on different aspects of L2 learning. For instance, Liu et al. (2010) examined the impact of a computer-mediated concept mapping learning strategy on EFL college learners' English reading comprehension. The findings revealed that computer-based concept mapping was more beneficial for the low-level condition than the high-level one. In addition, the outcome of the study indicated that computer-mediated concept mapping learning strategy enhanced students' use of other English reading strategies-listing, reviewing, and enforcing.

In another study, Chen and Hwang (2020) examined the effects of concept-mediated flipped learning approach on EFL learners' English-speaking performance, critical thinking awareness, and speaking anxiety. The results of the study revealed that concept mapping was beneficial for EFL learners' English speaking performance and critical thinking awareness, and also decreased students' speaking anxiety. Another study which examined the impact of computer concept mapping instruction on Iranian EFL learners' writing performance: complexity and accuracy in focus was conducted by Mashhadi et al. (2021). The findings of their study indicated that computer-mediated concept mapping had positive effects on EFL learners' writing performance.

Abd Karim et al. (2019) also investigated the effects of using mobile-mediated mind mapping technique on the development on undergraduate learners' writing performance. The outcome of the study showed that employing mobile-based mind mapping technique was an effective tool for undergraduate learners and enhanced their writing performance. Despite previous studies have provided positive evidence regarding technology-mediated concept mapping on L2 development, mobile-assisted concept mapping seems to receive less attention in L2 settings and thus little is known on the effects of mobile-mediated versus paper-based concept mapping on EFL learners' vocabulary learning. To this end, the following research questions guide the current study:

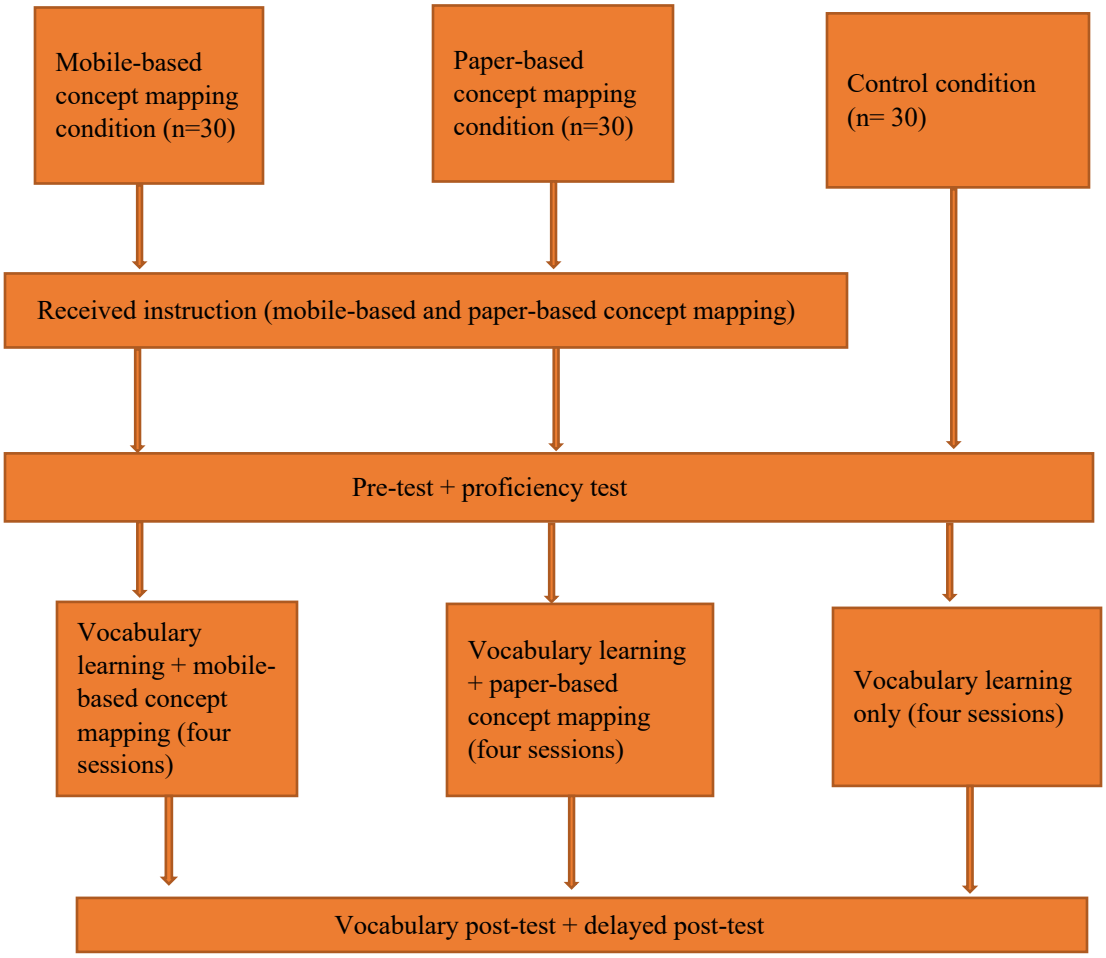
1) Does mobile-assisted concept mapping promote EFL learners' vocabulary knowledge?
2) Is there any statistically significant difference between the effectiveness of mobile-assisted and paper-based concept mapping for vocabulary learning?

Methodology

Design

The present study adopted a quasi-experimental design, including a pre-test, post-test, and also delayed post-test with Iranian EFL learners of the three intact classes being assigned into two experimental groups and one control condition. The placement test was held four days before the study while the vocabulary knowledge test was administered to learners one day before the first treatment session. The purpose of administering the vocabulary knowledge test was to find out to what extend the participants were familiar with the target words. In order to show the participants of the experimental groups how to install concept mapping application on their mobile phones and also draw paper-based concept mapping, the researchers asked the learners of both experimental conditions to attend an instruction session which took about forty-five minutes. Then, four treatment sessions were conducted for two weeks. The two experimental conditions were then designated as (a) mobile-mediated concept mapping condition, and (b) paper-and-pencil concept mapping. All the participants took the post-test in the last treatment session and the delayed post-test one week after the last treatment session. Figure I indicates the design of the current study.

Figure I. *Design of the current study*



Participants

Three EFL intermediate level classrooms in Iran provided the participants for the present study. The original number of participants enrolled in these classes was 120. After the administration of placement test, learners who did not meet the criterion for being assigned into mobile-mediated and paper-based concept mapping conditions were excluded from the study. Therefore, 90 participants were chosen as the final sample and were assigned into mobile-mediated and paper-and-pencil concept mapping groups. All the participants were female ranging in age from 20 to 33 and had experienced 4 to 5 years of learning English as a foreign language. Further, all the learners stated that they were familiar with WhatsApp technology which they claimed that they employed regularly for different objectives. Table 1 shows the number of participants and also the name of the conditions.

Table 1. *The number of participants and the conditions.*

	Name of Condition	Number
1.	Mobile-mediated concept mapping condition	30
2.	Paper-and-pencil concept mapping condition	30
3.	Control condition	30

Research Instruments

To examine the impact of mobile-mediated versus paper-and-pencil concept mapping on EFL learners' writing fluency, the following instruments were used for the purpose of data collection.

Michigan Language Proficiency Test

To find out if the participants had the same level of language proficiency, The Michigan language proficiency test (https://michiganassessment.org) was administered to them. The test consisted of three parts: 40 grammar items in a conversational format, 40 vocabulary items requiring the selection of a synonym or completion of a sentence, and 20 comprehension questions followed by reading passages. All the learners of the study were required to read and answer all the parts carefully.

Vocabulary Knowledge Test

This test was used in the current study to measure the participants' knowledge of the target words as pre-test, post-test, and delayed post-test. For each of the above tests, the researchers first provided the participants with a list of 25 words and then asked them to show whether they were familiar with those words by writing their Persian equivalences. Therefore, the learners' pre-test, post-test, and delayed post-test were quite similar but completely different from each other. Twenty minutes was allotted for each test. All the words were selected from the researchers' judgment based on the learners' level.

Procedure

The researchers asked the participants of both experimental conditions to attend a forty-five instructional session to find out how to do mobile-mediated and paper-based concept mapping. To achieve this, one of the researchers asked the participants of the mobile-mediated concept mapping condition to install the mind mapping application on their mobile phones and paper-based concept mapping group to take out a paper and pencil. Then, the researcher started talking about concept mapping and also showing the learners how to do and draw the mobile-mediated and classroom concept mapping. The researcher then presented the learners with a text that included 10 highlighted words and asked them to read and discuss it. After reading and discussing the text, the researcher drew the concept map of the highlighted words through both the mobile-mediated and paper-based concept mapping. To ensure all the learners have learned how to do mobile-mediated and paper-based concept mapping, the researcher gave another text to the students and asked them to draw the concept map of it.

Mind Mapping Application

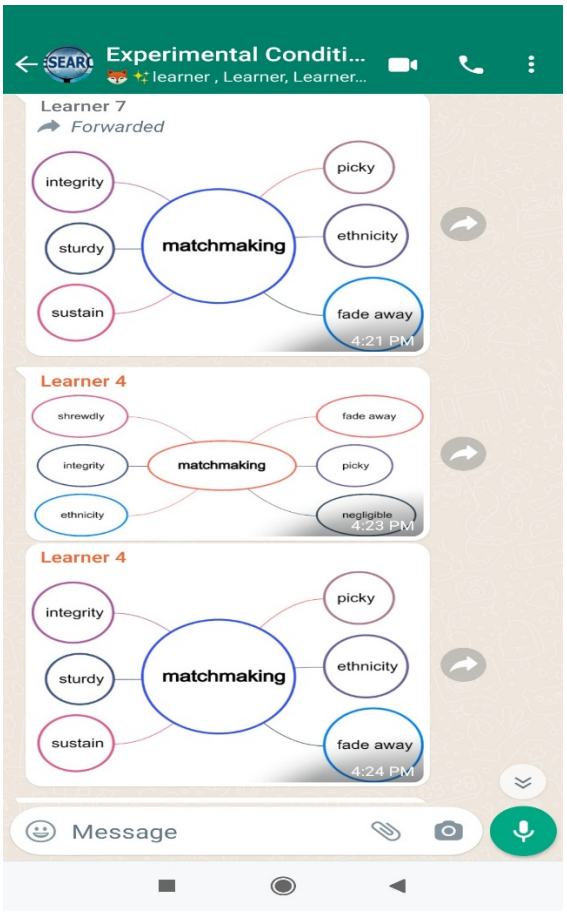
Mind mapping application was employed for the purposes of the present study. It consists of some concept maps that can be easily created and stored without the limitation of time and place. It should be stated that all the concept maps can be easily shared and edited with various shapes in the mind mapping application. All the learners are able to download and install the mind mapping application on their mobile phones and computers without any difficulties. The learners of the mobile-mediated condition used circle-shaped parts for the vocabulary items in the current study.

The Mobile-Assisted Concept Mapping Group

The learners of this condition first joined a WhatsApp group and accessed it via their mobile phones. Each mobile-assisted concept mapping session was already arranged with the learners. During each treatment session, the instructor sent a passage that included some highlighted words to the group and asked them to look at the words carefully online. Then, the instructor started asking them some questions about the highlighted words through a text message. The teacher then drew learners' attention toward any confusing words that seemed difficult to

learners. After making sure that all the learners could understand the difficult or confusing words, the instructor asked each participant to draw the concept map of that passage separately via the aforementioned application and send the mobile-based concept map of the words to the group. Finally, the instructor went through all the learners' files to let them know about their problems such as misspelling, use of incorrect words, connecting word meanings and etc. Figure II shows one screenshot of the interaction between the instructor and the learners.

Figure II. *Screenshot of the interaction between the instructor and the learners.*



Paper-and-Pencil Concept Mapping Condition

The current study also involved a paper-based concept mapping group in addition to the mobile-based concept mapping and control conditions to better investigate and compare the impact of mobile-based and paper-based concept mapping instruction on the development of L2

vocabulary learning. Similar to the mobile-mediated concept mapping condition, the learners in the paper-based group were provided with the same passage that consisted of some highlighted words for each treatment session and were required to look at the words. Then, the teacher began to ask the learners some questions regarding the highlighted words in the classroom. The instructor then tried to draw all the students' attention toward the words that were really difficult for the learners. After making certain that all the learners were able to comprehend the words, the teacher asked the learners to draw the concept map of the words through a paper and pencil concept map. In the end, the teacher checked all the students' concept maps to see if they did them correctly.

Control Group

For this condition, the students were just presented with the passages given to the other conditions and were asked to look at the words very carefully and also discuss them. In other words, the instructor just provided the control group's participants with the passages that included some highlighted words that were provided to both experimental conditions and asked them to discuss and also understand the words conventionally, without receiving the instruction.

Data Analysis

After obtaining the participants' scores concerning the impact of mobile-mediated versus paper-based concept mapping on EFL learners' vocabulary learning, one-way ANOVAs were run with the aim of analyzing and identifying the conditions' differences as a result of instruction in the pre-test, post-test, and delayed post-test.

Results

Effects of Mobile-Mediated versus Paper-based Concept Mapping on EFL Learners' Vocabulary Learning

As it is evident in Table 2, the mean scores of the three conditions on vocabulary learning are similar to each other. The mean score for mobile-based concept mapping group is (M= 10.66), the mean score for paper-based concept mapping group is (M= 10.63), and the mean score for the control group is (M= 10.60). This indicates that the conditions were almost the same in terms of L2 vocabulary knowledge. To see whether there were any statistically significant differences among the participating conditions, one-way ANOVA was performed on the learners' pre-test scores. The results of one-way ANOVA showed no statistically significant differences among the three conditions in the pre-test.

Table 2. *Descriptive statistics for the learners' pre-test, post-test, and delayed post-test*

		Pre-test		Post-test		Delayed post-test	
Condition	**N**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Mobile-based concept mapping	30	10.66	.71	22.40	.77	20.66	.80
Paper-based concept mapping	30	10.63	.76	19.23	.72	18.13	.77
Control	30	10.60	.77	10.63	.71	10.83	.87

Table 3. *ANOVA summary for the learners' pre-test scores.*

	Sum of Squares	df	Mean Square	F	Sig
Between Groups	.067	2	0.33	.059	.942
Within Groups	48.883	87	.561		
Total	48.900	89			

As Table 2 indicates, both experimental conditions, namely the mobile-mediated and paper-based concept mapping outperformed the control group. A one-way ANOVA was run on the participants' post-test score to see if the differences among the three participating conditions were statistically significant. Table 4 illustrates the outcome.

Table 4. *ANOVA summary for the participants' mean scores.*

	Sum of Squares	df	Mean Square	F	Sig
Between Groups	2224.422	2	1112.211	2035.674	000
Within Groups	47.533	87	.546		
Total	2271.956	89			

The data analysis of the participants' post-test scores revealed statistically significant differences among the conditions on the post-test since the P value is less than < 0.05. Therefore, it can be concluded that there is a statistically significant difference among the performance of the learners in the pre-test and post-test. To locate where the differences among the conditions happen, Tukey's post hoc comparisons were run. The results indicated that the mobile-based condition performed better (P<.001) than paper-based and control groups.

One way ANOVA was also run on the learners' delayed post-test scores to see whether the differences among the groups were statistically significant. The results of one-way ANOVA showed meaningful differences among the conditions because P<.001. Tukey's post hoc comparison was also used to find out where the differences among the groups occurred. The outcome of the Tukey's post-hoc comparison again revealed that the mobile-based group outperformed the control group (P<.001).

Table 5*. ANOVA summary for the students' delayed post-test scores.*

	Sum of Squares	df	Mean Square	F	Sig
Between Groups	1564.022	2	782.011	1166.981	.000
Within Groups	58.300	87	.670		
Total	1622.322	89			

Discussion

The current study examined the effects of mobile-assisted versus paper-and-pencil concept mapping on EFL learners' vocabulary development. The findings of the study indicated that both mobile-assisted and paper-and-pencil concept mapping were effective in promoting EFL students' knowledge of vocabulary. The findings showed that the mobile-assisted concept mapping was more effective than the paper-and-pencil concept mapping. The most important aspect of the study is that mobile-assisted concept mapping technique enabled the learners of the mobile-mediated group to enhance their vocabulary knowledge and performed better than the students of the paper-and-pencil and also control groups. Accordingly, the answer to the first research question is affirmative. In other words, with regard to the first research question that asked if mobile-assisted concept mapping promoted EFL learners' vocabulary learning, we can state that the mobile-assisted concept mapping is beneficial for L2 learners' vocabulary acquisition.

Therefore, the results of the study corroborate the previous research findings indicated that technology-mediated, and in particular mobile-assisted concept mapping is effective for language learners' performance (e.g., Chang et al., 2001; Chen, 2014; Evmenova et al., 2016; Hassanzadeh et al., 2021; Kaveh et al., 2023; Liu et al., 2010; Mashhadi et al., 2021; Reader & Hammond, 1994). Concerning the second research question of the study that asked whether there was any statistically significant difference between the effectiveness of mobile-assisted and paper-based concept mapping for vocabulary learning, the findings indicated that the mobile-assisted concept mapping is more beneficial for EFL learners' vocabulary learning. This finding is so important because a number of previous studies provided positive evidence regarding the conventional classroom concept mapping on students' vocabulary knowledge (e.g., Al-otaibi, 2016; Kaveh & Rassaei, 2016; Palmer et al., 2014; Naderifar, 2018; Zahedi & Abdi, 2012).

To the researchers' knowledge, few studies if any have directly examined and compared the effects of mobile-assisted and paper-and-pencil concept mapping on EFL students' vocabulary learning. One issue that needs to be considered is that why was the mobile-assisted concept mapping technique better than the paper-based concept mapping technique in the study? One possible reason could be the combination of recent mobile technology with concept mapping strategy which assists learners in going over the words much better and leads to meaningful learning. That is to say, for the mobile-assisted concept mapping group, the recent mobile-technology and concept mapping strategy were both combined which may result in meaningful learning and help students learn the words much better.

According to Novak and Gowin (1984), relating existing knowledge to previous one leads to meaningful learning. All the learners of the experimental conditions in this study, especially the mobile-assisted concept mapping condition have opportunities to learn L2 vocabulary in a stress-free learning environment through their smartphones. In fact, the researchers of this study presented the participants of the experimental groups with a list of words and asked them to relate all those words which may help them get better results. The other reason for such results could be the distinctive characteristics of smartphones such as ubiquity, portability, synchronous and asynchronous learning and also easy connectivity.

A unique characteristic of concept mapping used in the present study was that the experimental groups' participants were provided with assistance or scaffolding in creating the maps of the words. Wood et al. (1976) defined scaffolding as a graduated support of an expert which helps the new learners to complete a task that they were not able to do on their own. In fact, scaffolding provides the learners with gaining more control over doing a task which may be beyond their capabilities. In this regard, concept mapping is known as a kind of scaffolding which lets students gain more control over new vocabulary items gradually. So, providing learners with assistance to do the tasks such as the ones examined in the present study makes all the activities less complex.

The results of the study are also in line with the findings of previous research studies that provided evidence concerning the usefulness and effectiveness of mobile phones in EFL context (e.g., Hassan & Shafiqul Islam, 2020; Kaveh & Rassaei, 2022; Seraj et al., 2021). Ally and Samaka (2016) stated that mobile phones have some benefits for both students and teachers which results in promoting EFL students' learning. Moreover, they claimed that mobile phones are small devices to be carried easily everywhere without the restriction of time and place that lets learners share information and expertise, work collaboratively to do a project, and also complete a task much better (Ally & Samaka, 2016). Shahadat Hossein Khan et al. (2015) claimed that mobile phones are really useful tools because they create learner-centered teaching and learning context in which students' learning often occurs as a result of their active participation or involvement and teachers are usually known as facilitators.

Conclusion and Implications

Based on the results provided above, it can be concluded that mobile-assisted concept mapping has a significant and meaningful effect on improving EFL learners' vocabulary learning. The analysis of obtained data indicates that such a technique presents students with opportunities to enhance the participants' knowledge of vocabulary. The results of the study provide evidence for effectiveness and usefulness of the mobile-assisted concept mapping in the EFL context. During the mobile-mediated concept mapping process, it was found out that the EFL learners were provided with opportunity to learn the new words in a stress-free environment through their mobile phones. The usefulness of this technique may support the underlying ideas of concept mapping. That is, the present study supported the notion that technology-mediated concept mapping enhances learners' language learning. The results of the study also support the implementation of mobile technology, including smartphones in EFL settings. The findings suggest that smartphones can be employed in the educational environments such as EFL classrooms and EFL instructors are able to benefit from the benefits presented by mobile technology to promote learners' language performance.

The results in the current study suggest several theoretical as well as pedagogical implications. This study theoretically contributed to the areas of concept mapping, technology-mediated concept mapping, and MALL and pedagogically provides evidence regarding an innovative technique for EFL learners, teachers, and also curriculum designers.

Theoretical Implications

Several important implications can be drawn from the results of the study. First of all, the results of the present study made contributions to the literature on concept mapping in EFL settings. The importance of concept mapping has been widely emphasized in EFL context. Concept mapping is an effective technique which has been proposed as a consequence of limitations and inadequacies of conventional techniques. Therefore, a number of recent studies have examined the effects of concept mapping on EFL students' language performance. The results of the study contribute to this part of literature by showing that concept mapping is a useful technique to increase EFL learners' vocabulary learning.

Another implication of the study is providing positive evidence regarding mobile-assisted language learning. Recently, mobile phones are known as effective devices in different areas of education, including language learning and teaching. However, both educators and researchers still need to consider some specific issues to find out how different forms of mobile technology can help EFL or ESL learners improve their language skills. The present study presents positive evidence in this field, as the results indicated the implementation of mobile phones is beneficial for EFL students. Since little is done in the field of mobile-assisted concept mapping, the results of the study can offer a contribution in this area of literature.

Pedagogical Implications

The results of the study have also some pedagogical implications for instructors, syllabus designers, and EFL students. Language instructors can easily employ the mobile-assisted concept mapping as a new technology-mediated technique to teach different skills or sub-skills. The mobile-assisted concept mapping helps language instructors to teach the language both locally and globally. Furthermore, the mobile-assisted concept mapping allows instructors to determine the learners' weaknesses and help them perform better. The current study also provides language teachers with some practical guidelines which let them use the mobile-assisted concept mapping technique to teach words besides in-person teaching.

L2 students can also benefit from the mobile-assisted concept mapping for their vocabulary learning. They can use their mobile phones to learn new words outside of the classroom without the constraint of time and location. In addition, the results of the present study have some implications for all those syllabus designers who would like to use the mobile-assisted concept mapping technique to get better learning results.

Limitations and Suggestions for Future Directions

There are several important issues that need to be taken into consideration when interpreting the findings of this study. First, all the learners in this study were adult and no teenage learner participated in the study. Future research is needed to choose and involve teenage learners to see if the findings can be generalized to teenage EFL participants. Second, it is recommended to conduct a similar study and enrich the study with qualitative data in addition to quantitative

data. The third limitation of the study relates to the participants' delayed post-test. Since the researchers did not have access to the participants, they asked the learners to take the delayed post-test one week after the last treatment session which should be normally given to the learners two weeks after the post-test. In the end, the present study only investigated the effects of mobile-assisted versus paper-based concept mapping on EFL learners' vocabulary development and did not report on other language sub-skills. Therefore, other language researchers can replicate the current study with examining EFL learners' other sub-skills.

References

Abd Karim, R., Idris, N., Ismail, I., Mohd Saad, N. H., & Ghani Abu, A. (2019). The impact of utilizing mobile-assisted mind mapping technique (MAMMAT) on the development of undergraduate students' writing performance. *Journal of Adv in Dynamical & Control Systems, 11*(12), 674-680. DOI: 10.5373/JARDCS/V11SP12/20193264

Abraham, H. (2008). Computer-mediated glosses in second language reading comprehension and vocabulary learning: A Meta-Analysis. *Computer Assisted Language Learning, 21*(3), 199-226. DOI: 10.1080/09588220802090246

Adamson, H. D. (1993). *Academic competence, theory and classroom practice: Preparing ESL students for content courses*. Longman.

Al-Khasawneh, F. M. S., (2019). The impact of vocabulary knowledge on the reading comprehension of Saudi EFL learners. *Journal of Language and Education, 5*(3), 44-54. DOI: 10.17323/jle.2019.8822

Ally, M., & Samka, M. (2016). Guidelines for design and implementation of mobile learning. In Information Resources Management Association (Ed.). *Blended Learning: Concepts, methodologies, tools, and applications.* (pp. 443-458). Hershey: IGI Global.

Al-Otaibi, Gh. M. (2016). The effects of semantic mapping on students' vocabulary. *Arab World English Journal, 7*(1), 279-294. DOI: 10.2139/ssrn.2804012

Asiksoy, G. (2019). Computer-based concept mapping as a method for enhancing the effectiveness of concept mapping in technology-enhanced learning. *Sustainability, 11*(4), 1-19. DOI: 10.3390/su11041005

August, D., Carlo, M., Dressler, C., & Snow, C. (2005). The critical role of vocabulary development for English language learners. *Learning Disabilities Research & Practice, 20*(1), 50-57. DOI: 10.1111/j.1540-5826.2005.00120.x

Bashori, M., Van Hout, R., Strik, H., & Cucchiarini, C. (2021). Effects of ASR-based websites on EFL learners' vocabulary, speaking anxiety, and language enjoyment. *System*, 99, 1-16. DOI: 10.1016/j.system.2021.102496

Beyranvand, S., & Rahmatollahi, M. (2021). The effects of MALL on language learners' mastery of technical collocation: Use of Instagram and Adobe Connect. *Turkish Journal of Computer and Mathematics Education, 12*(11), 6697-6709. DOI: 7085/5763/12922

Chang, K., Sung, Y., & Chen, I. (2002). The effect of concept mapping to enhance text comprehension and summarization. *Journal of Experimental Education*, 71, 5-23. DOI: 10.1080/00220970209602054

Chang, Y. Ch., Liu, G. Y., Chen, K. J., Huang, Ch. H., Lai, Y. M., & Yeh, T. (2017). The effects of collaborative computer-based concept mapping strategy on geographic science performance in junior high school students. *EURASLA Journal of Mathematics Science and Technology Education, 13*(8), 5049-5060. DOI: 10.12973/eurasia.2017.00981a

Chang, K. E., Sung, Y. T., & Chen, S. F. (2001). Learning through computer-based concept mapping with scaffolding aid. *Journal of Computer Assisted Learning, 17*(1), 21-33. DOI: 10.1111/j.1365-2729.2001.00156.x

Chen, Ch. J. (2014). Using concept mapping instruction in mobile phone to learning English Vocabulary. *Creative Education, 5*(1), 4-6. DOI: 10.4236/ce.2014.51002

Chen, M. R. A., & Hwang, G. J. (2020). Effects of a concept mapping-based flipped learning approach on EFL students' English-speaking performance, critical thinking awareness and speaking anxiety. *British Journal of Educational Technology, 51*(3), 817-834. DOI: 10.1111/bjet.12887

Collier, V. P. (1989). How long? A synthesis of research on academic achievement in a second language. *TESOL Quarterly, 23*(3), 509-531. DOI: 10.2307/3586923

Cook, V. (2013). *Second language learning and language teaching* (4th ed.). Routledge.

Dilek, Y., & Yuruk, N. (2013). Using semantic technique in vocabulary teaching at pre-intermediate level. *Procedia-Social and Behavioral Sciences*, 70: 1531-1544. DOI: 10.1016/j.sbspro.2013.01.221

Dunston, P. J. (1991). A critique of graphic organizer research. *Reading Research and Instruction, 31*(2), 57-65. DOI: 10.1080/19388079209558079

Erdem, E., Yilmaz, A., & Oskay, O. O. (2009). The effect of concept mapping on meaningful learning of atom and bonding. *Procedia Social and Behavioral Sciences*, 1, 1586-1590. DOI: 10.1016/j.sbspro.2009.01.279

Evmenova, A. S., Regan, K., Boykin, A., Good, K., Hughes, M., Macvittie, N., Sacco, D., Ahn, S. Y., & Chirnios, D. (2016). Emphasizing planning for essay writing with a computer-based graphic organizer. *Exceptional Children, 82*(2), 170-191. DOI: 10.1177/0014402915591697

Ghalebi, R., Sadighi, F., & Bagheri, M. S. (2020). Vocabulary learning strategies: A comparative studies of EFL learners. *Cogent Psychology, 7*(1), 1-12. DOI:10.1080/23311908.2020.1824306

Guastello, E. F., Beasely, T. M., & Sinatra, R. C. (2000). Concept mapping effects on science content comprehension of low-achieving inner-city seventh graders. *Remedial and Special Education, 21*(6), 356-364. DOI: 10.1177/ 074193250002100605

Harmer, J. (1994). *The practice of English language teaching*. London: Longman.

Harris, M., Schumaker, J., & Deshler, D. (2011). The effects of morphological analysis instruction on the vocabulary performance of secondary students with and without disabilities. *Learning Disability Quarterly*, 34, 17-33. DOI: 10.1177/ 073194871103400102

Hasan, M., & Shafiqul Islam, A. B. M. (2020). The effectiveness of mobile assisted language learning (MALL) on ESL listening skill. *Noble Journal of Literature and Language Teaching, 11*(2), 188-202. DOI: 10.15642/NOBEL.2020.11.2.188-202

Hassanzadeh, M., Saffari, E., & Rezaei, S. (2021). The impact of computer-aided concept mapping on EFL learners' lexical diversity: A process writing on experiment. *ReCALL, 33*(3), 214-228. DOI: 10.1017/S095834402100001x

Hashim, H., Yunus, M. Md., Embi, M. A., & Mohammad Ozir, N. A. (2017). Mobile-assisted language learning (MALL) for ESL learners: a review of affordance and constraints. *Sains Humanika*, 9, 1-5. DOI: 10.11113/sh.v9n1-5.1175

Haugwitz, M., Nesbit, J. C., Sandman, A. (2010). Cognitive ability and instructional efficacy of collaborative concept mapping. *Learn Individual Differences, 20*(5), 536-543. DOI: 10.1016/j.lindif.2010.04.004

Hermagustiana, I., & Rusmawaty, D. (2017). The use of technology for vocabulary instruction in EFL classrooms: Support and challenges. *Advances in Intelligent Systems Research*, 144, 137-143. DOI: 10.2991/icedutech-17.2018-27

Hu, H. C. M., & Nassaji, H. (2016). Effective vocabulary learning task: Involvement load hypothesis versus technique feature analysis. *Systems*, 56, 28-39. DOI: 10. 1016/ j.system. 2015.11.001

Islim, OF. (2018). Technology-supported collaborative concept maps in classrooms. *Active Learning in Higher Education, 19*(2), 131-143. DOI: 10.1177/1469787417723231

Kaveh, A., & Rassaei, E. (2016). The effect of concept mapping on Iranian EFL learners' vocabulary learning and strategy use. *Journal of Studies in Learning and Teaching English, 5*(1), 151-177. https: //jstle.shiraz.iau.ir

Kaveh, A., & Rassaei, E. (2022). Mobile-mediated versus face-to-face dynamic assessment, EFL learners' writing fluency and strategy awareness: A sociocultural perspective. *Language and Sociocultural Theory*. DOI: 10.1558/lst.20288

Kaveh, A., Hadipourfard, E., & Bavali, M. (2023). The effects of mobile-assisted concept mapping on EFL learners' writing fluency and motivation. The JALT CALL, 19(2), 171-196. DOI: 10.29140/jaltcall.v19n2.209

Kayi-Aydar, H. (2018). Scaffolding vocabulary development. *The TESOL Encyclopedia of English Language Teaching*, 1-6. DOI: 10.1002/9781118784235.eelt0733

Kazemi, A., & Moradi, A. (2019). The influence of concept mapping and rehearsal on speaking accuracy and complexity. *Cogent Arts and Humanities, 6*(1), 1-21. DOI: 10.1080/233119 83.2019.1597463

Kilickaya, F., & Seferoglu, G. (2013). The impact of CALL instruction on English language teachers' use of technology in language teaching. *Journal of Second and Multiple Language Acquisition, 1*(1), 20-38. https: //www.semanticsscholar.org

Klopfer, E., Squire, K., & Jenkins, H. (2012). Environmental detectives: PDAs as a window into a virtual simulated world. In: Proceedings of IEEE International Workshop on Wireless

and Mobile Technologies in Education. Vaxjo, Sweden: *IEEE Computer society*, *4*(7), 95-98. DOI: 10.1109/ WMTE.2002. 1039227

Kukulska-Hulme, A. (2018). Mobile-assisted language learning. In Chapelle, Carol A.ed. *The Concise Encyclopedia of Applied Linguistics, 742-751.* DOI: 10.1002/978140519431. Wbeal0768

Kwon, S. Y., & Cifuentes, L. (2009). The comparative effect of individually-constructed vs. collaboratively-constructed computer-based concept maps. *Computers and Education, 52*(2), 365-375. DOI: 10.1016/j.compedu.2008.09.012

Laufer, B. (1997). The lexical plight in second language reading. In J. Coady & T. Huckin (Eds.), *Second language vocabulary acquisition* (pp. 20-34). Cambridge: Cambridge University Press.

Liu, P. L., Chen, Ch. J., & Chang, Y. J. (2010). Effects of a computer-assisted concept mapping strategy on EFL college students' English reading comprehension. *Computers and Education, 54*(2), 436-445. DOI: 10.1016/j.compedu.2009.08.027

Liu, P. L. (2016). Mobile English vocabulary learning based on concept mapping strategy. *Language Learning and Technology, 20*(3), 128-141. DOI: 10125/44485

Machida, N., & Dalsky, D. (2014). The effects of concept mapping on L2 writing performance: Examining possible effects of trait-level writing anxiety. *Canadian Center of Science and Education, 7*(9), 28-35. DOI: 10.5539/elt.v7n9p28

Mashhadi, J., Ahmadi, H., & Rajabi, P. (2021). Impact of computer concept-mapping instruction on Iranian EFL learners' writing performance: Complexity and accuracy in focus. *International Journal of Foreign Language Teaching & Research, 9*(35), 131-139. https: //journals.iau.ir

McCarthy, M. (1990). *Vocabulary*. Oxford: Oxford University Press.

McQuiggan, C. A. (2012). Faculty development for online teaching as a catalyst for change. *Journal of Asynchronous Learning Network, 16*(2), 27-61. DOI: 10.24059 /oli.v16i2.258

Naderifar, A. (2018). The comparative effect of concept mapping and vocabulary notebook keeping on Iranian EFL learners' self-regulation in vocabulary learning. *Cogent Education, 5*(1), 1-16. DOI: 10.1080/23311816X.2018.1491782

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

Nesbit, J. C., & Adescope, O. O. (2006). Learning with concept and knowledge maps: A meta-analysis. *Review of Educational Research, 76*(3), 413-448. DOI: 10.3102/0034654307600 3413

Nouri, N., & Zerhouni, B. (2018). Lexical frequency effect on reading comprehension and recall. *Arab World English Journal, 9*(2), 234-250. DOI: 10.2139/ ssrn.3201950

Novak, J. D., & Gowin, D. B. (1984). *Learning how to learn*. Cambridge, UK: Cambridge University Press.

Pellicer-Sanchez, A. (2020). Expanding English vocabulary knowledge through reading: Insights from eye-tracking studies. *RELC Journal, 51*(1), 134-146. DOI: 10.1177/00336882209069 04

Rassaei, E. (2018). Computer-mediated textual and audio glosses, perceptual style and L2 vocabulary learning. *Language Teaching Research, 22*(6), 657-675. DOI: 10.1177/1362168817690183

Rassaei, E. (2019). Effects of two forms of concept mapping on L2 reading comprehension and strategy awareness. *Applied Linguistics Review, 10*(2), 93-116. DOI: 10.1515/applirev-2017-0006

Readence, J. E., Bean, T., & Baldwin, R. S. (1989). *Content area reading: An integrated approach* (3rd ed.). Dubuque, IA: Kendall/Hunt.

Reader, W., & Hammond, N. (1994). Computer-based tools to support learning from hypertext: Concept mapping tools and beyond. *Computers and Education*, 12, 99-106. DOI: 10.1016/0360-1315(94)90078-7

Richardson, R., & Fox, E. A. (2005). Using concept map as a cross-language resource discovery for large documents in digital libraries. *Proceedings of the 5th ACM/ IEEE-CS Joint Conference on Digital Libraries*. DOI: 10.1145/1065385.1065519

Ritchhart, R., Truner, T., & Hadar, L. (2009). Uncovering students' thinking about thinking using concept maps. *Metacognition and Learning, 42*(2), 145-159. DOI: 10.1007/s11409-009-9040-x

Rubin, J. & Thompson, I. (1994). *How to be more successful language learner*. Boston, MA: Heinle & Heinle, 2nd edn.

Schmitt, N. (2002). Tracking the incremental acquisition of second language vocabulary: Longitudinal study. *Language Learning, 48*(2), 281-317. DOI: 10.1111/1467-9922.00042

Schmitt, N. (2010). Review article: Instructed second language vocabulary. *Language Teaching Research, 14*(4), 347-349. DOI: 10.1177/1362168808089921

Seraj, P. M. I., Klimova, B., & Habil, H. (2020). Use of mobile phones in teaching English in Bangladesh: A systematic review (2010-2020). *Sustainability, 13*(10), 1-13. DOI: 10.3390/su13105674

Shahadat Hossein Khan, M., Abdou, B. O., & Clemet, C. K. (2015). University student conceptions of M-learning in Bangladesh. In D. Churchill, T. K. F. Chiu, J. Lu, & B. Fox (Eds.). *Mobile learning design: Theories and application* (pp. 127-138). Singapore: Springer.

Tadayonifar, M., Entezari, M., Vakilzadeh, M. (2021). The effects of computer-assisted L1 and L2 textual and audio glosses on vocabulary learning and reading comprehension across different learning styles. *Journal of Language & Education, 7*(2), 202-221. DOI: 10.17323/jle.2021.11020

Thaledon, S. (2020). The use of semantic mapping to improve vocabulary comprehension, *HRD Journal, 11*(1), 8-21. http://ojslib3.buu.in.th

Taj, I. H., Ali, F., Sipra, M. A., Ahmad, W. (2017). Effect of technology enhanced language learning on vocabulary acquisition of EFL learners. *International Journal of Applied Linguistics and English Literature, 6*(3), 262-272. DOI: 10.7575/aiac.ijalel.v.6n.3p.262

Viera, R. T. (2017). Vocabulary knowledge in the production of written texts: a case study on EFL language learners. *Revista Technologica ESPOL, 30*(3), 89-105. https: //www.rte.espol.edu.ec/index.php/tecnologica/article/view/628/377

Wood, D., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry, 17(2), 89-100. DOI:* 10.1111/j.1469-7610. 1976.tb0038 1.x

Yaacob, A., Shapii, A., Alobaisy, A. S., Al-Rahimi, W. M., Al-Dheleai, Y. M., Yahaya, N., & Alamri, M. M. (2019). Vocabulary learning strategies through secondary students at Saudi School in Malaysia. *SAGE open*, *9*(1), 1-12. DOI: 10.1177/2158244019835935

Zaini, A., & Mazdayasna, G. (2014). The effect of computer assisted language learning on the development of EFL learners' writing skills. *Procedia- Social and Behavioral Sciences*, 98, 1975-1982. DOI: 10.1016/j.sbspro.2014.03.631

Zahedi, Y., & Abdi, M. (2012). The impact of imagery strategy on EFL learners' vocabulary learning. *International Conference on Education and Educational Psychology (ICEEPSY)*, 69, 2264-2272. DOI: 10.1016/j.sbspro.2012.12.197