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Research Article

Mobile-Assisted Versus Paper-and-Pencil Concept Mapping: Impacts on Iranian Intermediate EFL Learners' Vocabulary Learning

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ABSTRACT

Vocabulary acquisition can play a vital role in English as a Foreign Language learning. Using innovative strategies are needed to address the persistent challenges with traditional methods. This study aimed to investigate the comparative effects of mobile-assisted and paper-and-pencil concept mapping strategies on vocabulary acquisition among Iranian intermediate EFL learners. The study was based on the meaningful learning theory and explored how integrating concept mapping with mobile-assisted language learning can enhance vocabulary retention. A quasi-experimental design was employed which involved 75 students across three intact classes at the Safir Institute. The participants were assigned to a control group, a mobile-mediated concept mapping group using WhatsApp and digital tools, and a paper-and-pencil concept mapping group. All the three groups received instruction over four sessions using identical reading materials. However, different instructional strategies were used. Pre-tests, post-tests, and delayed post-tests were administered to assess vocabulary development and retention. The results from ANOVA, t-tests, and ANCOVA indicated significant vocabulary gains in both experimental groups compared to the control group. It was revealed that the mobile-mediated group demonstrated the highest improvement. Although the difference between the two experimental groups was not statistically significant, the effect size indicated practical relevance. The findings highlighted the pedagogical potential of mobile-assisted concept mapping in EFL contexts and offered insights for enhancing vocabulary instruction through digital tools.

Keywords: Mobile-assisted language learning (MALL), Paper-and-pencil language learning, Concept mapping, vocabulary learning

1. INTRODUCTION

Many teachers have concentrated on helping students learn more vocabulary because it is thought to be one of the most crucial aspects of teaching English as a foreign language (EFL). It is essential to the procedure of learning a language, because a lack of vocabulary hinders both language output and comprehension (Nouri & Zerhouni, 2018). Words are the fundamental units of a language because they mark things, behaviors, and concepts; without them, individuals are unable to express their intended meaning. In the past, teaching vocabulary was a neglected aspect of teaching languages (Carter & McCarthy, 1998; Taylor, 1990). However, because vocabulary is essential to learning a language, researchers are now focusing more on vocabulary learning (Harmon, Wood, & Keser, 2009).

When it comes to learning a second language (L2), expanding one's vocabulary is crucial because it is a necessary step toward becoming proficient (Nation, 2022). A large enough vocabulary helps students communicate more clearly, comprehend complex written content, and engage in complex conversations (Webb & Nation, 2017). The substantial relationship between linguistic proficiency and vocabulary size further emphasizes how important it is for L2 training programs to use efficient vocabulary-acquisition techniques (Clenton & Booth, 2020). According to Viera (2017), vocabulary is more important in learning a second or foreign language than learners' grammatical proficiency, which is no longer the focus of scholars and academics. Without having enough vocabulary, learners would not be able to communicate or comprehend others.

In the recent years, there has been a growing interest in how modern technology can enhance language learning. A huge number of studies have confirmed the effectiveness of Mobile-Assisted Language Learning (MALL) in EFL learning (Koleini et al., 2024; Pourhossein Gilakjani & Khodashenas, 2024; Vaseghi, Vahedi, & Babaei Bigham Lahiji, 2024).). Mobile apps and devices enable learners to access educational content anytime and anywhere. They offer a more personalized and learner-centered approach compared to traditional classroom methods. Zain and Bowles (2021) reviewed the research on MALL and stated that it is effective in improving the students' language skills, motivation, and vocabulary retention. They also demonstrated that it can encourage collaborative learning and give the students more chances to interact in the target language. Therefore, it can be said that MALL can lead to more effective vocabulary learning, especially when the students use tools like concept mapping to organize and visualize new words. However, there is still a lack of studies which compare digital tools with traditional techniques in vocabulary development. By focusing on mobile-assisted concept mapping, this research seeks to fill an important gap in EFL teaching practices.

Therefore, it can be stated that the significance of this study lies in its exploration of mobile-assisted concept mapping compared to traditional paper-and-pencil methods in enhancing vocabulary learning among Iranian intermediate EFL learners. This research addresses a critical gap in EFL pedagogy through evaluating the effectiveness of modern technology against conventional techniques. By demonstrating that mobile-assisted methods may offer superior benefits, the study contributes to the understanding of how digital tools can facilitate deeper vocabulary acquisition and engagement.

1.1. Statement of the Problem

Learning vocabulary can be regarded as one of the most important parts of EFL learning. The lack of vocabulary knowledge may block language production and comprehension of the EFL students (Delavari Khalifehkari & Pourhosein Gilakjani, 2022; Gheitasi Azami, 2024; Hadipourfard & Bavali, 2023; Shamsi & Rahimy, 2017). With the advent of technology in different areas of EFL learning and teaching, an increasing number of studies have investigated how various technology-based tools can support second language (L2) learning (Kave et al., 2023).

In the recent years, MALL has become so popular in language learning. It is integrated into foreign language curricula and can offer new learning tools for the digital generation (Hwang & Fu, 2018). MALL has received attention since it can provide authentic, contextual language learning experiences (Cheng & Chen, 2022; Shadiev et al., 2017). The previous studies on MALL have investigated the effects of mobile technologies on different language learning skills, such as writing (Eubanks et al., 2018), speaking (Sun et al., 2017), and reading (Chang & Hsu, 2011), as well as language sub-skills like vocabulary (Çakmak & Erçetin, 2018), grammar (Chu et al., 2019), and pronunciation (Wongsuriya, 2020). Among all MALL-related research, vocabulary learning has received the most attention.

Mobile-mediated concept mapping is also a beneficial technique for language learning. It differs from traditional paper-based methods. It can be used both online and offline, at any time and place which makes it especially effective for flexible learning environments like distance education (Lin & Lin, 2019). Many studies have used mobile phones to improve the vocabulary knowledge of the EFL learners (Rosell-Aguilar, 2018; Seibert Hanson & Brown, 2020; Xu & Peng, 2017). These studies have used different tools such as short messages (Kennedy & Levy, 2008), electronic dictionaries (Song & Fox, 2008), and flashcards (Başoğlu & Akdemir, 2010).

For example, Lai (2016) used WhatsApp to create a mobile learning environment for Chinese EFL learners. Students received high-frequency English verbs and discussed them through text chats. Although there was no major difference in vocabulary learning between the mobile and control groups after three months, the students who chatted more in the mobile group showed better vocabulary achievements. Lai also noted that the students' attitudes toward using smartphones for learning could help or limit their progress.

However, despite of the growing body of research supporting the integration of mobile technology in EFL learning, there is still a need for deeper investigation into how specific mobile-based strategies such as mobile-mediated concept mapping can affect vocabulary learning achievements among EFL learners. While many tools including flashcards and messaging apps have been explored, limited attention has been paid to the structured use of concept mapping on mobile devices—especially in comparison to traditional paper-and-pencil methods. Given the importance of vocabulary in language learning and the increasing reliance on digital tools in educational settings, it is essential to understand whether mobile-mediated concept mapping can offer a meaningful advantage. Therefore, this study seeks to examine the comparative effects of mobile-assisted versus paper-and-pencil concept mapping on the vocabulary learning of Iranian intermediate EFL learners. It aims to provide evidence-based insights for educators, curriculum designers, and policymakers in language education.

1.2. Research Questions

Given the challenges discussed above and the purpose of the study, the following research questions are formulated:

RQ1. Does mobile-assisted concept mapping promote EFL learners' vocabulary knowledge?

RQ2. Is there any statistically significant difference between the effectiveness of mobile-assisted and paper-based concept mapping for vocabulary learning?

1.3. Research Hypotheses

The following null hypotheses were established:

H01. Mobile-assisted concept mapping does not promote EFL learners' vocabulary knowledge.

H02. There is not any statistically significant difference between the effectiveness of mobile-assisted and paper-based concept mapping for vocabulary learning.

2. LITERATURE REVIEW

2.1. The Advent of Mobile-Assisted Language Learning (MALL)

The rapid advancement of technology in the globalized era has transformed instructional processes. Mobile-assisted Language Learning (MALL) can enable language learning anytime and anywhere via mobile devices like laptops, PDAs, tablets, and smartphones. Sharples (2009) highlighted mobile devices as ideal for modern education, and their ubiquitous nature has resulted in widespread adoption of MALL worldwide. Mobile learning is the use of Information Technology via mobile devices to enhance teaching and learning experiences. Previous studies have indicated that mobile technologies in education support six learning theories such as constructivism, behaviorism, collaboration, situated learning, informal learning, and lifelong learning. Therefore, it results in improving teaching and learning processes (Cakmak, 2019; Rahamat et al., 2017). Mobile technologies have been found to enhance learning by extending the learning environment beyond the classroom (Kukulska, 2009).

A large number of studies have explored the effectiveness of MALL in ESL and EFL contexts. They highlighted how mobile device accessibility can enhance language learning. For example, Iranian EFL learners in Foomani and Hedayati's (2016) study benefited from continuous learning opportunities in both real-life and virtual environments which fosters autonomous learning. Similarly, Ali et al. (2019) indicated that Pakistani EFL learners could learn flexibly anytime and anywhere, which increased their control and empowerment over the learning process. It is believed that MALL can sustain learners' interest, boost engagement, and enhance motivation in language learning. It can also facilitate collaborative communication between teachers and peers and allow for discussion and feedback exchange (Khan & Islam, 2019).

The previous studies indicate that MALL can support the development of language skills and knowledge in second and foreign language learning. John and Yunus (2019) confirmed that the use of various writing apps can significantly improve learners' writing performance by making learning enjoyable and engaging. In addition, Supti (2019) highlighted MALL via mobile phones as an excellent platform for collaborative learning and improving vocabulary, reading, and writing through text messaging. Khan and Islam (2019) examined the acceptance of MALL among university students in Bangladesh. The instruments in this study were questionnaires and interviews. The research indicated that the students viewed MALL as a practical and convenient tool for language learning. The findings also revealed strong enthusiasm and motivation among students to use mobile devices for developing their language skills.

Mobile learning games are also effective for learning language skills like vocabulary, grammar, pronunciation, and listening. The students can practice vocabulary on their phones and send their work to their teachers. Pictures on phones can also help students understand and remember new words better (AbuSa'aleek, 2014). The use of mobile phones to learn vocabulary is easy and useful. It can work well when it is connected to the real-life situations (Chen & Li, 2010). Another study by Thornton and Houser (2005) indicated that students who used mobile phones learned more vocabulary compared to those who used paper materials.

2.2. The Impact of Concept Mapping on Vocabulary Retention

There are different theories which can explain how concept maps help connect information to improve comprehension. Concept maps can be used for organizing information into a structure. According to Paivio's dual-coding model (1986), concept maps process information both visually and verbally. Therefore, they mobilize more resources in the working memory. Cognitive load theory is focused on the mental effort needed in working memory and suggests that concept maps can reduce cognitive load and help learners focus better on learning. These models emphasize that working memory has limited resources. Thus, concept maps can enable learners to use those resources more effectively to build a mental model that helps learning (Amadieu & Salmerón, 2014).

In vocabulary learning, concept maps provide a framework to organize conceptual information and define words. A typical concept map places the vocabulary word in the center and provides related ideas or words connected to it. It is helpful to learn key vocabulary before reading a text since it can guide understanding and analysis. A review of studies by Dexter and Hughes (2011) revealed that concept maps helped students especially those with learning disabilities to improve vocabulary knowledge, comprehension, and the ability to make inferences.

A study by Palmer, Boon, and Spencer (2014) compared two methods for teaching vocabulary to four seventh-graders with mild disabilities. These methods were using a dictionary and a learner-constructed concept-mapping approach. In the dictionary method, the students were supposed to look up a word and write it in a sentence. In the concept-mapping method, the students were asked to create a concept map that displayed the word's definition and then write the word in a sentence. The results showed that the students made significant improvements in vocabulary learning when they used the concept-mapping approach compared to the dictionary method.

Lio (2016) conducted a study to encourage the use of mobile phones and technology to facilitate vocabulary learning. The participants were divided into two groups. One group used a learner-constructed concept-mapping strategy and the other used a text-only strategy. The concept-mapping group learned vocabulary through maps created by the students. However, the text-only group learned vocabulary in a random order. The results indicated that the concept-mapping group had a better performance than the text-only group in both vocabulary acquisition and retention.

2.3. Case Studies on Mobile-Assisted Versus Paper-and-Pencil Concept Mapping

Mobile-mediated concept mapping is a technology-based approach to concept mapping that is different from traditional paper-and-pencil methods. It can be used online or offline, synchronously or asynchronously. Its flexibility in terms of time and location makes it particularly useful for specific instructional settings like distance education. Concept maps are diagrams that display relationships between ideas and are effective tools for organizing and presenting knowledge. They can enhance logical thinking and they are especially useful in group settings (Kaveh et al., 2023).

Behbahani and Karimpour (2024) explored the impacts of using mobile-mediated dynamic assessment on reading comprehension and fluency among Iranian learners ESL learners. Fifty students were divided into two groups. One used traditional teaching with teacher translation, while the other used a mobile app with interactive reading tasks and teacher support. The results showed no difference between the groups in the pre-tests. However,

after the intervention, the group using the mobile app had a better performance in both reading comprehension and fluency.

Hadipourfard and Bavali, (2023) conducted a study to examine the effects of mobile-assisted versus paper-and-pencil concept mapping on vocabulary learning among Iranian EFL learners. A total of 90 intermediate students were divided into two experimental groups and one control group. In the experimental groups, one group used a mind mapping application to create concept maps of highlighted words. However, the other group used paper-and-pencil for the same task. The control group received the same words without the concept mapping activity. The results indicated that both mobile-assisted and paper-and-pencil concept mapping were effective for vocabulary acquisition. It was proved that the mobile-assisted concept mapping was more effective than paper-and-pencil mapping.

Zafar (2023) explored the effectiveness of mind mapping as a pre-writing strategy to improve the L2 essay writing skills of Grade 10 Emirati boys. The research focused on the challenges that the students face in L2 writing and examined whether mind mapping could enhance their writing proficiency. The findings revealed that the use of mind maps significantly supported most learners and led to noticeable improvements in their essay writing. Mohammadi and Masoumi (2021) examined the relationship between learning English vocabulary through mobile phones and the learners' levels of social anxiety and loneliness. The findings revealed no significant correlation between vocabulary learning through MALL and the learners' social anxiety or loneliness. This can suggest that MALL can effectively support vocabulary acquisition without being hindered by emotional or social factors and offer learners greater flexibility and autonomy in their language learning process.

Kave et al. (2023) examined the effects of mobile-based concept mapping on the writing fluency and motivation of the EFL learners. A total of 70 upper-intermediate Persian EFL students took part in the study. They were divided into two groups including an experimental group and a control group. The experimental group was taught using mobile-based concept mapping, which helped them organize their ideas visually on their phones. The control group followed a traditional method and they only discussed topics and wrote about them without any specific tools or extra guidance. The study showed that the students who used mobile concept mapping wrote more fluently and were more motivated to write compared to those in the control group.

Hosseini Dinani and Chalak (2023) examined the impact of mobile-assisted concept mapping on vocabulary acquisition among 45 Iranian EFL learners. The study involved pre- and post-tests to evaluate vocabulary self-regulation and acquisition. Two experimental groups received concept mapping as treatment. However, the control group followed conventional methods. It was revealed that both concept mapping and traditional methods effectively enhancing vocabulary acquisition. However, the experimental group showed a more significant increase in vocabulary skills.

Phetsut and Waemusa (2022) performed a study to examine how the use of mobile apps, specifically WhatsApp, could improve speaking skills among EFL students in Thailand. Thirty secondary school students were asked to complete five oral tasks using WhatsApp as part of a MALL program. The students' speaking abilities were tested before and after the intervention using the oral pre-test and post-test. The results showed a significant improvement in the students' oral accuracy after using WhatsApp for practice. This suggested that MALL-based interventions can be effective for improving speaking skills in Thai classrooms. Overall, the growing body of evidence confirms that mobile-assisted concept mapping has a significant potential for improving vocabulary learning and broader language proficiency in EFL contexts.

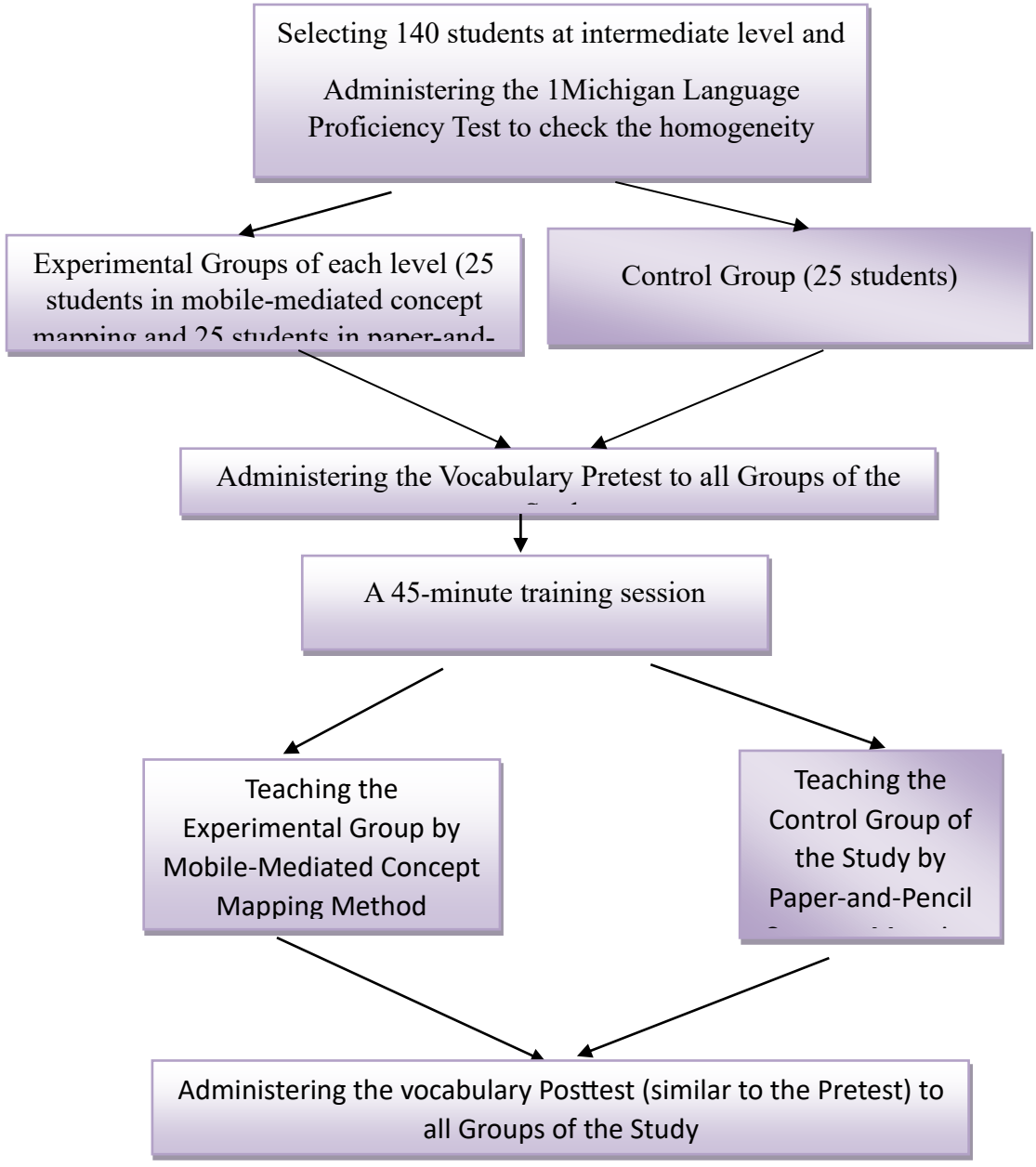
3. METHODOLOGY

3.1. Design of the Study

The current study used a quasi-experimental design featuring pre-tests, post-tests, and a delayed post-test. It involved EFL learners from three intact classes at the Safir Institute. The participants were allocated to two experimental groups and one control group. A placement assessment was conducted four days prior, while a vocabulary knowledge assessment was administered one day before the first treatment session to evaluate familiarity with the target vocabulary. To guide participants in installing a concept mapping application on their mobile devices and creating paper-based concept maps, a 45-minute instructional session was conducted. Four treatment sessions were occurred over a two-week period. The experimental groups were classified as (a) mobile-mediated concept mapping and (b) paper-and-pencil concept mapping. All the participants undertook the post-test during the final treatment session, followed by a delayed post-test one week later.

Figure 1

The Design of the Study



3.2. Participants

The participants of this study were drawn from three EFL intermediate level classrooms at Safir Institute. A purposive sampling method was used since the participants were selected based on specific criteria such as their proficiency level and familiarity with WhatsApp technology which were crucial for examining the effects of mobile-assisted and paper-and-pencil concept mapping on vocabulary learning. Initially, 140 students enrolled in these classes. Following the placement test, the students who did not fit the requirements to be placed in the paper-based and mobile-mediated idea mapping conditions were not allowed to continue with the study. As a result, 75

participants were selected as the final sample and divided into groups for concept mapping using paper and pencil and mobile media. The participants were males between the ages of 22 and 35 who had studied English as a foreign language for three to four years.

The distribution of the EFL participants is presented in Table 1.

Table 1

Distribution of the Participants

Participants	Male
EFL Learners	75
Total	75

Consequently, the final 75 participants were assigned to three groups to perform the study; control, mobile-mediated concept mapping, and paper-and-pencil concept mapping groups. The frequency of the participants in each group is presented in Table 2.

Table 2

Distribution of the Participants in the Experimental and Control Groups

Groups	Participants
Control	25
mobile-mediated concept mapping	25
paper-and-pencil concept mapping	25
Total	75

3.3. Materials

The following tools were used to collect data in order to compare the effects of mobile-mediated concept mapping with paper-and-pencil concept mapping on the vocabulary learning of EFL learners.

3.3.1. Material(s) and Procedure for the Proficiency Test of the Study

The Michigan language proficiency test (https://michiganassessment.org) was given to the participants in order to determine whether or not their levels of language competency are comparable. The Michigan English Placement Test (Michigan-EPT) is a computer-based standardized assessment which is designed to efficiently evaluate general receptive language proficiency in English. It is widely used for placement purposes. The test enables institutions to group learners into homogeneous ability levels. It is also occasionally used as a pre- and post-test to measure progress over time. The Michigan-EPT does not require preregistration.

The students can input their information at the time of testing. The interface is user-friendly. It has clearly marked sections, built-in time limits, and straightforward instructions. The test consists of 80 multiple-choice items divided into two major sections including Listening and Reading. The latter incorporates grammar and vocabulary components. The Listening section contains 25 items and is completed in approximately 25 minutes. It is divided into two parts: Part 1 includes 10 short questions where learners choose from three possible responses, and Part 2 features 15 short conversations, each followed by a comprehension question.

The Listening section assesses global skills (understanding the main idea), local skills (identifying specific details), and inferential skills (interpreting implied meaning). The Reading section, lasts 35 minutes and includes two parts: Part 1 has 5 single-sentence comprehension questions, and Part 2 consists of two passages, each followed by five questions (10 in total). Moreover, the Grammar section contains 20 items involving incomplete sentences, and the Vocabulary section includes 20 items testing appropriate word choice in context. All the items

reflect language used in everyday real-life situations and assess global, local, and inferential comprehension skills. The test served in this study as a reliable measure of participants' English proficiency to ensure comparability across groups before intervention.

The Michigan-EPT is scored automatically by the computer. It ensures consistency and objectivity in results. The test does not use pre-established pass or fail scores. Instead, institutions are responsible for setting their own cut scores based on their specific instructional context, program goals, and learner profiles. To assist in interpreting test scores, the Common European Framework of Reference (CEFR) is used as a standardized benchmark. Michigan Language Assessment conducted a standard-setting project to link scores from Form D of the Michigan-EPT to CEFR proficiency levels. According to this alignment, scores from 0–30 correspond to level A1, 31–38 to A2, 39–52 to B1, 53–60 to B2, and 61–80 to C1.

3.3.2. Material(s) and Procedure for the Vocabulary Knowledge Pre-Test and Post-Test

The vocabulary knowledge test was used as a pre-test, post-test, and delayed post-test in the current study to measure the participants' familiarity with the target words. The participants in each of the aforementioned exams were first given a list of twenty words, after which the researchers asked them to indicate whether or not they were familiar with the words by writing their Persian equivalents. As a result, the pre-test, post-test, and delayed post-test of the students were remarkably similar but entirely different from one another. Each test had a twenty-minute time limit. Every word was chosen based on the researchers' assessment of the students' proficiency.

3.3.3. Material(s) and Procedure for the treatment of the Study

After taking the pre-test and undergoing homogenization, the participants were randomly assigned to two experimental and one control group. The participants in the experimental groups received interventions. However, the control group received traditional instructional methods. The treatment period consisted of eight sessions each about 45- minute.

3.3.4 Mind Mapping Application

A mind mapping application was used for this study's objectives. It included a few concept maps that were simple to make and store, independent of location or time constraints. It should be mentioned that the mind mapping tool made it simple to share and modify all of the concept maps using different shapes. All of the students had no trouble downloading and installing the mind mapping tool on their PCs and smartphones. For the vocabulary items in the current study, the mobile-mediated condition's learners utilized circle-shaped components.

3.4. Procedures

In this study, a quasi-experimental design was used to examine the effects of mobile-mediated and paper-and-pencil concept mapping on vocabulary acquisition among intermediate EFL learners. The participants were divided into three groups including the Experimental Group 1 (mobile-mediated concept mapping), Experimental Group 2 (paper-and-pencil concept mapping), and a Control Group (conventional vocabulary instruction).

All the three groups received the same reading passages with identical highlighted vocabulary words throughout the treatment period. The main difference was in the method of vocabulary instruction and learning strategies used. The experiment took place over four sessions. Each session lasted approximately 45 minutes during the spring semester of the academic year 2025.

The goal was to determine whether mobile-based or traditional concept mapping strategies can lead to more significant vocabulary retention and whether these strategies are more effective than traditional vocabulary instruction. A pre-test was administered before the intervention to assess the learners' existing vocabulary knowledge. A post-test followed after the final session to evaluate the outcomes of the treatments. Both tests were scored using the same evaluation criteria to ensure consistency.

3.4.1. Experimental Group 1 (Mobile-Mediated Concept Mapping)

Twenty-five intermediate EFL learners studying at Safir Institute were attended in the experimental group 1. The course started in the spring of the academic year 2025 and lasted for four sessions each about 45 minutes. The students in this group were asked to sign up for a WhatsApp group and use their phones to access it. Every mobile-enabled concept mapping session was scheduled in advance with the students. The individuals in the mobile-mediated concept mapping condition were asked to install the mind mapping program on their phones. The

instructor sent a passage with certain highlighted words to the group during each treatment session and asked them to carefully examine the words online. After that, they received a text message from the instructor with some questions regarding the highlighted words. The instructor then called the students' attention to any unclear terms that they may find challenging. The educator asked each student to use the previously described application to create a concept map of the passage after ensuring that all of the students had a clear understanding of the challenging or perplexing terms. The teacher then emailed the mobile-based concept map of the words to the group. Lastly, the teacher reviewed each student's file to inform them of any issues, including misspellings, improper word usage, meanings of linking terms, etc. The post-test was conducted after session eight. The post-test was scored using the same criteria as the pre-test.

3.4.2. Experimental Group 2 (Paper-and-Pencil Concept Mapping)

Twenty-five intermediate EFL learners studying at ILI institute were attended in the experimental group 2. The course started in the spring of the academic year 2025 and lasted for eight sessions each about 45 minutes. The researchers asked the participants in the paper-based idea mapping group to get out a paper and pencil. Every treatment session, the students in the paper-based group were given the same passage with certain highlighted words, and they were required to look at the vocabularies, just like in the mobile-mediated concept mapping condition. The instructor next started asking the students questions on the terms that had been highlighted in the classroom. The teacher then made an effort to get every student to focus on the terms that they were finding particularly challenging**.** Throughout the eight sessions, participants were encouraged to reflect on their previous efforts, apply feedback from each session to subsequent tasks.

3.4.3. Control Group

Twenty-five students were attended in this group and they were though using conventional methods. The students in this group received the same passages as the experimental groups. The highlighted vocabulary items were embedded in the texts. However, unlike the other groups, these learners did not engage in any mapping activities. Instead, vocabulary instruction followed a teacher-centered approach which involved direct explanation, translation, and definition-based instruction. The learners were encouraged to ask questions and discuss meanings. However, the focus remained on rote memorization, dictionary use, and word-by-word comprehension rather than creating relationships between terms.

The teacher occasionally held short discussions about the highlighted words and their usage. However, no visual tools, apps, or graphic organizers were employed. There was no emphasis on linking concepts or constructing networks of meaning, which contrasts with the concept mapping strategies used in the experimental groups. The learners worked individually or in small groups to review vocabulary and complete short exercises based on the reading material. As with the other groups, the same post-test was administered after the final session to evaluate vocabulary gains and to compare learning outcomes across the three instructional methods.

3.5. Methods of Analyzing Data

The results of the statistical analysis were used to answer the research questions and to investigate the hypotheses of the present study. Right after the collection of participant scores regarding the relative effects of mobile-mediated and paper-based concept mapping on the vocabulary acquisition of EFL learners, one-way ANOVAs were conducted in order to examine and determine how teaching affected the pre-test, post-test, and delayed post-test's circumstances.

4. RESULTS AND DISCUSSIONS

In this section, the data analysis is employed to interpret the gathered data. Thus, a pre-test and post-test design was employed.

4.1 Data Analysis and Findings

Two different stages were utilized for data analysis. First, descriptive data were analyzed.

4.1.1. Descriptive Data Analysis

In the current study, a quantitative and comparative method using pre-test- post-test design was used to analyze the data. To this end, first, the participants completed a pre-test to determine whether they were homogeneous in

their vocabulary knowledge. Table 4 represents the mean and standard deviation of the pre-test scores among the participants.

Table 3

Descriptive Statistics of Pre test

Group	N	Mean	Standard deviation
Control	25	15.88	1.77529
Experimental 1 (Mobile-Mediated Concept Mapping)	25	15.62	1.89033
Experimental 2 (Paper-and-Pencil Concept Mapping)	25	15.64	.53005

As descripted in Table 3, the mean score for the control, experimental groups 1 and 2 was 15.88, 15.62, and 15.64 respectively. After the pre- test, tests of Normality namely Kolmogorov-Smirnov and Shapiro-Wilk were conducted to determine the normality assumption. The results were as follows:

Table 4

The Results for Kolmogorov-Smirnov and Shapiro-Wilk Test for Pre-Test Scores

Tests of Normality							
	group	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Pretest	Mobile	.171	25	.057	.936	25	.120
	Paper	.153	25	.135	.948	25	.220
	Control	.170	25	.061	.929	25	.083

a. Lilliefors Significance Correction

As indicated in Table 4, the normality tests (Kolmogorov-Smirnov and Shapiro-Wilk) for the pre-test scores of the Mobile-Mediated Concept Mapping, Paper-and-Pencil Concept Mapping, and Control groups indicated no significant deviations from normality. The Shapiro-Wilk p-values were .120 for the Mobile group, .220 for the Paper group, and .083 for the Control group. They were all above the .05 threshold. These results confirm that the pre-test scores for all three groups were normally distributed. Therefore, the assumptions for using parametric statistical methods were met. Given the normality of data in each group, a One-Way ANOVA test was conducted to determine whether there were any statistically significant differences among the groups in terms of vocabulary knowledge or not.

4.1.2 Inferential Data Analysis

This section is devoted to the procedures for drawing conclusions according to the data collected through pre-tests and post-tests to answer the research questions.

4.1.2.1 Results of the Pre-test

Before starting the intervention, the participants took a vocabulary pre-test. A One-Way ANOVA test was used to determine whether there was a statistically significant difference among their scores in terms of vocabulary knowledge or not. The results were as follows:

Table 5

Results of the One-Way ANOVA Test for Comparing the Pretest Score of the Experimental Groups and the Control Group

ANOVA					
Pretest					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	1.047	2	.523	.169	.845
Within Groups	222.540	72	3.091		
Total	223.587	74			

As indicated in Table 5, the results of the one-way ANOVA for the pre-test scores indicated that there was no significant difference in pretest scores between the three groups (Control, Mobile-Mediated Concept Mapping and Paper-and-Pencil Concept Mapping). The F-value was 0.169, and the p-value was 0.845, which were much greater than the significance level of 0.05. Therefore, it can be concluded that there was not a statically significant difference across the three groups (one control and two experimental) in terms of vocabulary knowledge in the pre-test.

4.1.2.2 Results of the First Research Question

The purpose of the first research question was to investigate whether mobile-assisted concept mapping can effectively promote EFL learners' vocabulary knowledge. The results were as follows:

Table 6

The Results for Kolmogorov-Smirnov and Shapiro-Wilk Test for Post-Test Scores

Tests of Normality							
	group	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
posttest	Mobile	.173	25	.052	.935	25	.114
	Paper	.146	25	.181	.957	25	.357
	Control	.162	25	.088	.942	25	.169
a. Lilliefors Significance Correction							

As depicted in Table 6, the results of the normality tests for the posttest scores across the three groups including Mobile-Mediated Concept Mapping, Paper-and-Pencil Concept Mapping, and Control indicated that the data were normally distributed. According to the Shapiro-Wilk test, the p-values were 0.114 for the Mobile-Mediated Concept Mapping group, 0.357 for the Paper-and-Pencil Concept Mapping, and 0.169 for the Control group. They were all above the 0.05 significance level. These findings suggest that there were no significant deviations from normality in any of the groups. Therefore, the assumption of normality for the data in each group was confirmed. This means that the data for all groups followed a normal distribution. This supported the use of parametric statistical test namely ANCOVA for subsequent analyses.

To answer the first research question, a quantitative data analysis procedure was conducted. The post-test scores of the participants were used as the quantitative data. The collected data were analyzed using SPSS software (version 27). There were twenty-five students in the two experimental groups and twenty-five students in the control group. Before the intervention they had no statistically difference in terms of writing performance. However, after conducting the post-test, the results were as follows:

Table 7

The Results of the Paired-Samples T-Test for Comparing the Pre-Test and Post-Test Scores of the Mobile-Mediated Concept Mapping

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Mobilepretest - Mobileposttest	-1.54000	1.35339	.27068	-2.09865	-.98135	-5.689	24	.000

As can be seen in Table 7, to examine the effect of mobile-assisted concept mapping on EFL learners' vocabulary knowledge, a paired-samples t-test was conducted comparing the Mobile group's pretest and posttest scores. The mean vocabulary scores significantly increased from 15.62 (SD = 1.60) in the pretest to 17.16 (SD = 1.92) in the posttest. The correlation between pretest and posttest scores was r = .719, p < .001. This indicates a strong positive relationship between the two measures. The results of the paired-samples t-test revealed a statistically significant difference between the pretest and posttest scores, t (24) = -5.689, p < .001. The mean difference was -1.54. The 95% confidence interval ranged from -2.10 to -0.98, which indicates a reliable and substantial improvement in vocabulary knowledge following the intervention.

Table 8

The Results of the Paired-Samples Effect Size for the Mobile-Mediated Concept Mapping Group

Paired Samples Effect Sizes

			Standardizer[a]	Point Estimate	95% Confidence Interval	
					Lower	Upper
Pair 1	Mobilepretest - Mobileposttest	Cohen's d	1.35339	-1.138	-1.637	-.625
		Hedges' correction	1.37501	-1.120	-1.611	-.615

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

In terms of practical significance, it was found that the effect size was very large. The Cohen's d was equal to 1.35 and Hedges' g was 1.38. These values reflect a strong impact of mobile-assisted concept mapping on vocabulary learning. The confidence intervals for both effect size estimates (Cohen's d: [-1.637, -0.625]; Hedges' g: [-1.611, -0.615]) further confirm the strength and consistency of the observed effect. The negative sign simply reflects the direction of improvement (i.e., posttest scores were higher than pretest scores). In sum, these findings provide strong evidence that mobile-assisted concept mapping significantly and meaningfully improved EFL learners' vocabulary knowledge within the Mobile group.

Table 9

The Results of the Paired-Samples T-Test for Comparing the Pre-Test And Post-Test Scores of the Paper-and-Pencil Concept Mapping

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Paperpretest - Paperposttest	-.76000	1.01160	.20232	-1.17757	-.34243	-3.756	24	.001

According to Table 9, the mean vocabulary score increased from 15.64 (SD = 1.89) in the pretest to 16.40 (SD = 1.85) in the posttest. A strong and statistically significant correlation was observed between the two sets of scores ($r = .854$, $p < .001$). This suggests consistency in learners' performance across the two time points. The t-test revealed a statistically significant difference between the pretest and posttest scores, $t(24) = -3.756$, $p = .001$. The mean difference of -0.76 indicates a significant improvement in vocabulary scores after the intervention. The 95% confidence interval ranged from -1.18 to -0.34 which confirms the reliability of the observed gain. The negative sign of the difference reflects that posttest scores were higher than pretest scores. Overall, these findings indicate that paper-and-pencil concept mapping led to a significant and meaningful enhancement in EFL learners' vocabulary knowledge within this group.

Table 10

The Results of the Paired-Samples for the Effect of the Paper-And-Pencil Concept Mapping

Paired Samples Effect Sizes

			Standardizer[a]	Point Estimate	95% Confidence Interval	
					Lower	Upper
Pair 1	Paperpretest - Paperposttest	Cohen's d	1.01160	-.751	-1.191	-.300
		Hedges' correction	1.02776	-.739	-1.172	-.295

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

According to Table 10, the paired-samples effect size analysis for the Paper group provided further evidence of the effectiveness of paper-and-pencil concept mapping on vocabulary learning. The calculated Cohen's d was 1.01 and Hedges' g was 1.03. They both indicate a large effect size based on conventional benchmarks (0.8 or above = large effect). These results suggest that the improvement in the learners' vocabulary scores from pretest to posttest was not only statistically significant but also practically meaningful. The 95% confidence intervals for Cohen's d [-1.191, -0.300] and for Hedges' g [-1.172, -0.295] did not include zero which confirms the reliability and consistency of the observed effect. The negative sign of the point estimate reflects the direction of change. In fact, the posttest scores were higher than pretest scores. Overall, these findings demonstrate that paper-and-pencil concept mapping had a strong and positive impact on EFL learners' vocabulary knowledge.

4.1.2.3 Results of the Second Research Question

The second research question aimed to examine whether there was a statistically significant difference in the effectiveness of mobile-assisted and paper-based concept mapping strategies on improving EFL learners' vocabulary knowledge. To answer this question, a quantitative data analysis procedure was used. The post-test scores of the participants were used as the quantitative data. The collected data were analyzed using SPSS software (version 27). There were twenty-five students in each experimental group. After conducting the post-test, the results were as follows:

Table 11

Results of the Independent- Samples T-Test for Comparing the Post-Test Scores of the Mobile-Mediated Concept Mapping and Paper-And-Pencil Concept Mapping Groups

Independent Samples Test										
		Levene's Test for Equality of Variances		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
Post1and2	Equal variances assumed	.036	.851	1.490	47	.143	.80833	.54263	-.28330	1.89997
	Equal variances not assumed			1.488	46.579	.143	.80833	.54324	-.28478	1.90144

The group statistics revealed that participants using the mobile method (N = 24) had a mean score of 17.21 (SD = 1.95), while those using the paper method (N = 25) had a lower mean score of 16.40 (SD = 1.85). An independent samples t-test was conducted to determine whether these differences in means were statistically significant. Levene's Test for Equality of Variances indicated that the variances were equal (F = 0.036, p = 0.851), This allows to proceed with the t-test under the assumption of equal variances. The results of the t-test indicated that the t-value was 1.490 with 47 degrees of freedom which yields a two-tailed significance (p-value) of 0.143. This p-value indicates that there was no statistically significant difference between the two groups at the 0.05 significance level.

Table 12

The Results of the Independent-Samples Effect Size for The Experimental Groups

Independent Samples Effect Sizes					
		Standardizer[a]	Point Estimate	95% Confidence Interval	
				Lower	Upper
Post1and2	Cohen's d	1.89881	.426	-.143	.990
	Hedges' correction	1.92980	.419	-.141	.974
	Glass's delta	1.84842	.437	-.140	1.006

a. The denominator used in estimating the effect sizes.

Cohen's d uses the pooled standard deviation.

Hedges' correction uses the pooled standard deviation, plus a correction factor.

Glass's delta uses the sample standard deviation of the control group.

In terms of effect size, Cohen's d was calculated at 1.90, which suggests a large effect. This indicates that the mobile-assisted strategy may have a substantial impact on vocabulary knowledge, despite the lack of statistical significance in this particular sample. The confidence interval for Cohen's d ranged from 0.43 to 0.99. This further supports the potential relevance of the mobile strategy. Overall, the findings did not reach a statistically significant difference. However, the large effect size suggests that further investigation with larger sample sizes could be beneficial to ascertain the true impact of mobile-assisted concept mapping on vocabulary acquisition among EFL learners.

To investigate whether there was any significant difference between the impacts of Mobile-Mediated Concept Mapping and Paper-and-Pencil Concept Mapping strategies on Iranian intermediate EFL learners' vocabulary knowledge, while controlling for their initial vocabulary levels, a One-Way Analysis of Covariance (ANCOVA) was conducted in SPSS.

Table 13

Results of the One-Way Analysis of Covariance (ANCOVA)

Tests of Between-Subjects Effects						
Dependent Variable:	**posttest**					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	189.316[a]	3	63.105	65.983	.000	.736
Intercept	6.528	1	6.528	6.826	.011	.088
Pretest	171.956	1	171.956	179.798	.000	.717
group	24.131	2	12.066	12.616	.000	.262
Error	67.904	71	.956			
Total	20725.500	75				
Corrected Total	257.220	74				
a. R Squared = .736 (Adjusted R Squared = .725)						

To determine whether there were significant differences in vocabulary achievement among the three groups including Mobile-Mediated Concept Mapping, Paper-and-Pencil Concept Mapping, and Control, while controlling for learners' initial vocabulary knowledge, a one-way ANCOVA was conducted. The dependent variable was the post-test vocabulary score, and the covariate was the pre-test vocabulary score. The results showed a statistically significant effect of group on post-test scores after controlling for pre-test scores, $F(2, 71) = 12.62$, $p < .001$, partial $\eta^2 = .262$. This indicates that the type of concept mapping strategy had a significant impact on the learners' vocabulary knowledge. The covariate (pre-test) was also statistically significant, $F(1, 71) = 179.80$, $p < .001$, partial $\eta^2 = .717$, which suggests a strong relationship between pre-test and post-test vocabulary scores. Descriptive statistics revealed that the mobile group had the highest adjusted post-test mean ($M = 17.16$), followed by the paper-based group ($M = 16.40$), and the control group ($M = 16.00$). The model explained approximately 73.6% of the variance in post-test scores (Adjusted $R^2 = .725$). This indicates a strong overall effect.

To investigate the long-term retention of vocabulary knowledge, a delayed post-test was administered several weeks after the intervention. The delayed post-test scores were analyzed using SPSS to determine whether the improvements observed immediately after the instructional period were maintained over time. First, a one-way ANOVA was conducted to compare the delayed post-test scores across the three groups. To control for any initial differences in vocabulary knowledge, an ANCOVA was also performed using the pre-test scores as a covariate and the delayed post-test scores as the dependent variable and group as the fixed factor. Moreover, repeated measures ANOVA was applied to investigate changes in vocabulary scores across the three time points (pre-test, post-test, and delayed post-test) and to explore interaction effects between time and group. These analyses allowed for a comprehensive evaluation of both immediate and sustained vocabulary gains attributable to the different instructional methods. The results were as follows:

Table 14

Results of the One-Way Analysis for The Delayed Post-Test Scores

ANOVA					
delayed					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	16.107	2	8.053	2.489	.090
Within Groups	232.940	72	3.235		
Total	249.047	74			

As shown in Table 14, the results indicated that there was no statistically significant difference between the groups, $F(2, 72) = 2.489$, $p = .090$. Although the Mobile group showed a higher mean score descriptively, the difference was not large enough to reach the conventional level of significance ($p < .05$). This can suggest that, at the delayed post-test stage, the vocabulary retention across the three instructional methods was comparable. However, the p-value approached the significance level which indicates a trend that might warrant further investigation with a larger sample size or longer intervention period.

The post hoc analysis using Tukey's HSD test was implemented to explore pairwise differences in delayed post-test vocabulary scores between the three groups. None of the pairwise comparisons reached statistical significance at the 0.05 level. The Mobile group scored, on average, 0.72 points higher than the Paper group ($p = .338$) and 1.12 points higher than the Control group ($p = .078$). This indicates a trend toward better performance with the mobile-assisted method, although this difference was not statistically significant. Similarly, the Paper group scored slightly higher than the Control group by 0.40 points. However, this difference was also not significant ($p = .713$). The confidence intervals for all comparisons included zero which confirmed the lack of significant differences. These results suggest that while there may be a practical advantage for the mobile-assisted approach in vocabulary retention, the evidence is not strong enough to conclusively state differences among the groups at the delayed post-test stage. Then, The ANCOVA was conducted to examine the effect of the instructional group on delayed post-test vocabulary scores while controlling for pre-test scores. The results were as follows:

Table 15

Results of the One-Way Analysis of Covariance (ANCOVA) for Delayed Post-test

Tests of between-Subjects Effects					
Dependent Variable: delayed					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Corrected Model	168.357[a]	3	56.119	49.380	.000
Intercept	11.733	1	11.733	10.324	.002
Pretest	152.250	1	152.250	133.967	.000
group	22.280	2	11.140	9.802	.000
Error	80.690	71	1.136		
Total	20982.500	75			
Corrected Total	249.047	74			
a. R Squared = .676 (Adjusted R Squared = .662)					

The results indicated that the covariate, pre-test scores, had a significant effect on delayed post-test scores, $F(1, 71) = 133.967$, $p < .001$. This confirms that initial vocabulary knowledge was an important predictor of later performance. After adjusting for pre-test scores, there was a statistically significant difference between the groups on the delayed post-test, $F(2, 71) = 9.802$, $p < .001$. This suggests that the type of instructional method can significantly influenced vocabulary retention over time. The model explained approximately 67.6% of the variance in delayed post-test scores (adjusted $R^2 = .662$) which indicates a strong fit. Overall, these findings

support the conclusion that both Mobile-Mediated and Paper-and-Pencil Concept Mapping had differential impacts on vocabulary learning outcomes, even when accounting for initial learner differences.

The present study investigated the comparative effects of mobile-assisted concept mapping and paper-and-pencil concept mapping on the vocabulary acquisition of intermediate Iranian EFL learners. The results indicated significant vocabulary improvements in both experimental groups relative to the control group. The mobile-assisted group demonstrated the highest improvement. These findings were aligned with prior research that emphasizes the effectiveness of concept mapping as a meaningful learning strategy for vocabulary development. For instance, the findings supported the results of Hadipourfard and Bavali (2023) who found that both mobile-assisted and paper-based concept mapping improved vocabulary learning and the mobile-assisted mapping showed greater effectiveness. Similarly, Koleini et al. (2024) reported that digital flashcards outperformed traditional paper flashcards in both immediate and delayed vocabulary retention. This supports the advantage of mobile tools for long-term learning.

The efficacy of concept mapping in this study confirms the meaningful learning theory which claims that the learners achieve deeper comprehension and retention when new information is connected to existing knowledge structures (Ausubel, 1963). Both mobile and paper-based concept mapping encouraged the learners to actively organize and relate new vocabulary terms, enhancing cognitive engagement and long-term memory retention. This finding is consistent with the results of Zafar (2023) found that mind mapping can help Grade 10 Emirati learners to overcome challenges in vocabulary use and paragraph organization during L2 writing tasks. The use of concept maps enabled the learners to connect ideas meaningfully. This supports Ausubel's theory by fostering deeper understanding and better-prepared writing. The interactive nature of mobile concept mapping in the present study can offer a comparable cognitive advantage by helping the learners integrate vocabulary with prior knowledge.

Moreover, Yan and Singh (2023) emphasized the importance of self-monitoring and self-management in mobile-assisted learning. They suggested that active learner involvement in organizing knowledge can enhance perceived skill improvements. This reflects the cognitive engagement required by meaningful learning theory, as learners are not passive recipients but actively construct connections within their knowledge networks. The present study highlighted the vital role of cognitive organization via concept mapping. This approach emphasizes on relating new information with existing knowledge and fostering active learning, which may help reduce emotional obstacles by boosting learners' confidence as they gain mastery over the material. This is in contrast to the study performed by Mohammadi and Masoumi (2021) who reported that social anxiety and loneliness did not significantly impact vocabulary learning through mobile phones

In the current study, the mobile-assisted concept mapping group outperformed the paper-based group in vocabulary retention. This is in line with the growing body of literature on MALL. As evidenced by Koleini et al. (2024), digital flashcards and mobile tools facilitate better immediate and delayed vocabulary retention compared to traditional methods. This can be attributed to the inherent flexibility, interactivity, and multimodal input afforded by mobile applications, enabling learners to engage with materials anytime and anywhere, and often in more personalized ways (Nikou, 2018). Mobile concept mapping apps can provide visual, interactive platforms that encourage exploration and self-regulated learning. These factors are identified by Yan and Singh (2023) as the critical mediators between learners' self-monitoring and improved language skills in MALL environments.

Moreover, the positive impact of mobile-assisted concept mapping on the learners' vocabulary learning are consistent with the findings from Kaveh et al. (2023) and Hosseini Dinani and Chalak (2023) who highlighted that technology-supported concept mapping can enhance both cognitive and affective domains of language learning. The greater engagement of the students using mobile tools may also be explained by the reduction of affective barriers such as anxiety and passivity. This finding is also observed in the studies by Al-Ahdal and Alharbi (2021) and Dong et al. (2022) in which mobile devices fostered increased classroom participation, especially among shy learners.

The present study's findings are further supported by the longitudinal studies such as Li et al. (2022) which showed that consistent use of mobile vocabulary learning applications can improve the students' attitudes toward vocabulary acquisition and strengthen their ability to self-regulate learning over time. This confirms the importance of sustained integration of mobile technologies in language curricula, rather than short-term interventions. Moreover, the improvement in vocabulary retention following the mobile-assisted approach supports the conclusions of Mohammadi and Masoumi (2021), who reported that vocabulary acquisition through mobile phones was effective without being negatively impacted by the learners' social anxiety or loneliness. This indicates that mobile learning can offer an inclusive and flexible mode of study.

In comparison to the traditional paper-based methods, mobile concept mapping can facilitate more efficient vocabulary retention and encourage autonomous learning and collaborative interaction. Al-Ahdal and Alharbi (2021) demonstrated that MALL combined with group work can increase engagement and learner responsibility.

This synergistic effect may contribute to the higher vocabulary gains observed in the mobile-assisted group since the learners benefit from both technological affordances and social interaction.

However, despite the positive outcomes, some challenges remain in fully harnessing the potential of MALL and mobile-assisted concept mapping. Consistent with Sahril et al. (2022), technical issues and a lack of teacher preparedness can hinder the effectiveness of mobile learning tools. Moreover, Martin (2022) highlighted that barriers such as limited guidance, time constraints, and technological proficiency issues affect learners' full utilization of MALL strategies, especially among less formally educated populations. Addressing these challenges requires comprehensive teacher training, robust technical support, and carefully designed instructional materials that integrate mobile tools meaningfully.

In conclusion, the results of the present study can reinforce the significant role of mobile-assisted concept mapping as an effective, engaging, and learner-centered strategy for vocabulary acquisition in EFL settings. This approach can offer considerable advantages over the traditional paper-based methods by leveraging technological affordances to enhance learner autonomy, motivation, and retention. Despite the existing challenges, combining MALL with concept mapping has a significant potential to enhance vocabulary acquisition and promote overall language skills development for EFL learners globally.

5. CONCLUSION

This study selected two methods including mobile-mediated concept mapping and paper-and-pencil concept mapping to determine their effects on vocabulary learning of the Iranian intermediate EFL learners. The findings indicated that both concept mapping approaches had significant effects on learners' vocabulary knowledge. However, the mobile-assisted group indicated greater gains. These results suggest that incorporating digital tools into vocabulary learning can foster better retention and increase the learner motivation and engagement. The study highlighted the potential of mobile-assisted learning to create more flexible, accessible, and learner-centered environments.

Despite the fact that the research had some limitations, such as a relatively small sample size and a short intervention period, it offered valuable insights for educators and curriculum developers aiming to enhance EFL vocabulary teaching. Overall, the study supported the integration of technology-based strategies in language education and encourages further research into innovative mobile-assisted learning approaches. 0The results from this study can provide some significant pedagogical implications for vocabulary teaching in EFL settings. This study indicated that mobile-mediated concept mapping and paper-and-pencil concept mapping were particularly effective in improving vocabulary learning among the Iranian EFL students.

The findings highlighted that both mobile-assisted and paper-and-pencil concept mapping techniques are effective in enhancing vocabulary acquisition. However, the slightly stronger performance of the mobile-assisted group can support the potential of digital tools in facilitating deeper and more sustained learning. This shows the growing importance of MALL as a valuable component of modern EFL classrooms. These findings can be useful for EFL instructors, since they suggest that incorporating concept mapping particularly through mobile platforms can help students in making meaningful connections between new vocabulary and prior knowledge. This is aligned with constructivist and cognitive learning theories that emphasize active learner engagement. Also, mobile tools support differentiated instruction due to their interactive features, convenience, and capacity for personalization. They allow learners to work at their own pace and based on their own needs. Teachers are encouraged to move beyond the traditional vocabulary instruction methods and adopt more student-centered approaches that integrate technology effectively.

The findings demonstrate the effectiveness of embedding mobile-assisted visual learning strategies into EFL curricula. Digital concept mapping can support multimodal learning and promote critical thinking, organization, and long-term retention which are all essential skills in language acquisition. Curriculum designers should consider incorporating structured concept mapping tasks and app-based vocabulary activities as core components of vocabulary instruction. Finally, for the researchers and academic practitioners, the study contributes to the growing body of evidence which support the use of MALL in vocabulary instruction. It validates the pedagogical value of concept mapping in digital contexts and offers a framework for examining its impact on learner outcomes. The findings can encourage further investigation into how mobile-based strategies can be integrated with other instructional models, such as task-based learning, collaborative learning, and flipped classrooms.

References

AbuSa'aleek, A. O. (2014). A review of emerging technologies: Mobile assisted language learning (MALL). *Asian Journal of Education and e-learning*, *2*(6), 469-475.

Al-Ahdal, A. A. M. H., & Alharbi, M. A. (2021). MALL in collaborative learning as a vocabulary-enhancing tool for EFL learners: A study across two Universities in Saudi Arabia. *Sage Open*, *11*(1), 2158244021999062. https://journals.sagepub.com/doi/pdf/10.1177/2158244021999062

Ali, M. M., Mahmood, M. A., Anwar, M. N., Khan, L. A., & Hussain, A. (2019). Pakistani learners' perceptions regarding mobile assisted language learning in ESL classroom. *International Journal of English Linguistics*, *9*(4), 386-398. doi:10.5539/ijel.v9n4p386

Alqahtani, M. (2015). The importance of vocabulary in language learning and how to be taught. *International Journal of Teaching and Education, 3*(3), 21-34. doi: 10.20472/TE.2015.3.3.002

Amadieu, F., & Salmerón, L. (2014). Concept maps for comprehension and navigation of hypertexts. In D. Ifenthaler & R. Hanewald (Eds.), *Digital knowledge maps in education: Technology-enhanced support for teachers and learners* (pp. 41–59). New York, NY: Springer.

Ausubel, D. P. (1963). *The psychology of meaningful verbal learning.* Grune & Stratton.

Basoglu, E. B., & Akdemir, O. (2010). A comparison of undergraduate students' English vocabulary learning: Using mobile phones and flash cards. *Turkish Online Journal of Educational Technology-TOJET*, *9*(3), 1-7.

Behbahani, H. K., & Karimpour, S. (2024). Exploring the role of mobile-mediated dynamic assessment in L2 learners' reading comprehension and reading fluency. *Educ Inf Technol 30,* 6237–6260 (2025). https://doi.org/10.1007/s10639-024-12994-4

Cakmak, F. (2019). Mobile learning and mobile assisted language learning in focus. *Language and Technology*, *1*(1), 30-48. https://dergipark.org.tr/tr/download/article-file/665969

Çakmak, F., & Erçetin, G. (2018). Effects of gloss type on text recall and incidental vocabulary learning in mobile-assisted L2 listening. *ReCALL, 30*(1), 24–47. https://doi.org/10.1017/S0958344017000155

Carter, R., & McCarthy, M. (1998). *Vocabulary and Language Teaching,* London, Longman.

Chang, C. K., & Hsu, C. K. (2011). A mobile-assisted synchronously collaborative translation annotation system for English as a foreign language (EFL) reading comprehension. *Comput. Assist. Lang. Learn. 24*(2), 155–180. https://doi.org/10.1080/09588221.2010.536952

Chen, C. M., & Li, Y. L. (2010). Personalized context-aware ubiquitous learning system for supporting effective English vocabulary learning. *Interactive Learning Environments*, *18*(4), 341-364. https://doi.org/10.1080/10494820802602329

Cheng, C. H., & Chen, C. H. (2022). Investigating the impacts of using a mobile interactive English learning system on the learning achievements and learning perceptions of student with different backgrounds. *Comput. Assist. Lang. Learn*. *35*(1-2), 88–113. https://doi.org/10.1080/09588221.2019.1671460

Chu, H. C., Wang, C. C., & Wang, L. (2019). Impacts of concept map-based collaborative mobile gaming on English grammar learning performance and behaviors. *Journal of Educational Technology & Society*, *22*(2), 86-100.

Clenton, J., & Booth, P. (Eds.). (2020). *Vocabulary and the four skills: Pedagogy, practice, and implications for teaching vocabulary*. Routledge.

Dexter, D. D., & Hughes, C. A. (2011). Graphic organizers and students with learning disabilities: A meta-analysis. *Learning Disability Quarterly*, *34*(1), 51–72. https://doi.org/10.1177/073194871103400104

Delavari Khalifehkari, G., & Pourhosein Gilakjani, A. (2022). A comparative study of effects of computer-assisted language learning (CALL) and conventional methods of instruction on intermediate EFL learners' vocabulary learning. *IJREE*, *7*(3), 94-104. doi:10.52547/ijree.7.3.94

Dong, L., Jamal Mohammed, S., Ahmed Abdel-Al Ibrahim, K., & Rezai, A. (2022). Fostering EFL learners' motivation, anxiety, and self-efficacy through computer-assisted language learning-and mobile-assisted language learning-based instructions. *Frontiers in Psychology*, *13*, 899557. https://doi.org/10.3389/fpsyg.2022.899557

Eubanks, J., Yeh, H., and Tseng, H. (2018). Learning Chinese through a twenty-first century writing workshop with the integration of mobile technology in a language immersion elementary school. *Comp. Assist. Lang. Learn. 31*(4), 346–336. https://doi.org/10.1080/09588221.2017.1399911

Foomani, E. M., & Hedayati, M. (2016). A seamless learning design for mobile assisted language learning: An Iranian context. *English Language Teaching*, *9*(5), 206-213. doi:10.5539/elt.v9n5p206

Gheitasi Azami, A. (2024). The effects of growth mindset intervention on Iranian EFL learners' vocabulary development. *IJREE*, *9*(2), 20-29. http://ijreeonline.com/article-1-845-en.html

Hadipourfard, E., & Bavali, M. (2023). The effects of mobile-assisted versus paper-and-pencil concept mapping on EFL learners' vocabulary learning. *Computer-Assisted Language Learning Electronic Journal*, *24*(3). https://callej.org/index.php/journal/article/view/70

Harmon, J. M., Wood, K. D., & Keser, K. (2009). Promoting vocabulary learning with interactive word wall. *Middle School Journal*, *40*(3), 58-63. doi:10.1080/00940771.2009.11495588

Hosseini Dinani, B., & Chalak, A. (2023). Effect of mobile-assisted concept mapping on Iranian EFL learners' self-regulation in vocabulary learning. *International Journal of Practical and Pedagogical Issues in English Education*, *1*(4), 48-62.

Hwang, G. J., & Fu, Q. K. (2018). Trends in the research design and application of mobile language learning: a review of 2007–2016 publications in selected SSCI journals. *Interact. Learn. Environ. 27*(4), 567–581. https://doi.org/10.1080/10494820.2018.1486861

John, D. S., & Yunus, M. M. (2019). Students' perceptions on the use of mobile learning to improve writing proficiency in the MUET. *Pertanika Journal of Social Sciences & Humanities*, *27*(2).

Kaveh, A., Hadipourfard, E., & Bavali, M. (2023). The effects of mobile-assisted concept mapping on EFL learners' writing fluency and motivation. *The JALT CALL Journal*, *19*(2), 171-196. doi:10.29140/jaltcall.v19n2.1037

Kennedy, C., & Levy, M. (2008). L'italiano al telefonino: Using SMS to support beginners' language learning. *ReCALL*, *20*(3), 315-330. doi:10.1017/S0958344008000530

Khan, M. M., & Islam, M. (2019). Tertiary Level Students' attitude towards the use of mobile assisted language learning (MALL). *Bauet Journal*, *2*(1), 139-146.

Koleini, N., Boroughani, T., Eslami, Z. R., & Xodabande, I. (2024). Exploring the impacts of mobile-assisted learning on university students' technical vocabulary knowledge. *International Journal of Educational Research Open*, *7*(1), 100344. doi:10.1016/j.ijedro.2024.100344

Kukulska-Hulme, A. (2009). Will mobile learning change language learning? *ReCALL*, *21*(2), 157-165. doi:10.1017/S0958344009000202

Lai, A. (2016). Mobile immersion: An experiment using mobile instant messenger to support second-language learning. *Interactive Learning Environments*, *24*(2), 277-290. doi:10.1080/10494820.2015.1113706

Lin, J. J., & Lin, H. (2019). Mobile-assisted ESL/EFL vocabulary learning: A systematic review and meta-analysis. *Computer Assisted Language Learning*, *32*(8), 878-919. https://doi.org/10.1080/09588221.2018.1541359

Martin, M. L. (2022). *The use of mobile-assisted language learning to acquire English by students with limited or interrupted formal education: An exploratory case study*. Northcentral University.

Mohammadi, E., & Masoumi, A. (2021). The relationship between learning vocabulary via mobile (Mobile-assisted language learning) and Iranian EFL learners' social anxiety and loneliness. *Jordan Journal of Modern Languages and Literatures*, *13*(4), 775-800. doi:10.47012/jjmll.13.4.10

Nation, I. S. P. (2022). *Learning vocabulary in another language* (3rd ed.). Cambridge University Press.

Nouri, N., & Zerhouni, B. (2018). Lexical frequency effect on reading comprehension and recall. *Arab World English Journal, 9*(2), 234-250. doi:10.24093/awej/vol9no2.16

Paivio, A. (1986). *Mental representations: A dual coding approach*. Oxford, UK: Oxford University Press.

Palmer, J., Boon, R. T., & Spencer, V. G. (2014). Effects of concept mapping instruction on the vocabulary acquisition skills of seventh-graders with mild disabilities: A replication study. *Reading & Writing Quarterly*, *30*(2), 165-182. doi:10.1080/10573569.2013.818890

Parsa, N., & Anjomshoa, L. (2022). Impact of mobile-assisted language learning (mall) on EFL learners' grammar achievement and self-efficacy. *International Journal of Language and Translation Research*, *1*(4), 71-94. https://www.ijlatr-ac.ir/uploads/pdf/Vol1Is4P5.pdf

Phetsut, P., & Waemusa, Z. (2022). Effectiveness of mobile assisted language learning (mall)-based intervention on developing Thai EFL learners' oral accuracy. *International Journal of Technology in Education*, *5*(4), 571-585. doi:10.46328/ijte.271

Pourhossein Gilakjani, A., & Khodashenas, S. F. (2024). Mobile Assisted Language Learning: Investigating Receptive and Productive Vocabulary Knowledge of Iranian Intermediate EFL Learners. *Journal of Applied Linguistics Studies*, *3*(2), 71-89. https://oiccpress.com/jals/article/view/5606

Rahamat, R. B., Shah, P. M., Din, R. B., & Abd Aziz, J. B. (2011). Students' readiness and perceptions towards using mobile technologies for learning the English language literature component. *The English Teacher*, *40*(1), 69-84. https://melta.org.my/journals/TET/downloads/tet40_01_06.pdf

Rosell-Aguilar, F. (2018). Autonomous language learning through a mobile application: a user evaluation of the busuu app. *Computer Assisted Language Learning*, *31*(8), 854-881. doi:10.1080/09588221.2018.1456465

Sage, K., Piazzini, M., Downey IV, J. C., & Ewing, S. (2020). Flip it or click it: Equivalent learning of vocabulary from paper, laptop, and smartphone flashcards. *Journal of Educational Technology Systems*, *49*(2), 145-169. https://doi.org/10.1177/0047239520943647

Sahril, S., Butarbutar, R., Ardiningtyas, S. Y., & Alimuddin, A. H. (2022). A systematic review on integrating MALL in English language teaching. *ELT WorldWide*, *9*(1).

Seibert Hanson, A. E., & Brown, C. M. (2020). Enhancing L2 learning through a mobile assisted spaced-repetition tool: an effective but bitter pill? *Computer Assisted Language Learning*, *33*(1-2), 133-155. doi:10.1080/09588221.2018.1552975

Shadiev, R., Hwang, W. Y., & Huang, Y. M. (2017). Review of research on mobile language learning in authentic environments. *Comput. Assist. Lang. Learn.* *30*(3-4), 284–303. https://doi.org/10.1080/09588221.2017.1308383

Shamsi, M., & Rahimy, R. (2017). The impact of l2 semantic tasks (l2 collocation versus l2 definition) on Iranian intermediate EFL learners' vocabulary achievement. *IJREE*, *2*(1), 58-67. doi:10.18869/acadpub.ijree.2.1.58

Sharples, M. (2015). Making sense of context for mobile learning. In *Mobile learning* (pp. 140-153). Routledge.

Song, Y., & Fox, R. (2008). Using PDA for undergraduate student incidental vocabulary testing. *ReCALL*, *20*(3), 290-314. doi: https://doi.org/10.1017/S0958344008000438

Sun, Z., Lin, C. H., You, J., Shen, H. J., Qi, S., & Luo, L. (2017). Improving the English-speaking skills of young learners through mobile social networking. *Comput. Assist. Lang. Learn.* *30*(3), 304–324. doi:10.1080/09588221.2017.1308384

Supti, F. K. (2019). *The impact of mobile assisted language learning (MALL) on ESL learners' language skills: a study of tertiary level students* (Doctoral dissertation, Brac University).

Taylor, L. (1990). *Teaching and learning vocabulary.* New Jersey: Prentice Hall

Thornton, P., & Houser, C. (2005). Using mobile phones in English education in Japan. *Journal of Computer Assisted Learning*, *21*(3), 217-228. https://doi.org/10.1111/j.1365-2729.2005.00129.x

Vaseghi, R., Vahedi, M., & Babaei Bigham Lahiji, B. (2024). The effectiveness of using Wordup in enhancing EFL learners' vocabulary learning: A corpus-based Mobile App. *IJREE*, *9*(3), 46-60. http://ijreeonline.com/article-1-921-en.html

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

Webb, S., & Nation, I. S. P. (2017). *How vocabulary is learned*. Oxford University Press.

Wongsuriya, P. (2020). Improving the Thai students' ability in English pronunciation through mobile application. *Educational Research and Reviews*, *15*(4), 175-185. doi: 10.5897/ERR2020.3904

Xu, Q., & Peng, H. (2017). Investigating mobile-assisted oral feedback in teaching Chinese as a second language. *Computer Assisted Language Learning*, *30*(3-4), 173-182. https://doi.org/10.1080/09588221.2017.1297836

Yan, Y., & Singh, M. (2023). On the educational theory and application of mobile-assisted language learning and independent learning in college English teaching. *Educational Administration: Theory and Practice*, *29*(3), 137-151. doi: 10.52152/kuey.v29i3.675

Zafar, T. (2023). *The benefits of using mind maps in l2 essay writing: Improving grade 10 Emirati B boys' achievement in English.* M.A. Thesis, English Language & Applied Linguistics, College of Arts & Law, University of Birmingham, Edgbaston, Birmingham, B15 2TTUnited Kingdom doi: 10.13140/RG.2.2.11841.94567

Zain, D. S. M., & Bowles, F. A. (2021). Mobile-assisted language learning (MALL) for higher education instructional practices in EFL/ESL contexts: A recent review of literature. *Computer-Assisted Language Learning Electronic Journal*, *22*(1), 283-307. https://old.callej.org/journal/22-1/Zain-Bowles2021.pdf