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Enhancing Iranian EFL Learners' Vocabulary Learning Through Technology-Assisted Mind-Mapping: The Mediating Role of E-Learning Enjoyment

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Abstract

The rapid revolutionary advances of computer technologies have led to the employment of various learning multimedia applications in second language (L2) learning. One such technology is a mind-mapping application, which helps L2 learners retain vocabulary. However, the literature lacks studies exploring the interactions of these applications with L2 learners' positive psychosocial factors, such as learning enjoyment. Thus, the present study investigates the effect of mobile-based mind-mapping on English vocabulary learning mediated by e-learning enjoyment among English as a foreign language (EFL) learners in Iran. To this end, 80 EFL learners were classified based on the treatment and level of enjoyment into four groups, including high enjoyed experimental group (HEEG, N = 20), high enjoyed control group (HECG, N = 16), low enjoyed experimental group (LEAG, N = 14), and low enjoyed control (LECG, N = 15) group. Three measurement instruments were employed to collect the required data: the Oxford Placement Test (OPT), a vocabulary achievement test, and a Foreign Language Enjoyment Scale. The results of ANOVA showed that mobile–assisted mind mapping significantly positively affected both low and high-assisted EFL learners' vocabulary knowledge. The findings also indicated that the high-enjoyed EFL learners who received pleasure reading had substantially higher vocabulary knowledge performance than the low-enjoyed EFL learners receiving the same treatment. The findings might be conducive to Iranian EFL learners and teachers, giving them some fruitful insights into alternative ways to learn vocabulary.

Keywords: Mobile-assisted language learning, Mind-mapping, Vocabulary learning, EFL learners, E-learning enjoyment

Introduction

Teaching and learning second language (L2) vocabulary through Computer-Assisted Language Learning (CALL) activities has been a usual phenomenon among English as a foreign language (EFL) learners (Bhattacharya & Mohalik, 2020; Hao et al., 2021). The use of CALL approaches in teaching vocabulary helps L2 teachers to be freed from the long and boring process of teaching vocabulary and allows them to deal with other language skills like writing, listening, and speaking of language learners (Li & Hafner, 2022; Lin & Lin, 2019; Yu & Trainin, 2022). Technology can also improve learners' long-term retention of newly acquired vocabulary (Alhamami, 2016; Fithriani, 2021; Ruiz et al., 2021). Notably, greater benefits were observed with mobile devices, indicating that second language vocabulary learning may be most effective when students utilize mobile phones and multimedia activities that are not confined to a classroom environment (Hao et al., 2021). One of the multimedia activities known as mind-mapping software, which is freely accessible on the Internet, can be used to reorganize learners' ideas, take notes, develop concepts and ideas, and improve memory (Lin & Chen, 2006). Evidence from some experimental studies has established that mind mapping enhances L2 vocabulary learning (Liu et al., 2023; Shi & Tsai, 2022). However, no empirical research examines the interplay of mind-mapping applications with L2 learners' psychological states.

These psychological states of L2 learners include the influential positive and negative affective factors involved in language learning. However, second language acquisition (SLA) researchers were formerly focused on the role of negative affective factors in the L2 learning process, with foreign language anxiety (FLA) being among the most widely studied concepts (e.g., Gregersen et al., 2017; Horwitz, 1986, 2000; MacIntyre, 2002). The interest "in positive psychological states" (Csikszentmihalyi, 2006, p. 3), shared by proponents of the movement, is of great relevance to L2 learning as "positive and negative are not opposite ends of the same spectrum" (MacIntyre & Gregersen, 2012b, p. 193). Positive psychologists, therefore, stress the need to investigate positive emotions for their different powers and influences on the language learner (MacIntyre & Mercer, 2014; MacIntyre, Gregersen, & Mercer, 2016). A happy feeling throughout gaining knowledge and learning is vital to engaging in the educational context (Hidi & Renninger, 2006). Therefore, enjoyment in learning is considered one of the students' rights in the educational context or a vital tool that raises students' academic achievement in subject areas (Griffin, 2005; Goetz et al., 2006). Although this learning enjoyment has frequently been investigated in teaching language skills and components (e.g., vocabulary), its effect on language learning, specifically on MALL platforms (e.g., Mind Meiser), has remained under-explored.

On the other hand, there is a range of studies that have explored the link between L2 learners' vocabulary learning through traditional mind-mapping (Abate & Tefera, 2015; Al-Jarf, 2015; Aljaser, 2017; Syafrizal et al., 2018) and technology-mediated mind-mapping (Shi & Tsai, 2022); however, the interplay of L2 learners' positive affective

factors, i.e., e-learning enjoyment, with their L2 vocabulary retention through mind-mapping applications has not been investigated in any EFL context, e.g., Iran. Thus, this study examines the effects of technology-assisted mind-mapping on EFL learners' vocabulary development with high and low e-learning enjoyment and the difference in this effect between these two groups.

The results of this study will fill a gap in the literature and provide empirical evidence for the effectiveness of mind-mapping software on learners' vocabulary mediated by e-learning enjoyment in an EFL context. The present study holds significant importance in both theoretical and practical aspects. Theoretically, it enriches the existing literature in L2 education by clarifying the intricate relationship between technology-enhanced mind mapping, vocabulary acquisition, and the enjoyment derived from e-learning. This study enhances theoretical frameworks and paves the way for future research, offering a fresh viewpoint on how technology-driven vocabulary learning can affect e-learning enjoyment. On a practical level, the findings of this study are of considerable relevance to various stakeholders within EFL contexts. For example, educational policymakers might leverage the insights gained from this research to update and improve teacher training programs by integrating modules emphasizing vocabulary learning applications in second language education. EFL educators are also direct beneficiaries, as the study underscores the significance of mind-mapping applications in enhancing their students' enjoyment of learning, boosting their motivation to learn.

Literature Review

Significance of Vocabulary in L2 Learning

Vocabulary knowledge is often viewed as a critical tool for second language learners because a limited vocabulary in a second language impedes successful communication. Milton (2009) puts forward that vocabulary, the most significant criterion for proficiency in a target language, is one of any language's dynamic and effective elements. Harmer (2000) argues that "If language structures make up the skeleton of language, then it is vocabulary that provides the vital organs and the flesh" (p. 246). Nation (2001) further describes the relationship between vocabulary knowledge and language use as complementary: knowledge of vocabulary enables language use, and conversely, language use leads to an increase in vocabulary knowledge. Therefore, learning vocabulary seems to be critically important in L2 learning.

Technology-assisted Mind-mapping in L2 Learning

As a useful technique for vocabulary learning, mind mapping uses whole-brain learning to create a much more rewarding and enjoyable English learning atmosphere (Gavens et al., 2022). Al-Jarf (2015, p. 4) states that a "mind-map is a graphic organizer in which the major categories radiate from a central idea, and sub-categories are represented as branches of larger branches." Hence, teachers can use it to enhance learners' vocabulary development, enabling students to organize better, prioritize, and integrate vocabulary

items presented in a course (Batdi, 2015). Jones et al. (2012, p. 2) state, "Mind-mapping helps students learn information by forcing them to organize it and add images and colors to it. It allows students to create a visual image to enhance their learning". Therefore, mind mapping can be regarded as a helpful technique in teaching vocabulary.

Taking the benefits of mind mapping on enhancing L2 learning, various studies have been carried out to inspect its impacts on students' language learning achievements. In a meta-analysis, Ying et al. (2014) examined the influence of mind-mapping on L2 education. Their research findings illustrated that mind mapping impacted L2 language teaching and students' language learning. In an experimental study, Heidari and Karimi (2015) inspected the impacts of mind mapping on L2 learners' vocabulary retention. They collected data from 40 senior high school students divided into a control group (CG) and an experimental group (EG). Comparing the results of the vocabulary pre and posttest showed that the participants who underwent mind-mapping techniques outperformed the CG taught by the regular vocabulary instruction by providing the students with the direct translation of the words, definitions, antonyms, and synonyms.

Further, Aziz and Yamat (2016) conducted a study examining the effectiveness of mind-mapping techniques in developing students' vocabulary knowledge. In a similar design to the previous study, 38 high school students were recruited and homogenously divided into the CG and EG. The posttest results suggested that mind-mapping techniques enhance students' vocabulary knowledge more effectively.; however, these studies did not employ technology to implement mind mapping in vocabulary learning.

Applying mind-mapping application in L2 students' vocabulary learning, Alba (2022) explored obtained data from 62 students divided into the CG and EG. While the EG was taught vocabulary through various mind-mapping techniques, regular vocabulary instruction was used to introduce the CG. The results of pre-and posttests revealed that, compared to CG, EG performed better in vocabulary learning. Similarly, Shi and Tsai (2022) inspected the effect of a mind-mapping app on Taiwanese EFL participants' vocabulary development. The results of this experimental study revealed that using the mind-mapping MALL app boosted EFL learners' vocabulary knowledge. The results of their delayed posttest also indicated that the learners benefited from the long-term effects of the mind-mapping app on their vocabulary development learning. Nevertheless, none of the studies mentioned above have explored the mediational effect of learners' psychological state (e.g., e-learning enjoyment) in using mind-mapping apps for vocabulary development.

E-enjoyment in L2 learning

The rapid advancement and enhanced capabilities of digital technologies have enabled individuals to access and produce information in English at any time and from any location, thereby creating many learning opportunities. These opportunities possess the potential to significantly alter the landscape of language acquisition (Richards, 2015). It has been noted that modern EFL learners are increasingly engaging with English

informally through a diverse array of digital platforms, including language learning applications, social media, online communities, and massively multiplayer online role-playing games (MMORPGs) (Dressman & Sadler, 2019; Lai, 2017; Sauro & Zourou, 2019; Sockett, 2014; Sundqvist & Sylvén, 2016). This emerging trend of technology-enhanced activities has been associated with beneficial outcomes for second language acquisition, particularly vocabulary development (Lee, 2019a). Furthermore, these activities are linked to psychological dimensions of second language acquisition, such as the enjoyment derived from learning in technological settings, referred to as e-learning enjoyment (Lai et al., 2015).

One of the pioneering studies in this area was conducted by Lai et al. (2015), who discovered a significant positive relationship between the use of technology and e-learning enjoyment among Chinese EFL secondary students. Qualitative findings indicated that the students who reported higher levels of e-learning enjoyment participated in various authentic technological activities, such as practicing on mobile apps, listening to English music, watching English films, or conversing in English through microblogging. In another study involving Korean EFL university students with limited international exposure, Lee (2019b) found a significant correlation between MALL and e-learning enjoyment. This implies that increased use of technology for English learning is associated with elevated levels of enjoyment in the e-learning experience. Yet, the literature lacks a study exploring the modifying role of e-learning enjoyment when L2 learners use applications to learn vocabulary (e.g., mind-mapping applications). Therefore, this study is an attempt to fill this gap. In so doing, 80 study participants were grouped based on their level of e-learning enjoyment into four groups. Then, the effects of mind-mapping apps on learners' in-group and between-group vocabulary enhancement were examined. To achieve the purpose of the present study, the following research questions (RQs) are posed:

RQ1. Does technology-assisted mind mapping significantly affect EFL learners' vocabulary development?

RQ2. Is there any significant difference in the effect of technology-assisted mind mapping on the vocabulary development of EFL learners with high and low e-learning enjoyment?

Method

Design

The quantitative study was designed based on a quasi-experimental approach (pretest and posttest treatment), where two experimental groups and two control groups were formed to reveal the effects of mind-mapping and e-learning enjoyment on enhancing EFL learners' vocabulary learning. In this study, mobile mind-map application will be the independent variable; vocabulary development will be the dependent variable, and e-learning enjoyment will be the moderating variable.

Participants

The participants in this study were 80 Iranian intermediate EFL learners (56 females and 24 males) from two language institutes in Kermanshah. They were selected based on a convenience sampling procedure and the Oxford Placement Test (OPT) scores. In the convenience sampling method, the availability of the EFL learners is the main rationale behind selecting the participants for the study. However, based on the learners' performance on the OPT test, the study participants were reduced to those reported to be intermediate EFL learners. Therefore, the EFL learners who obtained scores between 40 and 50 were considered intermediate EFL learners and were recruited for the study. All the participants spoke Kurdish as their mother tongue, used Persian as the formal language, and learned English as a foreign language. The age range of them was 17-24 years old. All the participants had at least five years of language learning at school and language institutes. It is notable that, before the study, the willing participants filled out and signed a consent form.

After selecting the sample, they were assigned into four groups based on the results and scores obtained from the Foreign Language Enjoyment Scale. To do so, learners' mean scores and standard deviation in the questionnaire were calculated. Those who scored more than 1 SD above the mean were classified as high-enjoyed learners, while those who scored beyond 1 SD below the mean were classified as low-enjoyed learners. The final classification comprised high enjoyed experimental group (HEEG, N =20), high enjoyed control group (HECG, N=16), low enjoyed experimental group (LEAG, N=14), and low enjoyed control (LECG, N=15) group.

Instruments and Materials

Three measurement instruments, including two tests, the Oxford Placement Test (OPT), a vocabulary achievement test, and a Foreign Language Enjoyment Scale, were employed to collect the required dataoyed. A detailed description of the instruments is presented in the following sections.

Oxford Placement Test (OPT)

Oxford Placement Test (OPT) was employed to homogenize the participants of this study in terms of their English language proficiency level. The test consisted of reading, vocabulary, and grammar sections. It comprised 60 questions in two parts. The first part contained 40 multiple choice items in 4 subparts, including the grammatical questions about prepositions (items 1-5), the cloze passage test in which one option out of three ones should be selected (items 6-10), cloze passages test in which one option from four ones should be chosen (items 7-20), and finally testing grammatical knowledge (21-40). The second part of this test included two sub-sections; for the first one, the learners were required to read two cloze passages and select the correct option (items 41-50), and in the second section, taped learners' vocabulary format (items 51-60). The participants were allotted 60 minutes to answer the questions.

Moreover, to check whether the OPT test suited this study, the test was reviewed by two experts in the field of TEFL and reported to match the study's aims. The reliability of the

test was also measured by piloting the tests to a sample of 21 EFL learners with the maximum similarity with the present study's participants in terms of age, gender, and ethnicity. The Cronbach Alpha was reported to be 0.792, which showed an acceptable level of reliability.

Vocabulary Achievement Test

This test was designed and employed to measure the participants' vocabulary achievement. It was utilized as a pretest and posttest. The vocabulary pretest was a 30-item test developed and created by the researchers based on the English words extracted from the Top-Notch Level 3 textbook units. This vocabulary test included three subsections: a) multiple-choice (10 items), b) matching (10 items), and c) fill-in-the-blank (10 items).

The same 30-item vocabulary test was administered as the posttest. It was conducted immediately after the treatment to determine the effectiveness of the intended intervention on vocabulary learning achievement. The only difference between vocabulary pre-and posttests was the organization and order of the items to prevent the effect of learning and memorizing.

To ensure the validity of the test, it was sent to three TEFL professors and three experienced and knowledgeable EFL teachers. Based on their recommendations, some trivial changes were made in the wording of some items. After validating the test, it was piloted with 30 students similar to the study participants to check its reliability. The reliability was computed using the Cronbach alpha method and turned out to be 0.82, which was acceptable and satisfactory. For scoring this vocabulary test, one point was given for each correct answer and zero for each incorrect one. Furthermore, as the values of Cronbach's alpha for the pre-and posttest vocabulary achievement test were found to be 0.88 and 0.81, respectively, the vocabulary tests were indicated to possess acceptable reliability (Table 1). Therefore, they could be considered appropriate and suitable for the present study as data collection instruments.

Table 1

The Reliability of the Pre- and posttest on the Vocabulary Achievement Test

Vocabulary Achievement tests	Number of Items	N	Cronbach's alpha
Pretest	30	80	.88
Post-test	30	80	.81

Foreign Language Enjoyment Scale

To measure the participants' level of enjoyment, the Foreign Language Enjoyment Scale (FLES) developed by Dewaele and MacIntyre (2014b) was deployed, which includes three subscales of FLE-Private, FLE-Teacher, and FLE-Atmosphere. It consists of 21 five-point Likert scale items, each scored from 1 to 5 (1 = strongly disagree, 2 =

disagree, 3 = undecided, 4 = agree, 5 = strongly agree). The time for completing the 21 items was approximately 15 minutes. FLES had been validated by Dewaele & MacIntyre (2014a). Also, the questionnaire was pilot-tested with 15 international foreign language learners by Dewaele and MacIntyre (2014b) and was then employed with 1746 foreign language learners.

Moreover, the content validity of FLES was determined through experts' judgments and pilot testing with 30 intermediate-level EFL learners from a language institute in Isfahan. To find out whether there were any ambiguous items and eliminate any misunderstanding on behalf of the Iranian EFL learners, they were asked to fill out the FLE questionnaire. Besides, two applied linguistics professors with a language teacher education background proofread the questionnaire to ensure it was accurately planned for the study. Moreover, several studies have reported the high-reliability index of this scale (Dewaele & MacIntyre, 2014a, 2016). Also, the coefficient alpha reliability of FLES in the present investigation was 0.78, indicating an acceptable level of internal validity.

Mind Meister

Mind Meister is a mind-mapping application based on multi-platforms. It makes it easy for researchers, teachers, and learners to visualize their thoughts through electronic mind maps and make them accessible via cloud or in a standalone file. This software is developed and released for different platforms such as Windows, Android, iOS, and Web to make it handy for various situations. Mind Meister provides a way to visualize information in mind maps utilizing user modeling while providing tools to facilitate real-time collaboration, coordinate task management, and create presentations. Mind Meister is based on a premium model, with a basic account available free of charge, providing limited functionality. The commercial model is built upon four different pricing levels with a choice of monthly or yearly subscription charges. Different functional levels are available for use in the education sector.

Data Collection Procedures

In the study's first phase, 80 participants were selected from a private language institute based on the Oxford Placement Test (OPT). Then, these participants were labeled as high and low-enjoyed learners based on the results obtained from the Foreign Language Enjoyment Scale. Furthermore, there were four groups: the high-enjoyed experimental group (HEEG, N = 20), the high-enjoyed control group (HECG, N = 20), the low-enjoyed experimental group (LEAG, N = 20), and low-enjoyed control (LEAG, N = 20) group. After grouping the participants, all the groups were given the pretest of vocabulary to ensure their homogeneity in terms of vocabulary knowledge before the treatment. Then, a 10-session treatment was started in which all the materials and conditions were the same for all the participants, and the only difference was in the teaching procedure. For the two experimental groups, vocabulary items were taught using Mind Meister, while for the control group, the participants underwent traditional vocabulary teaching. One of the authors conducted the teaching process in all the groups, and the students were provided

with an average of 20 vocabulary items each session. In the CGs, after introducing the vocabulary items and their definitions, the students went through paper-based vocabulary activities, such as paper-based mind-mapping, matching, filling the gap, checking the best options, etc. However, in the EGs, the students used Mind Meister on their smartphones to practice the vocabulary items under the surveillance of one of the researchers. The study for all groups lasted for ten sessions, each for 60 minutes. At the end of the treatment, the participants were given the vocabulary posttest to determine the effectiveness of the treatment.

Data Analysis Procedures

The data analysis process consisted of the following steps. In the first step, the descriptive statistics and the measures of central tendencies were calculated for all the study variables. The mean and standard deviation were calculated to analyze the obtained data from the questionnaire and select the intended sample. Also, the Cronbach alpha method was adopted to ensure the reliability and internal consistency of the questionnaire items. Then, the Kolmogorov-Smirnov test was conducted to check the normality of the data. Finally, ANOVA was run to answer the research questions. Notably, the data analysis was carried out using SPSS version 29.

Results

Preliminary Measurements

To ensure that the scores of vocabularies pre-and posttest for each of the first experimental groups (LEEG) (Pre1- Post1), the second experimental group (HEEG) (Pre2-Post2), as well as the first control group (LECG) (Pre3 and Post3) and second control group (HECG) (Pre4 and Post4), were normality distributed; Kolmogorov-Smirnov Test was employed. The obtained results for the normality of the pretests are illustrated in Table 2 below.

Table 2

The Normality Test for the Vocabulary Pretests for the Four Groups

		Pre1	Pre2	Pre3	Pre 4
N		23	18	22	17
Normal Parameters	Mean	17.23	16.39	17.89	16.71
	Std. Deviation	3.65	3.76	4.65	4.22
Test Statistic		.254	.387	.338	.298
Asymp. Sig. (2-tailed)		.117[c]	.144[c]	.198[c]	.311

As demonstrated in Table 2, since both the Sig value of Kolmogorov-Smirnov tests were greater than 0.05 in all the pretests, it could be concluded that for the four groups of the participants, the dependent variable of the study (vocabulary pretest scores) was normally distributed. The Kolmogorov-Smirnov test revealed a significant level of normality of the vocabulary pretest for the first experimental group (W (23) = 0.254, p = .117) and the second experimental group (W (18) = 0.384, p = .144), the first control group (W (22) = 0.338, p = .198) and the second experimental group (w (17) = .298, p = .311). Thus, the results suggested that the pretest scores of all groups were normally distributed. Furthermore, the results for the normality of the collocation posttests for each of the three groups are indicated in Table 3 below.

Table 3

Normality Test for the Vocabulary Posttest for All the Four Groups

		Post1	Post2	Post3	Post4
N		23	18	22	17
Normal Parameters	Mean	22.11	25.58	18.11	19.23
	Std. Deviation	5.43	2.66	4.24	3.22
Test Statistic		.435	.398	.277	.343
Asymp. Sig. (2-tailed)		.111[c]	.199[c]	.222[c]	.201

According to the results of the Kolmogorov-Smirnov test, which have been demonstrated in Table 3, the Sig value of tests was greater than 0.05 in all the groups; it could be concluded that for the four groups of the participants, the posttests of collocation were normally distributed. The Kolmogorov-Smirnov test revealed a significant level of normality of the collocation posttest 1 (W (23) = 0.435, p = .111), posttest 2 (W (18) = 0.398, p = .199, posttest 3 (W (22) = 0.277, p = .222) and posttest 3 (W (17) = 0.343, p = .201). Accordingly, it was ensured that the posttest scores of all the study groups were normally distributed.

Moreover, before starting the treatment phase, the homogeneity of the participants in terms of initial level of vocabulary knowledge before the treatment (mobile-assisted mind-mapping) was investigated. The findings of the homogeneity tests are illustrated in Table 4 below.

Table 4

Descriptive Statistics for the Four Groups' Scores on Pretest of Vocabulary

Groups	N	Mean	Std. D	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
LEEG	23	17.34	3.67	.13	2.58	3.02
HEEG	18	16.55	4.13	.09	2.77	3.18
LECG	22	17.82	3.87	.15	2.38	2.83
HECG	17	16.33	4.33	.19	2.67	3.12
Total	80	17.01	4.71	.05	2.71	2.93

- LEEG= Low Enjoyment Experimental Group
- HEEG= High Enjoyment Experimental Group
- LECG= Low Enjoyment Control Group
- HEEG= High Enjoyment Control Group

According to Table 4, the Mean scores of the four groups, i.e., LEEG (M = 17.34, SD = 3.67), HEEG (M = 16.55, SD = 4.13); LECG (M = 17.82, SD = 3.87); and HECG (M = 16.33, SD = 4.33) did not differ greatly on the pretest of vocabulary knowledge. To ensure that these descriptive statistics were significant, the result of ANOVA illustrated in Table 4 should be considered.

Table 5

ANOVA for the Mean Scores of the Four Groups in the Vocabulary Pretest

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.518	3	.342	3.28	.376
Within Groups	3241.12	79	.754		
Total	6743.32	77			

As demonstrated in the above table, there was not any significant and meaningful difference between the groups' scores on vocabulary pretest ($F(3, 79) = 3.28$, $p > 0.05$). Accordingly, the results suggested that the participants had approximately a similar

vocabulary knowledge before the treatment and were homogeneous at the start of the study.

Main Statistical Analyses

A one-way between-groups ANOVA was conducted to compare the scores obtained by the intended groups of participants in the posttest of vocabulary**.** In the previous section**,** the homogeneity analyses indicated no pre-existing difference among the participants regarding vocabulary knowledge before the treatment. Therefore, any likely development and improvement of the participants' vocabulary knowledge could be attributed to the effect of the treatment (Mobile-assisted mind mapping). The descriptive statistics for the four groups' scores on the posttest of vocabulary are demonstrated in Table 6 below.

Table 6

Descriptive Statistics for the Four Groups Scores on the posttest of vocabulary

Groups	N	Mean	Std. D	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
LEEG	22	22.98	3.76	.11	3.42	3.86
HEEG	25	25.48	4.87	.11	3.41	3.88
LECG	18	18.39	4.11	.14	2.45	3.04
HECG	19	19.44	3.98	.10	2.67	3.12
Total	80	21.57	2.89	.07	3.08	3.38

- LEEG= Low Enjoyment Experimental Group
- HEEG= High Enjoyment Experimental Group
- LECG= Low Enjoyment Control Group
- HEEG= High Enjoyment Control Group

According to the descriptive results illustrated in Table 6, the mean scores of the first experimental group (LEEG) (M = 22.98, SD = 3.76) in the vocabulary posttest were higher than the first control group (LECG) (M = 18.39, SD = 4.11). This implies that the low-enjoyed EFL learners who underwent the treatment (mobile-assisted mind-mapping) had higher vocabulary knowledge levels than the low-enjoyed EFL learners who were taught through the traditional teaching method.

Further, the Mean score of the second experimental group (HEEG) (M = 25.48, SD = 4.87) in the posttest of writing was higher than the HECG (M = 19.44, SD = 3.98). This means that the highly enjoyed EFL learners who received mobile-assisted mind-mapping possessed a higher vocabulary knowledge than those who underwent the traditional teaching method. ANOVA analysis was run to ensure that the above-mentioned descriptive findings were significant and meaningful. The summary of ANOVA for the groups on the post-survey of SRSU is presented in Table 7 below.

Table 7

ANOVA Analysis for Comparing Mean Scores posttest of vocabulary

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	6564.23	3	92.33	10.22	.000
Within Groups	383.23	79	6.22		
Total	775.57	77			

As illustrated in Table 7, there is a statistically significant difference at the $p < .05$ level in the posttest of vocabulary for the given groups: (F (3, 79) = 10.22, p = .000). It means that the descriptive findings presented in the previous section were statistically significant. Therefore, it was revealed that the high and low-enjoyed EFL learners who received the instruction of vocabulary using mobile-assisted mind-mapping gained much higher scores on the vocabulary posttest compared to the high and low-enjoyed participants in the control group who did not receive any treatment in the form of mind-mapping for vocabulary instruction. Furthermore, the effect size was calculated to obtain a comprehensive result in this section. The effect size for the effectiveness of the treatment in the EFL learners' vocabulary knowledge was found to be 0.58, which, based on Cohen's instruction, indicated a relatively large effect size (Cohen, 1988). In addition, to find out where the exact difference is located, a post hoc comparison using the Scheffe test was run, and the results obtained are presented in Table 8 below.

Table 8

Multi-comparison of the Four Groups Level of Vocabulary Knowledge

(I) Id	(J) Id	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval

					Lower Bound	Upper Bound
LEEG	HEEG	-2.5*	.32	.000	-.49	.46
	HECG	3.54*	.32	.000	.40	1.36
	LECG	4.59*	.32	.000	.24	1.24
HEEG	LEEG	2.5*	.32	.000	-.46	.49
	LECG	7.09*	.32	.000	.41	1.38
	HECG	6.04*	.32	.000	.26	1.22
LECG	HEEG	-7.09*	.32	.000	-1.36	-.40
	LEEG	-4.59*	.32	.000	-1.38	-.41
	HECG	-1.05	.32	.023	-.63	.32
HECG	HEEG	-6.04*	.32	.000	-1.21	-.24
	LEEG	-3.54*	.32	.000	-1.22	-.26
	LECG	1.05	.32	.023	-.32	.63

*. The mean difference is significant at the 0.05 level.

Post-hoc comparisons, using the Scheffe test in Table 8, indicated that the Mean scores for the low-enjoyed participants in the experimental group (LEEG) (M = 22.98, SD = 3.76) and high-enjoyed participants in the experimental group (HEEG) (M = 25.48, SD = 4.87) were significantly different and higher from the low enjoyed (M = 18.39, SD = 4.11) and high enjoyed (M = 19.44, SD = 3.98) participants in the two control groups. Furthermore, there was a significant difference between the two experimental groups (i.e., LEEG and LEEG) in terms of the obtained mean scores in the posttest of vocabulary. More specifically, it was revealed that the highly enjoyed EFL learners who received mobile–assisted mind-mapping as treatment outperformed the highly enjoyed control group by 6.04 points in vocabulary knowledge. Furthermore, the low-enjoyed EFL learners who underwent mobile-assisted mind mapping outperformed the low-enjoyed control group by 4.59 points in terms of vocabulary knowledge. A comparison of the high and low-enjoyed EFL learners who received the treatment revealed that the enjoyed

experimental group gained 2.5 points higher than the low-enjoyed counterparts in the vocabulary achievement test.

Discussion

The first research question examined the effectiveness of mobile-assisted mind mapping as an instructional strategy for enhancing vocabulary acquisition among EFL learners with varying degrees of e-learning enjoyment. The results indicated a significant improvement in vocabulary knowledge for both high- and low-enjoyment learners who received instruction via the mind-mapping technique compared to those subjected to traditional vocabulary instruction. This finding supports prior research by Alba (2022) and Shi and Tsai (2022), who reported that electronic mind mapping facilitates improved vocabulary retention. A plausible explanation for this effect is how mobile devices stimulate inquiry-based learning, as suggested by Suarez et al. (2018). Studies have demonstrated that applications designed for mobile platforms foster deeper inquiry and more effective engagement with learning materials compared to other technological tools (Sung et al., 2016). Sharples et al. (2005) highlight that learning is driven by the learner's mobility rather than the technology itself, a dynamic that emphasizes the adaptability and learner-centered nature of MALL.

While these results are promising, it is important to critically assess the underlying mechanisms that contribute to the observed improvements. The integration of inquiry-based learning within mobile-assisted mind-mapping is likely a key factor in enhancing learners' retention, as inquiry-based learning has been shown to promote deeper cognitive processing and better long-term knowledge retention (Ahmed & Parsons, 2013; Garzón Bernal, 2018; Ibrahim, 2020). However, attributing these outcomes solely to technological tools risks oversimplification. The success of mobile-assisted mind mapping may also be due to its ability to create an optimal learning environment not constrained by time or place, allowing for asynchronous engagement with content. This flexibility may have facilitated learners' sustained interaction with the vocabulary material, improving their performance.

The facilitative nature of mind mapping in vocabulary learning should not be overlooked. Huyen and Nga (2003) noted that mind mapping encourages learners to organize information to enhance memory retention, particularly for vocabulary. Moreover, its multimodal features, including visual and textual cues, align with the principles of effective vocabulary learning proposed by Nation (2001). Including techniques such as colorization, text stylization, and retrieval practices in mind-mapping apps enhances learners' noticing, retention, and generative use of vocabulary. This multimodal approach supports a deeper engagement with language items, enabling learners to internalize vocabulary more effectively. Yet, while mind mapping offers a robust tool for vocabulary learning, it is essential to recognize that the success of such approaches may vary depending on individual learner characteristics, such as cognitive styles or prior language proficiency.

The second research question sought to determine whether a significant difference existed in the effectiveness of mobile-assisted mind-mapping on vocabulary acquisition between EFL learners with high and low levels of e-learning enjoyment. The findings demonstrated a notable disparity in performance, with learners in the high-enjoyment group outperforming their low-enjoyment counterparts by an average of 2.5 points on the vocabulary achievement test. This result underscores the profound influence of affective factors on language learning, aligning with research emphasizing the critical role emotions play in shaping educational outcomes (Namaziandost et al., 2023; Pekrun & Perry, 2014; Rezai, 2023). As Dewaele (2015) argued, positive emotions are not merely peripheral to language acquisition but integral, driving engagement and enhancing cognitive processing.

The relevance of these emotional dynamics is further supported by positive psychology, which has increasingly guided inquiries into the intersection of affect and language learning (MacIntyre & Mercer, 2014; MacIntyre, Gregersen & Mercer, 2016). Positive emotions foster heightened attentional capacities and greater receptiveness to language input, as Dewaele and Alfawzan (2018) suggested. These affective states counterbalance the narrowing effects of negative emotions, which can otherwise restrict learners' cognitive focus and diminish the intake of new language material. Additionally, positive emotions have been shown to cultivate resilience, promoting behaviors such as exploration and collaboration, which are essential to language development (MacIntyre & Gregersen, 2012).

The current study's results resonate with previous research on mind mapping and vocabulary development. For instance, Abate and Tefera (2015) demonstrated the efficacy of semantic mapping strategies in enhancing EFL learners' vocabulary, while Ghuzayyil (2016) similarly found that semantic mapping significantly expanded vocabulary acquisition among nursing students. Such parallels suggest that mind-mapping strategies' cognitive and emotional dimensions offer fertile ground for vocabulary enhancement, particularly when coupled with the motivational boosts provided by e-learning enjoyment.

Moreover, Csikszentmihalyi's (1991) theory of flow provides a valuable lens through which to interpret the influence of enjoyment on learning outcomes. The key components of flow, such as clear goals, deep task involvement, and a sense of control, appear to contribute to the superior performance observed among high-enjoyment learners. Flow theory posits that when learners experience a state of deep enjoyment, they are intrinsically motivated to engage more fully with the task, which in turn enhances learning outcomes. Thus, the present study highlights the importance of fostering positive emotional experiences within the language learning context to optimize cognitive engagement and achievement.

Conclusion and Pedagogical Implications

The study demonstrated that incorporating MALL significantly enhanced Iranian EFL learners' vocabulary acquisition and positively influenced their learning experience by fostering a heightened sense of enjoyment. The observed improvements in vocabulary size could be attributed to the dynamic and interactive nature of the technology-assisted mind-mapping technique, which appears to have provided the EFL learners with more engaging and cognitively stimulating activities than traditional methods. Specifically, using visual elements such as images, symbols, and colors in mind-mapping likely captured the EFL learners' attention, fostering deeper cognitive processing and facilitating a more enjoyable learning environment. These multimodal cues may have enhanced the learners' ability to retain and recall vocabulary more effectively, suggesting a cognitive advantage of visual-spatial learning over text-based approaches. Moreover, the findings indicate that mind mapping supports vocabulary retention and promotes creativity and efficiency in language learning. The technique's ability to link new vocabulary with existing knowledge structures likely enabled the EFL learners to form stronger semantic connections, aiding in recalling and applying new terms across different linguistic contexts. This process, in turn, may have contributed to improved academic performance and higher grades among participants. The data also point to the potential of mind mapping as an especially effective strategy for visual learners who thrive on organizing and representing information through images and diagrams, as opposed to more linear or auditory methods. The significant expansion of the EFL learners' vocabulary due to this approach suggests that mind mapping could be a powerful tool for promoting long-term retention and application of language skills, ultimately leading to sustained improvements in motivation and overall proficiency in English as a foreign language.

The findings of this study hold significant implications for several stakeholders in the field of language education. First, for Iranian language learners, these results provide a valuable perspective on alternative strategies for vocabulary acquisition, particularly highlighting the potential efficacy of mind mapping as a learning tool. By engaging learners in visually structured tasks that incorporate both pictorial representations and verbal contexts, mind mapping can offer a more engaging and participatory learning experience. This could lead to more effective retention and production of lexical items, thus enhancing the learners' ability to apply new vocabulary in practical communication contexts. Second, language instructors may find this study particularly insightful, as it illuminates alternative pedagogical approaches that can support the development of long-term vocabulary retention among learners. Mind-mapping integration, particularly when aligned with task-based learning and problem-solving objectives, allows for a more dynamic classroom environment that fosters creativity and critical thinking. Such methods can reduce learner anxiety, increase motivation, and promote more active participation in the learning process. Third, this approach offers instructors a nuanced understanding of how visual and verbal elements interact to support language acquisition, thereby equipping them with strategies to enhance engagement and learning outcomes.

Fourth, for material developers, the study underscores the importance of incorporating mind-mapping techniques into instructional design. Visual representations of target vocabulary within a structured verbal framework could enhance the effectiveness of learning materials, making them more aligned with the cognitive processes involved in language learning. Developers are encouraged to consider how mind mapping can be integrated into existing curricula to promote deeper engagement with content, thereby supporting learners in their journey toward language proficiency. Fifth, the study's exploration of MALL suggests a need for a paradigm shift in how technology is utilized in language education. While MALL presents substantial benefits for enhancing learner autonomy and engagement, it also requires careful implementation by educators. The increasing reliance on mobile devices in educational contexts necessitates a thoughtful integration of technology that aligns with pedagogical objectives. This study highlights the importance of balancing technological innovation with the foundational principles of effective language instruction, urging educators to consider both the opportunities and challenges associated with MALL.

However, it is important to acknowledge the potential barriers to adopting such technologies. The findings suggest that instructors and students may face difficulties adapting to new methods, particularly in contexts where access to modern technology is limited. In this regard, the study recommends targeted professional development for teachers, emphasizing the need for training to incorporate MALL into their teaching practices effectively. Additionally, providing students an introductory orientation to the technological tools and platforms used in their courses could mitigate challenges and facilitate smoother transitions to tech-enhanced learning environments.

Limitations and Suggestions for Further Research

The present study encountered several significant limitations, each of which constrains the interpretability and generalizability of the findings. First, the reliance on self-report measures introduces issues related to the validity of the data, as such instruments are inherently vulnerable to the participants' subjective interpretations, potential miscomprehensions, and varying levels of willingness to provide candid responses. These limitations in self-reporting raise concerns about the accuracy and reliability of the insights gathered on learner enjoyment within the context of computer-assisted vocabulary learning. To address these concerns, future research could benefit from employing qualitative methodologies, such as in-depth interviews or observational techniques, that may offer more nuanced understandings of learner experiences. Another limitation of the study pertains to participants' varying levels of familiarity with mobile technology and computers. The uneven distribution of technological proficiency across the sample likely influenced individual performance, confounding the results. This factor underscores the need for future studies to control for or account for such disparities in technological expertise to ensure more accurate assessments of learner engagement.

Additionally, the narrow age range of the participants presents a constraint on the broader applicability of the findings. The homogeneity of the sample, in terms of age, limits the extent to which these results can be generalized to a wider population. To mitigate this issue, subsequent research should incorporate participants from diverse age groups and language proficiency levels. Expanding the demographic and experiential range of participants would enable a more robust exploration of learner enjoyment across different contexts.

Moreover, the study's focus on commercial mind-mapping applications rather than educational ones may have further restricted the scope of the findings. Educational apps, specifically designed with pedagogical objectives, might offer more effective means of enhancing vocabulary learning. Therefore, future investigations should consider evaluating the impact of these tools in educational settings. Comparative analyses of commercial versus educational applications could yield valuable insights into their relative efficacy. Finally, it is essential to acknowledge that this research constitutes a preliminary investigation. As an initial foray into this study area, it provides foundational insights but lacks the comprehensive scope for definitive conclusions. Consequently, further research that builds on this groundwork is necessary to produce a more thorough and nuanced understanding of learner enjoyment in computer-assisted vocabulary learning.

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