Research paper

Using Mind Map in Developing EFL Learners' Vocabulary

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Abstract

The use of technology in learning vocabulary can be regarded as a tool assisting English language learning. This study investigated the use of mind mapping software in learning vocabulary among English as foreign language (EFL) learners. In doing so, 62 learners were selected based on a Language Placement test. Then they were randomly divided into two experimental and control groups. The experimental group received vocabulary instruction in the passages of the learners' textbooks and several mind maps were used in the class. Twelve passages including their new words were covered in 12 sessions. The control group received traditional method of reviewing the definitions, using the dictionary, and teachers' explanation. After treatment sessions, they took the post-test of vocabulary designed based on the reading passages. Independent and paired samples t-test were used to compare learners' means of pre and posttests. findings revealed that the learners who used the mind mapping software could perform better than the control group at the significant level. Implications of the study suggest learning vocabulary can be boosted if effective software like mind mapping used in teaching processes.

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Introduction

Teaching vocabulary through Computer-Assisted Language Learning (CALL) activities has been popularly used in English as a foreign/second language learning (English as a Foreign Language/English as a Second Language) contexts (Bhattacharya & Mohalik, 2020). The use of CALL approaches to teaching vocabulary, teachers are also freed from long and boring process of teaching vocabulary and are allowed to deal with other language skills like writing, listening and speaking of language learners (Gorjian, 2008). Thus, for vocabulary instruction,

teachers could make great use of technology by using multimedia activities through appropriate software. Mind mapping software are available on the Internet and they are freely accessible. Thy may be used in a more comprehensible way to boost learners' language achievement. According to Budd (2004), mind mapping software is a graphic organizer in which the major categories radiate from a central image and lesser categories are portrayed as branches of larger branches. This software can be used to reorganize learners' ideas, take notes, develop concepts and ideas, and improve memory (Lin & Chen, 2006). Kintsch and Rawson (2005) believe that learners' comprehension skills can be aided by mind maps as a kind of mental graphic organizers. They further may develop learners' reading abilities. Therefore, incorporating mind mapping software for learning tasks helps students in developing their reading skill and vocabulary achievement (Gorjian, 2017).

Studies in the literature review have highlighted the link between students' attention to text structures and vocabulary role in reading comprehension (Grabe, 2009; Grabe & Stoller, 2002; Jiang & Grabe, 2007). This is a mental awareness that make the learners focus on the text as a context clue and learn the vocabulary in the context of a reading passage (Martinez, 2002; Wang & Cao, 2009). The next issue refers to the link between reading comprehension and the use of various types of visual representations of a vocabulary. This representation of mind may be assumed as semantic maps that are the conceptual frameworks of related hints in hierarchical boxes (Suzuki, Sato & Awazu, 2008). However, the possible impacts of the use of text graphic organizers on L2 learners reading comprehension are in need of problem-solving strategies in which the learners try to move step by step to solve a problem and learn more by adding words to the previous ideas. Jiang (2007) did empirical studies to explore the roles of mental maps in learning contexts. According to the literature of the study, there are many areas to investigate the role of mind map software in learning a language to broaden and deepen teachers of knowledge of mind mapping software for better new word teaching of vocabulary.

Although a considerable amount of research conducted on the link between learners' mind map awareness and reading comprehension (Gorjian, 2017), the area of learning vocabulary has not been investigated regarding the use of mind map software in reading comprehension. 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' achievement of vocabulary. This study has set out with the aim of discovering whether the use of mind mapping software may affect the learners' achievement of vocabulary.

Investigation of the impact of software mind mapping on the learners' activities of as post-reading activities may be beneficial for students learning new words. The present study examines mind map software as a practical strategy in providing the learners with appropriate exposure to their reading comprehension input. Accordingly, research questions addressing the use of mind mapping in learning vocabulary are as follows:

RQ[1]. To what extent does mind mapping software affect learners' vocabulary achievement?

RQ^2. What is the difference between the groups' achievement of vocabulary in the classes with using software of mind mapping and without it?

Literature Review

Learning through visuals helps students in comprehending passages more effectively than other reading strategies like skimming, scanning, note making, etc. According to Slavin (2011), research in pedagogy and psychology demonstrates that visual learning is among the most effective methods for teaching comprehension skills to students of all ages. Helping students organize the content helps them better comprehend texts for information such as main ideas supporting details, facts, opinions, comparisons and contradictions. Ciascai (2009) believes that learners are three types, (1) the learners who learn when they see something (as visualizers), (2) The learners who are listeners and learn when the listen to something (auditory), and (3) the ones who are kinesthetic learners. They are the learners who lear something by moving, hand using, playing, or dancing. Teacher may know the learners and classify them based on their styles in learning. Use of mind maps as visual tools for visual learners could be the best and they may move through the boxes of the maps and this need them to be kinetics as well. In short, we may conclude that, learners who use the mind map strategies can use their visual and kinetics abilities in learning (Nasr-Esfahani, Chalak & Heidari Tabrizi, 2021). If the teacher explains the links between boxes in a map, the learners may arrive at three styles at the same time (Torkashvand, 2015; Wang & Dostal, 2018).

Learners may make a connection between the words in the boxes of maps and this may increase the effectiveness of reading comprehension (Al Shdaifat, Al-Abed Al-Haq & Al-Jamal, 2019). Mind mapping can play a vital role establishing the connections of words in the text and this boost the theme or content of a text they read. Moreover, mind mapping diagrams illustrate learners' concepts and relationships between conceptual words in a text (Baleghizadeh & Yousef Poori Naeim, 2011; Hall & Strongman, 2002; Vaughn & Edmonds, 2006).

Hall and Strangman's (2002) note descriptive or thematic map works well for mapping in providing the learners with required information. This information is designed in a hierarchical relationship, network tree or in a linear relation reflecting supper ordinate or subordinate elements. Various mind maps are useful for specific texts. A spider map can help with organization when the information relating to a main idea or theme does not fit into a hierarchy. A problem-solution outline encourages learners to compare different solutions to a problem. A fishbone map may be particularly useful when cause-effect relationships are complex and non-redundant. A compare-contrast matrix helps students to compare concepts involved in the text. A series of events are designed in chains that can help learners organize information according to steps or stages. Whiteley (2005) believes that mind maps expand on spider maps that have a tree structure with one tree with some branches off in many directions.

Mind Mapping and Learning Vocabulary

Mind mapping software may be used in learning vocabulary if the words are used in the boxes of the map based on the structured outline of the graphic organizer. Mind mapping is a

special software which is a visual representation of knowledge. Mind mapping software structures categories are five including star web, chain, sketch, chart matrix, and tree map. Mind mapping software purposes have eight categories. They are as follows:

KWL (i.e., *K-W-L* stands for "Know", "Want to Know", and "Learned") chart, Venn diagram, zooming in and zooming out – concepts, history frames, word map, zooming in and zooming out –people, Inquiry chart, and column notes. KWL can be used as an activity to introduce a new topic by the teacher. A history frame helps students look at historical events and make relations between the past and present of information. A word map helps students analyze a new data from many different angles and relates the words in the boxes. Zooming in and out – concepts helps the learners students examine complex concepts. An inquiry chart or I-chart is used to organize information obtained during research. A Venn diagram is used to compare two ideas, events or people and makes clear the similarities and differences of an issue. A column is completed the required boxes based on the information gathered (Jiang, 2007).

Mind mapping strategies provide learners teachers with tools to achieve the meaning relations of the words in the passages. They also analyze the key words in the texts and help the learners focus on the target critical and creative thinking elements. In this case, the learners may improve their understanding of the text and classify the content into small understandable boxes or columns. Mind mapping software provides new language that facilitates classroom communication, as well as deepen understanding of the content that teachers work to transmit (Marzano, Pickering & Pollock, 2001).

A review of recent articles indicates that the use of spatial graphic representation of textual information in the construction of reading activities is likely to create positive results in terms of increased comprehension, and the employment of a greater number of strategies (Kools, Van De Wiel, Ruiter, Crüts, & Kok, 2006; Lin & Chen, 2006; Suzuki, 2006; Suzuki, Sato & Awazu, 2008). The findings of recent researches revealed mind mapping activities help students since three activities of listening, seeing and doing are interconnected. On the basis of the findings of Liu, Chen and Chang (2010), it is claimed that mind maps representation of information in a text help both good and poor readers and boost their confidence in learning to read and gain new words in English.

Types of Mind Maps

When the aim is to choose a format of mind map, teachers may think of two things including the structure of the map and the purpose of the reading text. For instance, if the text is dealing with comparing and contrasting issues, the related features of the text structure may be matched with comparative and contrastive map (Figures 7 and 8). Figures 1 through 10 below show examples of mind mapping software developed by Strangman, Hall, & Meyer (2003). These software activities are available on the Internet (e.g., www.mindmup.com). The use of such software is based on the teachers 'experiences. For example, a *Descriptive* or *Thematic Map* (Figure 1) is effective in presenting generic information and lends itself to

highlighting hierarchical relationships. While reflecting a hierarchical set of information, a teacher might want to draw learners' curiosity to superordinate and subordinate elements in the text in a linear and cyclical fashions. In this situation, the workable format to construct would be a *Network Tree* (Figure 2). When the information that is related to a main idea or theme cannot be integrated into a hierarchical structure, a *Spider Map* (Figure 3) could be useful to classify information (Strangman et al., 2003).

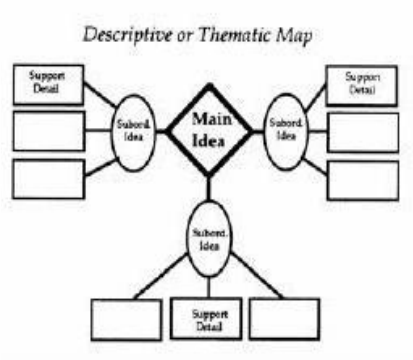


Figure 1 Descriptive map

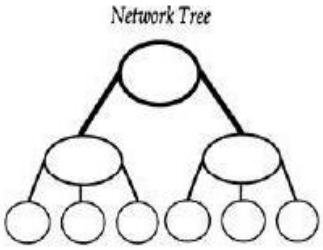


Figure 2. Network Tree

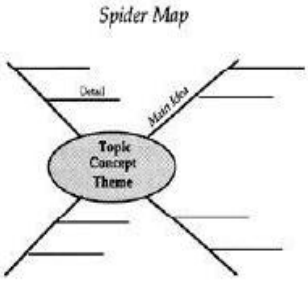
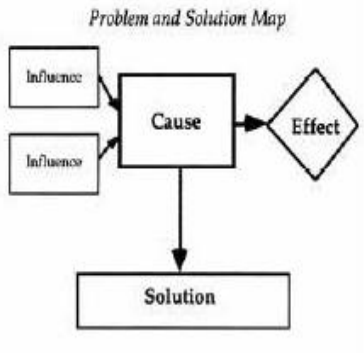
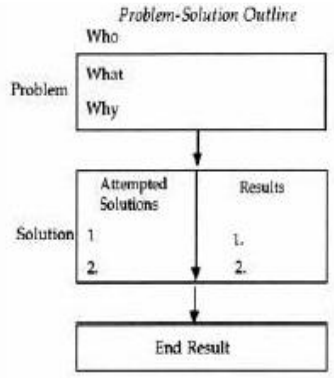


Figure 3. Spider Map

A Problem and Solution Map (Figure 4), a *Problem-Solution Outline* (Figure 5), or a *Sequential Episodic Map* (Figure 6) (Strangman et al., 2003) are used to make a comparison or contrast between the issues in the passage.





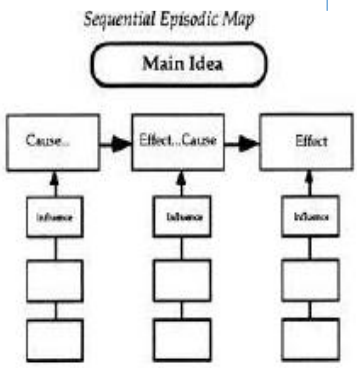


Figure 4. Problem and Solution Map Figure 5. Problem-Solution Outline Figure 6. Sequential Map

A *Comparative and Contrastive Map* (Figure 7) or a *Compare-Contrast Matrix* (Figure 8) let learners to compare and contrast the concepts and realize these concepts in the related columns (Strangman et al., 2003).

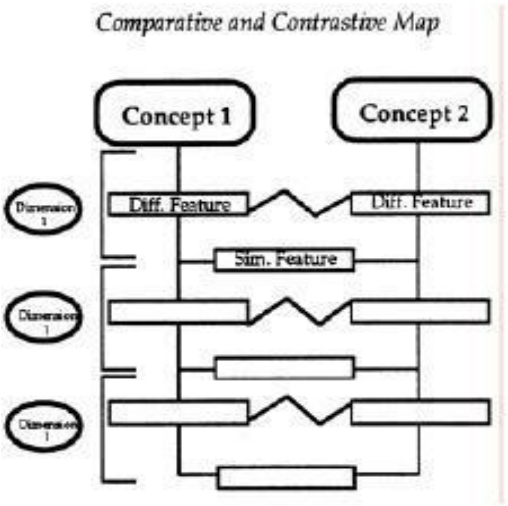


Figure 7. Comparative and Contrastive Map

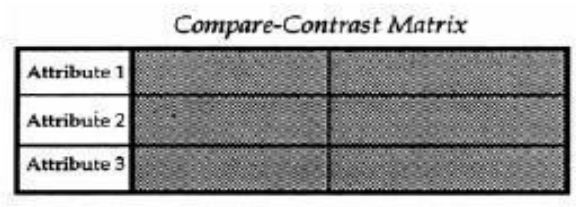


Figure 8. Compare-Contrast Matrix

A *Series of Events Chain* (Figure 9) can be useful in displaying the step by step procedure of the activities in the passage. A *Cycle Map* (Figure 10) makes positive results if the information is cyclical (Strangman et al., 2003) or the staring/ending point is merged.

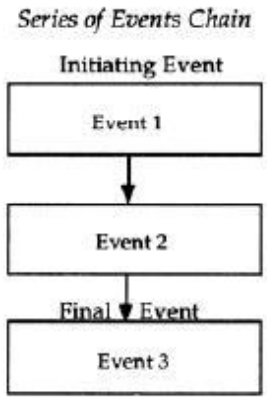


Figure 9. Series of Events Chain

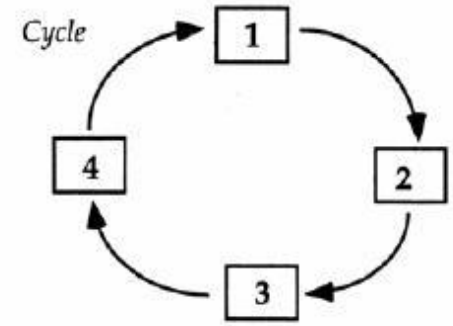


Figure 10. Cycle

Using a pre-fabricated mid map or the one which is designed by the teachers is based on the content of the text and its aim. Constructing mind mapping software as a graphic organizer is a matter of novelty since the teachers may modified or changed the structure of the mind map aligned with the purpose of the text theme. Grabe (2009) believes that mind map formats are available to teachers who use *definitions, comparison-contrast, description/classification, argument, cause-effect, process/sequence, problem-solution, for-against* and *timeline.* However, it is crucial for teachers to meet certain demands while undertaking the task of developing mind mapping software as a tool for teaching specific language skills. Grabe and Jiang (2010) make guidelines that teachers should take into consideration during the

development processes of discourse structure-based mind mapping software. They suggest that mind mapping software could include both micro and the macro level structures of the text effectively. Since the ideas in a given text are ideally logically developed in a sequential manner, the same pattern should be simulated in the organization of mind mapping. Micro structures are as important as macro level ideas. However, it is the teacher who is responsible for paying attention to the micro structures of vocabulary learning and morphological issues in language learning. Macro structures include the coherence of the text features and sentence relations (Grabe & Jiang, 2010; Liu, Zhao & Bo, 2014).

Leaners should be taught on how to use the mind map choices concerned with the purpose and structure of the text. The mind map activities may be used as reading instruction of pre-reading, during-reading and post-reading tasks. The teacher can use a mind mapping software as an adjunct aid to brainstorming in advance of students' exposure to reading materials. With the help of mind mapping software, teachers can help students analyze the text and reorganize the main points of the text in the specific boxes. They be asked to focus on both the semantic relationships among the words they produce and the inter-relationships of their statements. According to Suzuki (2006) mind mapping software might work when students are required to find key points and note information in the text. Mind mapping software can improve active processing and reorganization of information as an alternative to note-taking and summarizing.

Method

Participants

Participants of the study were selected from among Payam-Noor University students in Ahvaz, Iran. The participants of the study were 62 learners majoring in English Language Translation. Their age was ranging 27-38 years old. They were selected out of the research population (n=96) after administering a New Interchange Language Placement test (Richards, 2007). The learners who achieved the scores one standard deviation below the mean were regarded as pre-intermediate learners. The learners whose scores were one standard deviation above and one standard deviation below the mean were selected as the participants of the study. Then they were randomly divided in two experimental and control groups through systematic random sampling.

Instrumentation

Pre and post-test of vocabulary was designed based on the learners' textbook of reading comprehension book. The target words are the new words of 12 passages in the book. The same test was used for both pre and post-tests. They included 42 multiple-choice items. A pilot test was used on a small sample of the learners to determine the reliability and validity of the test. The content validity of the tests was confirmed by two experts in teaching EFL. The post-test was the same in format but several changes were made in the post-test to remove the learners' reminding the test format. The reliability of the tests was calculated through KR-21 formula as ($r_{=}72$, and $r_{=}79$ respectively).

Materials

Twelve reading passages were chosen from a pre-Intermediate textbook of Connect developed by Richards (2009). The passages were chosen based on the schedule planned by the university in 12 sessions. The researcher made used specific passages aligned with the mind map structures, purposes and steps. These structures included *definition, sequence, description, procedure, cause-effect, classification.* Each passage was taught in two sessions and various mind mapping software available in www.mindmup.com that used in the experimental group. The materials for both groups was the same in terms of time allocation and contents.

Procedure

Both groups reported their consent of participating in the research before the experiment. The learners who got the scores within one standard deviation below the mean in the placement test were accepted as the participants of the study. The researcher made the learners familiar with the procedure of the study by using several samples of text structure-based mind mapping software. Experimental and control groups were selected through systematic random sampling. During 12 sessions of instruction, 90 minutes each, 12 passages were worked. The selection of the texts and the development of the related mind mapping software was done by the researcher. The participants of the study knew how to complete the charts and maps and the use of computer software (www.mindmup.com) in the experimental group. In the control group, the learners received the same instruction without the software. They were taught traditionally through using definitions, dictionary, and explanation. In the first week of the experiment, a homogeneity test, that was used as pre-test was administered. Such test was 42 multiple-choice items that got from reading texts, the test material was designed based on the scope of the study. It was made up of 8 passages, totaling 30 items which can be classified into five types of reading questions including: (1) finding the main idea (10), (2) marking the supporting details (8), (3) defining vocabulary (8), (4) guessing (8), and (4) making inferences (8). Each item was worth 1 mark and the sum total of the test was 42, students took the test in 50 minutes.

The students in the experimental group were also trained to download the related maps or charts and use them for different types of passages. They were taught the use of mind map software and they also started creating their own mapping designs. In the following 12 sessions they structured their own mind mapping designs for reading texts in the class and the teacher/researcher checked their validity. Then they outlined the key points of the passages. Finally, they checked whether they used the new words of the passages in their conceptual maps.

The control group followed the same time allocation and materials and read the passages in the class and the teacher/researcher explain the new words, gave the definition, and defined the words. The learners were able to use the dictionary or referred to the Internet to get the meaning by their own. This may be assumed as a conventional method in learning new words o the passages since students were made to read the texts again to understand the content. Then they needed to answer the comprehension questions of the passages. The main issues are the use of context clues to guess the meaning and the directions coming from the teacher/teacher. At the end of treatment sessions, a post-test was administered to both groups. The pre-test was

modified in the format to avoid the learners' reminding the content in the pre-test. It was 42 multiple-choice items designed based on the new words off the passages. The time allocated to the pre and post-test was 50 minutes. Then the data were collected and analyzed the Statistical Package for Social Sciences (SPSS), version 17. The paired and independent samples t-test were used to analyze descriptive and inferential statistics. The aim was to measure the groups' means in the pre and post-test since the effects of the treatment on the groups and the role of mind mapping software in learning vocabulary among the experimental group comparing the control one.

Results

Research questions of the current research addressed to two main issues including the effect of mind mapping software (i.e., www.mindmup.com) on the learners' vocabulary gain. And the exploring of learners' differences in the vocabulary gain in both groups. The effect of treatment in the experimental group can be regarded as the basic element in this research. Results of the comparison between the groups are presented in Table 1.

Table 1.
Pre and posttest in each Group (Experimental vs. Control)

	Groups	Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre-test Experimental	16.56	31	8.56	1.56
	Post-test Experimental	23.30	31	7.55	1.37
Pair 2	Pre-test Control	17.00	31	8.09	1.47
	Post-test Control	18.36	31	6.68	1.22

Table 1 displays experimental groups' mean is (M=16.56, SD=8.56) and control groups' one (M=17.00, SD=8.09) in the pre-test. That indicates a slight difference since both groups' means at the beginning of the research period and gained vocabulary proficiency before the intervention. This table reports the experimental group's mean as (M=23.30, SD=7.55) and control group's one as (M=18.36, SD=6.68). The difference in the post-tests can be analyzed via t-tests to address the possible significant difference between the tests. Results are clarified in Table 2.

Table 2.
Paired Samples Test (Pre and post-test, Experimental and Control groups)

		Paired Differences					t	df	Sig.
					95% Confidence Interval of the Difference				
	Groups	Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Pre vs. post-test (Exper.)	-6.73	11.42	2.08	-10.99	-2.46	-3.228	30	.003
Pair 2	Pre vs. post-test (Control)	-1.36	7.95	1.45	-4.33	1.60	-.941	30	.354

Table 2 shows there are statistically significant differences between the two means of the experimental post-test as (p=0.00<0.01, t=-3.22) while the control groups' means in the post-test is not significantly different. Independent samples t-test can give a comparison between the pre and post-tests of the groups separately. Table 3 addresses the difference between both groups' means in the pre-test.

Table 3.
Descriptive Statistics of Pre-test in both Groups

Groups	N	Mean	Std. Deviation	Std. Error Mean
Experimental	31	16.56	8.56	1.56
Control	31	17.00	8.09	1.47

Table 3 presents the mean scores and standard deviations of both groups of the experimental (M=16.56, SD=8.56) and control (M=17.00, SD=8.09) groups. Independent samples t-test may reveal the possible difference between the two means statistically.

Table 4.
Comparison of Pre-test in Experimental and Control groups

	Levene's Test for Equality of Variances		t-test for Equality of Means						
								95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	.151	.699	-.201	59	.841	-.433	2.15	-4.74	3.87
Equal variances not assumed			-.201	58.8	.841	-.433	2.15	-4.74	3.87

Table 4 shows there is not a significant difference between pre and post-test of vocabulary in the control groups (p>0.05, t=.201). Results depict that that both groups approximately had similar proficiency before the treatment. Descriptive statistics of learners' vocabulary post-testy are presented in Table 5.

Table 5.
Descriptive Statistics (Post-test, Experimental and Control groups

Groups	N	Mean	Std. Deviation	Std. Error Mean
Experimental	31	23.30	7.55	1.37
Control	31	18.36	6.68	1.22

Table 5 displays that the experimental group (M=23.30, SD 7.55) scored better presentation compared with the control group (M=18.36, SD=6.68). An independent sample t-test was run to figure out the exact difference between the groups' means at the significant level in the post-test in the Table 6.

Table 6.
Comparison of Post-test in Experimental and Control groups)

	Levene's Test for Equality of Variances		t-test for Equality of Means						
								95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	.007	.935	2.679	59	.010	4.93	1.84	1.24	8.62
Equal variances not assumed			2.679	58.1	.010	4.93	1.84	1.24	8.62

Table 6 indicates there is a significant difference between the control and experimental groups' means in the post-test since the difference is at (p>0.05, t=2.679). In other words, the experimental group outperformed the control one in the post-test.

Discussion

Discussion section addresses the results of the study regarding the groups' pre and post-test mean scores in the treatment sessions. Research question one refers to the effectiveness of mind mapping software on learners' vocabulary achievement. Findings of the study showed that there was a significant difference between the post-tests of both groups' means regarding learners' vocabulary gains. This agrees with Gorjian (2017) who emphasizes the effectiveness of technology on learning language skills. He focuses on the role of computer software and mobile apps as available and inexpensive pedagogical tools in learning vocabulary. This effectiveness may be outstanding if we think of the classes that are closed during COVID-19 pandemic. The role of technology and its various tools that could change the face-to-face classes into virtual classes without any hazard coming from the crackdown of the universities and schools since we have faced such a disaster for about two years.

The use of mind mapping software may provide teachers with English language teacher-researchers with a twofold purpose. Firstly, they access to ample of documents, materials, and data that are cheaply available. They are also context free that means they are available everywhere at any time. Thus, they are not bounded to time and place. Learners may use the

recorded classes at any time and do the exercises when they are out of the class (a)synchronously. The teachers can use computer mind mapping based on the subject and themes of the passages to follow the specific structures and purposes of the texts. Using mind mapping strategies and computer-based systems that use various types of content, such as text, audio, video, graphics, animation, and interactivity may give the chance to the teachers and learners to think of novelty and innovation in trying new ways and methods in teaching and learning vocabulary.

A study conducted by Wang and Cao (2009) supports the results of the current study. It has provided empirical evidence for the assumption that mind mapping structure awareness that has a positive effect on the learners' quality and quantity of information. In the same vein, the findings of the study are in line with Bhattacharya and Mohalik (2020) who worked on digital mind mapping software as a new horizon in the modern teaching-learning strategy. They concluded that link between increasing students' awareness of mind mapping in learning language skills can enhance their reading performance. Findings are also agreeing with Martinez (2002) who notes learners can identify novel context for reading and gain textual meaning that scaffolds their recall and retention. In sum, teachers may focus on the positive effects of using mind mapping strategy on reading comprehension and even reproduction of information in the mind mapping grids and boost in the processes of learning vocabulary. The second research question of the study is:

Research question two addresses the difference between the groups' achievement of vocabulary in the classes with using software of mind mapping and without it. Findings showed that mind mapping software makes a difference between the experimental and control groups at the significant level. This is matched with Grabe (2009) who worked on reading in a second language and believe that audio-visual stimuli facilitate learning and this can be achieved via technology. The difference can be the results of new look at the innovations coming from technology that are absent in most traditional classes. Teachers may pay attention to the novelties that can enhance learners' motivation and enthusiasm in learning vocabulary in different contexts. Thus, mind mapping context may provide learners with new area in which the learners can move toward prefabricated or self-made grids for outlining the passages they read in the class.

There are several studies that confirm the results of the study (e.g., Bhattacharya & Mohalik, 2020; Gorjian, 2017; Jiang, 2007; Liu, Chen & Chang, 2010) reviewing the role of mind mapping and conceptual maps as an effective cognitive process in designing spatial reality of the key concepts of a text. This may be regarded as a map of following the road of comprehensibility of a text. This can guide the learners read the text and then outline it in a hierarchical or cyclical manner to make relations between the ideas of a passage. Mind mapping strategy can facilitate learners' cognitive processes in terms of putting together the pieces of information and making the whole picture of the passage in several boxes that are interconnected. The mind map of a reading passage may give immediate understanding of the

passage regarding the theme or the subject of the text in a very short time. It also may reduce the learners' burden of thinking processes and make reading comprehension enjoyable.

Conclusion

The main purpose of the current research is to assess the effectiveness of mind mapping strategy creating a meaningful environment by the help of mind mapping software promoting the vocabulary skills of learners and overcome limitations of a successful comprehension. Moreover, the results of the study help learners to strengthen their cognitive abilities. Teaching vocabulary through mind mapping strategies could be successful since traditional methods may be time-consuming like looking up the meaning of new in the printed dictionaries or just listening to teachers' explanations. Computer technologies can support learning vocabulary if the teachers are competent enough to examine new methods of teaching language skills. This chance has been achieved in many countries due to the crisis of COVID-19 pandemic that closed many face-to-face classes. This could be a good time to assess all e-learning and virtual classes in which mind mapping software can be used via various online and offline Apps. Implications of the study suggest the use of recent technologies in facilitating vocabulary learning which is the backbone of language learning. Furthermore, teachers should pay more attention to various e-teaching tools that help learners' vocabulary development, both traditional, and technology-enhanced. Using mind mapping software can give autonomy to the learners to find or design their own appropriate grids aligned with the passages they are going to study.

Results have indicated that ideal mind mapping software aim at enabling students to recognize the interrelationships and patterns of organization in a text. Furthermore, it is useful if the content of the text is taught aligned with the related mind map since the selection of mind map can be effective in learning the task. Further investigations are needed to explore the role of mind mapping software in developing learners' cognitive and metacognitive reading styles. There is also a need to do the future research on the role of various mind mapping Apps in teaching language skills. In doing so, the textbook designers may incorporate mind mapping techniques in text-books not only for teaching vocabulary but also for teaching other language skills and subskills.

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