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The Effect of Mind Mapping on Vocabulary Learning and Retention

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Abstract – This study attempted to explore the effect of mind mapping on vocabulary learning and its retention. To fulfill this purpose, 40 Iranian male first-grader high school students from two intact classes in Shahed High School in Hamedan, Iran, were selected conveniently and were randomly assigned to the experimental and control groups, each including 20 male students. Before the treatment, a researcher-made vocabulary pre-test was administered to the groups. As to the experimental group, vocabulary was taught by a myriad of mind mapping options such as color, symbols, keywords, design, images, and chunks. The control group was taught through traditional techniques such as translation into L1 and provision of synonyms and antonyms. Then, a researcher-made posttest was administered to the groups. To analyze the data Multivariate Analysis of Covariance (MANCOVA) was run. The major finding of the current study was that teaching English vocabulary through the use of mind maps could help the experimental group outperform the control group on the delayed posttest. The findings of this study have some pedagogical implications for the language learners, language teachers, and syllabus designers.

Keywords: mind map, vocabulary learning, retention

1. INTRODUCTION

Vocabulary learning is a vital part of education. Some scholars such as Nation (2001) have viewed vocabulary as the most important component of language learning. Language learning, whether first or second, starts with learning words. Vocabulary learning is an incremental process and never stops in the course of learning and using a language (Thornbury, 2002). So, the more words one knows, the more he/she equips himself/herself with a good body of vocabulary knowledge, and the greater ability he/she will have to express his/her thought in a comprehensive, efficient way (Nation & Chung, 2009).

Vocabulary, as Brown (2001) states, forms the building block of any language. Vocabulary is "a core component of the language proficiency and provides much of the basis for how well learners speak, listen, and write" (Richards & Renandya, 2002, p. 255). Without having a comprehensive body of vocabulary and clear-cut strategies for acquiring new vocabulary, learners often fail to fulfill their potentials and may lose their enthusiasm in using opportunities available around them (Richards & Renandya, 2002).

In the past, vocabulary teaching and learning were often given scant attention in language programs, but recently we have witnessed a renewed surge of interest in the nature and the role

vocabulary plays in learning and teaching a language (Richards & Renandya, 2002). This can be attributed to the fact that traditionally it was believed that vocabulary knowledge can be gained incidentally in an automatic fashion, so attention was given to other aspects of language such as grammar, reading or speaking (Brown, 2001). But nowadays, the status of vocabulary seems to be changing (Richards & Renandya, 2002).

According to Nation (2001):

> "learning vocabulary is a cumulative process and that it must be deliberately taught, learned, and recycled. This is critical for several reasons: 1) learners need to encounter the words in a variety of rich contexts, often requiring up to sixteen encounters, 2) learners remember words when they have manipulated them in different ways, so variety is essential for vocabulary teaching, and 3) learners forget words within the first twenty-four hours after class, so it is important to follow up a vocabulary lesson with homework that recycles the words" (p. 4).

Vocabulary is a very important component within a language as meaning is carried out lexically (Hunt & Beglar, as cited in Richards & Renandya, 2002). Learning a language cannot be diminished to, of course, only learning vocabulary but, it is also true that no matter how well the student learns grammar, no matter how successfully the sounds of L2 are mastered, without words to express a wide range of meanings, communication in an L2 just cannot happen in any meaningful way (Brown, 2007).

Mind mapping is a pedagogical technique which involves creating diagram for visual presentation of ideas. The diagram is focused on a main concept which is placed in the center and therefore certain ideas, words or even phrases related to main concept can be connected (Rabeka, 2014). Mind-maps have been considered as very beneficial teaching tools by some experts (Budd, 2003; Fiktorius, 2013; Hofland, 2007; Murley, 2007).

As Hofland (2007) mentioned, mind mapping is a way that provides L2 learners with more meaningful repetitions and retention of the new words in any target language. By using pictorial and graphical design, mind mapping can provide a more vivid teaching atmosphere which promotes memory retention as well as the motivation of the learners (Liu, Zhao, & Bo, 2014).

Mind maps are pictorial techniques which facilitate knowledge acquisition and retrieval of information through the use of visual clues such as images, shapes and colors (Budd, 2004). Mind maps are specifically beneficial for young learners to recall their memories. Based on Miao (2007), teaching and learning a foreign language by the use of the mind-mapping is very effective and enjoyable, because they aid to motivate L2 learners to study and employ new words, concepts, notions and themes regularly and effortlessly.

Al-Jarf (2011) defined the concept of mind as follows:

> 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. It is a visual tool that can be used to generate ideas, take notes, organize thinking, and develop concepts. Teachers can use it to enhance learning. It is helpful for

> visual learners as an illustrative tool that assistswith managing thought, directing learning, and making connections. It is a skill that cuts across ability levels and encompasses all subject matters. It enables students to better organize, prioritize, and integrate material presented in a course. (p.4)

Leyden (2015) suggested the following mind mapping strategies for teachers: pre-class, in-class, and out-of-class strategies. This paradigm of tree phases can be implemented for teaching a foreign or second language. Pre-class mind-map strategies include strategies such as planning, organizing, preparing the materials for learning, setting the ground for classroom discussion, encouraging the learners to study before attending the class, and activating the previous knowledge about a specific topic which is the focus of the L2 class for the upcoming session (Buzan, 2005; Hofland, 2007). In-class teaching strategies can also be designed based on mind maps. A vast range of other in-class strategies can be referred to which enhance L2 learners acquisition of the target language which promote creativity, motivation, enthusiasm, cooperation, peripheral and focused learning, and authentic interaction between learners. Outside class strategies include collaboration, assessment, and comprehension. Students can easily work together on group projects or assignments using free online study tools such as Exam Time where they can share your mind map with friends or a group of people.

Liu, Zhao and Bo (2014) explored the role of mind mapping on teaching and learning. To this end, a meta-analysis of related studies was conducted and experimental and quasi-experimental studies were reviewed. The meta-analysis shows that mind-mapping has positive effect on teaching and learning.

Horst (2005) conducted an investigation on the impact of extensive reading on the development of foreign language vocabulary and found that extensive reading not only promotes the quantity of L2 vocabulary but it also increases the quantity of the vocabulary knowledge.

2. METHODOLOGY

2.1 Research Question

Does mind-mapping have any significant effect on Iranian EFL first-grader high school students' vocabulary development and retention?

2.2 Research Hypothesis

Mind-mapping does not have any significant effect on Iranian EFL first grade-one high school students' vocabulary development and retention.

2.3 Participants

The sample of this study was 40 male Iranian high school students who were conveniently selected from two intact classes. Their age ranged from 14 to 16 years old. Then, they were randomly assigned into two equal groups, experimental (mind mapping group) and

control, 20 participants in each. The selected participants were from different social strata and their mother tongues were Persian, Kurdish, and Turkish. They had no other language learning experience based on their own reports except for the instruction they had received during the school years in junior and high schools.

2.4 Instruments

Three instruments, a pretest, a posttest, and a delayed posttest were used in this study to collect the necessary data. Each one is described below.

2.4.1 Pre-test

This was a researcher-made test consisting of 40 multiple choice vocabulary items. The text upon which the items of the test were made was the English course book for the first grade high school students entitled English Book 1, developed by Birjandi et.al (2013). Out of the forty items in the test, fifteen, thirteen, eight, and four items were devoted to nouns, verbs, adjectives, and adverbs, respectively. The reason why these proportions of different parts of speech were included in the test was the frequency of the word type in the text. The book had 840 new words: 315 nouns, 273 verbs, 168 adjectives, and 84 adverbs.

Since the test was a researcher-made one, it needed to be piloted. The allocated time for answering the test was one hour. So it was administered to 35 Iranian grade one high school students and Cronbach's Alpha was run to estimate its reliability which was found to be .85.

2.4.2 Post-test

After the treatment, an equivalent vocabulary test with the same features but different similar items was used as the post-test. The number of the items and the proportion of item for each part of speech was the same as the pretest. It had 40 multiple-choice items: 15 nouns, 13 verbs, 8 adjectives, and 4 adverbs. The difference was that the stems and the alternatives chosen for each item were different. The Cronbach's alpha reliability for this posttest in the pilot study turned to be .83. The time allocated for answering the test was one hour.

2.4.3 Delayed Post-test

The same posttest was given to the participants in the experimental and the control group a month after its first administration. The purpose of using this delayed posttest was to examine if the special treatment of this study given to the experimental group and the traditional treatment given to the control group participants had any significant impact on the vocabulary retention of Iranian grade-one high school students.

2.5 Instructional Materials

The materials used were from the English course book for the first grade, high school students entitled English Book 1, compiled by Birjandi et.al (2013) published by Ministry of Education. This book had nine unites and two exercise reviews in 102 pages.

2.6 Procedure

Two intact classes in Shahed High School in Hamedan, Iran, were conveniently chosen for the purposes of the current investigation. The students were randomly assigned to experimental and control groups. Each group included 20 male students. The researcher-made vocabulary pre-test was administered to all participants to capture the initial differences and check their homogeneity regarding their vocabulary knowledge before the treatment. The students' vocabulary was homogeneous for the two groups of students present in this study.

The teacher produced the first mind map to show them how to develop these vocabulary organizers during the treatment. Before engaging in developing the mind maps, students in the experimental group were divided into five groups of equal size group to better handle the use of mind maps for teaching of EFL vocabulary.

The students put the key word in the middle of the page and then branched out in different directions by the words which were more directly related. Then other less related secondary words were connected to the higher words. Students could use any geometrical shape including rectangles, circles, triangles, clouds around each word in the organization of their mind maps. They were also required to draw and develop mind-maps with pencils to have the chance to change them more easily.

Later, the experimental group was taught vocabulary by a myriad of options in mind mapping such as color, symbols, keywords, design, images, chunking and brainstorming. Each lesson provided student with one or two primary themes and two or more secondary ones. These themes were the main topic of the lessons. For example, for lesson 1 it was "kindergarten" and for lesson 2, it was "farmhand monkeys". When students produced the related mind maps for all the themes, they were asked to connect all of them through the most directly related words in the adjacent theme(s).

No special shape, direction, or pattern was imposed by the teacher when learners attempted to branch out their mind-maps on the A4 pages or whiteboard. The students in each sub-group received feedback from their peers and when necessary from their teacher. After the final mind-maps, the teacher assessed them in their skill to draws mind maps and asked students to improve producing the maps for the next session.

Next, one or two of the groups were asked to go to the whiteboard and draw their mind maps for other groups and receive their corrective feedback. Such feedback was absent for the control group. The students were asked to use different colors, shapes, or branches to highlight the strength of the word relationships. Students in the experimental group were taught to use

lines, arrows, branches, and other symbols to show the connection between the central word, primary words (nodes), and secondary words (nodes).

Cooperation between learners was emphasized and encouraged by the teacher to produce the most relevant and the largest possible mind-maps. And when each team needed help or guidance, the teacher assisted them both with the exact meaning of the words and with the plausible relationships between the included words.

Final step involved some follow-up activities for the students in the experimental group after drawing the mind-maps. For example, the teacher asked the students to write a short paragraph or composition about the mind-map and around the central theme or the key word to learn the words better. Some students were also asked to talk about the mind-map and try to explain or describe it. To make a more artistic mind-map, the teacher sometimes asked the student to draw some symbols or images representing each keyword if they were possible. The teacher also encouraged all the students to engage in conversations about favorite themes related to their developed mind-maps.

This treatment was given to the 20 learners in the experimental group for a whole semester (3 months), twice a week. Each session lasted from 70 to 90 minutes. All the sessions were held in the same class at 10 to 11:30 am.

The control group was taught through traditional techniques such as translation into L1 and provision of synonyms and antonyms. No treatment using the mind-maps was given to the control group. It was mostly a teacher-centered class. In this class, the teacher translated the English words into Persian and sometimes mentioned some synonyms and antonyms for the words and no other special technique was adopted for teaching vocabulary. The students were required to memorize the words based on their Persian translation equivalents or synonyms and they did not receive feedback from the teacher. This treatment was repeated the same for all the class sessions.

After the treatment, a researcher-made post-test, equivalent to the pre-test was administered to the participants. The purpose for this first administration of the posttest was to scrutinize the vocabulary development of the study participants after giving the treatment. Then, after a month, the same vocabulary posttest known as the delayed posttest was taken by the participants in the two groups in order to check their vocabulary retention.

3. RESULTS

Since pretest or covariate is assumed to affect the groups' scores on the posttest and there were two dependent variables (vocabulary learning and retention) the researchers ran MANCOVA to adjust or remove the effect. The results of all statistical operations are presented below.

Table 1: ***Tests of Normality showing the Normal Distribution of the Groups' Scores on Tests***

Tests of Normality [a]

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	group	Statistic	df	Sig.	Statistic	df	Sig.
pretest	experimental	.115	20	.200*	.967	20	.694
posttest	experimental	.103	20	.200*	.960	20	.539
delayed	experimental	.129	20	.200*	.954	20	.431

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

b. group = experimental

As it is evident in Table 1, the experimental group's scores on tests were distributed normally, that is, $p > 0.05$ in any case.

Table 2: ***Tests of Normality showing the Normal Distribution of the Groups' Scores on Tests***

Tests of Normality [b]

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	group	Statistic	df	Sig.	Statistic	df	Sig.
pretest	control	.097	20	.200*	.983	20	.970
posttest	control	.108	20	.200*	.971	20	.774
delayed	control	.115	20	.200*	.974	20	.831

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

b. group = control

As it is evident in Table 2, the control group’s scores on tests were distributed normally, that is, $p > 0.05$ in any case.

Table 3: ***Descriptive Statistics of the Groups***

group		pretest	posttest	delayed
experimental	Mean	17.30	26.95	25.75
	N	20	20	20
	Std. Deviation	4.131	4.628	4.518
	Minimum	10	20	19
	Maximum	24	35	34
	Kurtosis	-1.006	-1.094	-.953
	Skewness	-.093	.060	.330
control	Mean	16.50	22.45	18.15
	N	20	20	20
	Std. Deviation	4.261	4.249	4.082
	Minimum	9	15	11
	Maximum	25	30	26
	Kurtosis	-.545	-.756	-.754
	Skewness	.272	-.101	.205
Total	Mean	16.90	24.70	21.95
	N	40	40	40
	Std. Deviation	4.162	4.942	5.733
	Minimum	9	15	11
	Maximum	25	35	34
	Kurtosis	-.877	-.538	-.498
	Skewness	.083	.090	.225

Table 3 clearly shows various descriptive indexes or parameters (mean, number, standard deviation, minimum and maximum scores, skewness, and kurtosis) of the groups' scores on tests. As it is evident the mean scores of the groups have dropped from posttest to delayed posttest. The experimental group's mean score was 26.95 on the posttest and it decreased to 25.75 on the delayed posttest. As to the control group, its mean score on the posttest was 22.54 which decreased to 18.15 on the delayed posttest.

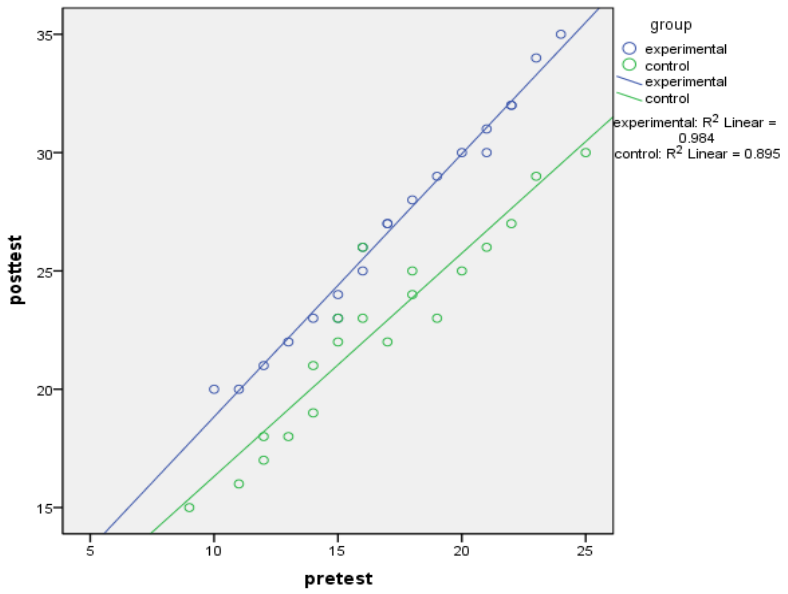

***Figure 1*: The Linear Relationship between the Scores of the Groups on Pretest and Posttest (posttest 1) and the Homogeneity of Regression Lines.**

As the figure shows there is a linear relationship between the groups' scores on the pretest and posttest.

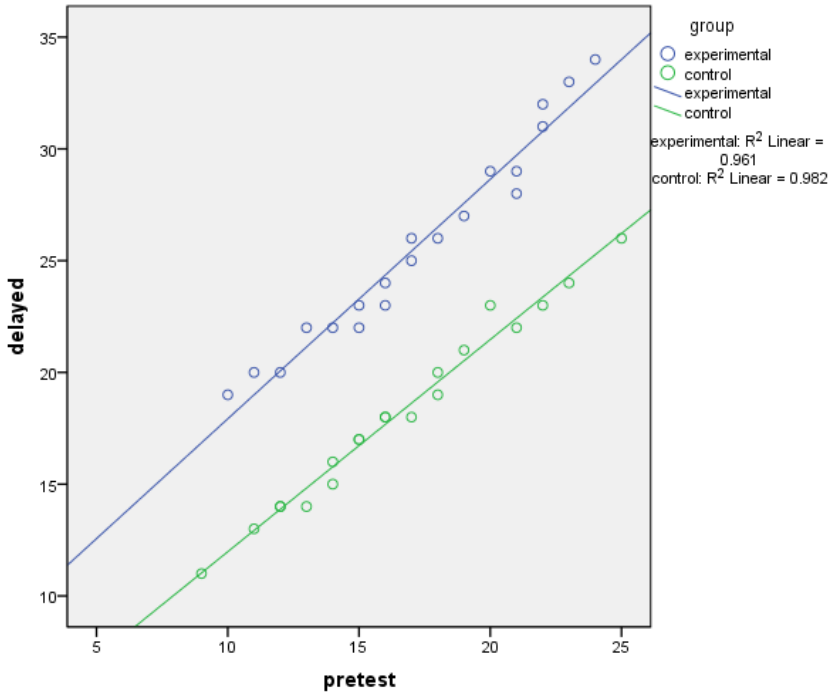

***Figure 2*: The Linear Relationship between the Groups' scores on pretest and delayed posttest and the Homogeneity of Regression Lines.**

As the figure shows there is a linear relationship between the groups' scores on the pretest and delayed posttest (posttest 2).

Table 4: ***Tests of Between-Subjects Effects Showing the Homogeneity of Slope of Regression Lines***

Dependent Variable :posttest					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	910.022[a]	3	303.341	257.687	.000
Intercept	117.719	1	117.719	100.002	.000
group	.390	1	.390	.332	.568
pretest	705.712	1	705.712	599.500	.000
group * pretest	4.710	1	4.710	4.001	.053
Error	42.378	36	1.177		
Total	25356.000	40			
Corrected Total	952.400	39			

a. R Squared = .956 (Adjusted R Squared = .952)

As Table 4 shows, the slope of regression lines is homogeneous for groups concerning dependent variable or the scores of posttest [$F_{(1,36)} = 4.001$, $p > 0.05$].

Table 5: ***Tests of* Between-*Subjects Effects Showing the Homogeneity of Regression Lines***

Dependent Variable :delayed					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1260.962[a]	3	420.321	722.692	.000
Intercept	51.849	1	51.849	89.149	.000
group	12.291	1	12.291	21.134	.000
pretest	682.765	1	682.765	1173.932	.000
group * pretest	2.512	1	2.512	4.319	.051
Error	20.938	36	.582		
Total	20554.000	40			
Corrected Total	1281.900	39			

a. R Squared = .984 (Adjusted R Squared = .982)

As Table 5 shows the slope of regression lines is homogeneous for groups concerning dependent variable or the scores of delayed posttest [$F_{(1,36)} = 4.319$, $p > 0.05$].

Table 6: ***Box's Test of Equality of Covariance Matrices***[a]

Box's M	4.907
F	1.542
df1	3
df2	259920.000
Sig.	.201

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept + pretest + group

As Table 6 shows the observed covariance matrices of the dependent variables (posttest and delayed posttest) are equal across groups [$B_{(3,\ 259920)} = 4.907$, $p > 0.05$]. So, this important requirement of running MANCOVA is fulfilled.

Table 7: ***Multivariate Tests Showing the Difference in Linear Combination of the Dependent variables between the groups***

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.785	65.889[a]	2.000	36.000	.000	.785
	Wilks' Lambda	.215	65.889[a]	2.000	36.000	.000	.785
	Hotelling's Trace	3.661	65.889[a]	2.000	36.000	.000	.785
	Roy's Largest Root	3.661	65.889[a]	2.000	36.000	.000	.785
pretest	Pillai's Trace	.972	614.107[a]	2.000	36.000	.000	.972
	Wilks' Lambda	.028	614.107[a]	2.000	36.000	.000	.972
	Hotelling's Trace	34.117	614.107[a]	2.000	36.000	.000	.972
	Roy's Largest Root	34.117	614.107[a]	2.000	36.000	.000	.972
group	Pillai's Trace	.951	352.344[a]	2.000	36.000	.000	.951
	Wilks' Lambda	.049	352.344[a]	2.000	36.000	.000	.951
	Hotelling's Trace	19.575	352.344[a]	2.000	36.000	.000	.951
	Roy's Largest Root	19.575	352.344[a]	2.000	36.000	.000	.951

a. Exact statistic

b. Design: Intercept + pretest + group

Based on the results of Wilks' Lambda in Table 7 , the main effect of the treatment has been highly significant, that is, the independent variable (mind map) has had positive effect on the dependent variable [$F_{(2, 36)} = 352.344$, $p < 0.001$, $\eta^2 = 0.951$]

Table 8: ***Tests of Between-Subjects Effects for the Effect of Group on the Dependent Variables***

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	posttest	905.312[a]	2	452.656	355.678	.000	.951
	delayed	1258.450[b]	2	629.225	992.819	.000	.982
Intercept	posttest	120.577	1	120.577	94.745	.000	.719
	delayed	53.220	1	53.220	83.973	.000	.694
pretest	posttest	702.812	1	702.812	552.241	.000	.937
	delayed	680.850	1	680.850	1074.275	.000	.967
group	posttest	134.152	1	134.152	105.412	.000	.740
	delayed	457.086	1	457.086	721.210	.000	.951
Error	posttest	47.088	37	1.273			
	delayed	23.450	37	.634			
Total	posttest	25356.000	40				
	delayed	20554.000	40				
Corrected Total	posttest	952.400	39				
	delayed	1281.900	39				

a. R Squared = .951 (Adjusted R Squared = .948)

b. R Squared = .982 (Adjusted R Squared = .981)

Table 8 shows a significant difference between the performances of the groups on the posttest [$F_{(1, 37)}$= 105.412, p < 0. 025, Eta = 0.740] and delayed posttest [$F_{(1,37)}$ = 721. 210, p < 0. 025, Eta = 0.951].

Note: Based on Boferroni's correction p-value should be calculated as: $\alpha' = \frac{\alpha}{2} = \frac{0.05}{2} = 0.025$

Table 9: ***Estimated Marginal Means***

				95% Confidence Interval	
Dependent Variable	group	Mean	Std. Error	Lower Bound	Upper Bound
posttest	experimental	26.540[a]	.253	26.028	27.052
	control	22.860[a]	.253	22.348	23.372
delayed	experimental	25.347[a]	.178	24.985	25.708
	control	18.553[a]	.178	18.192	18.915

a. Covariates appearing in the model are evaluated at the following values: pretest = 16.90.

Based on Table 9, the experimental group's adjusted mean score was 26.540 on the posttest and it decreased to 25.374 on the delayed posttest. As to the control group, its adjusted mean score on the posttest was 22.860 which decreased to 18.553 on the delayed posttest. Since the experimental group's adjusted mean scores were higher than those of the control group, this implies that the participants in the experimental group who had received mind map were able to keep the taught vocabulary in their mind for a longer time than the participants in the control group did.

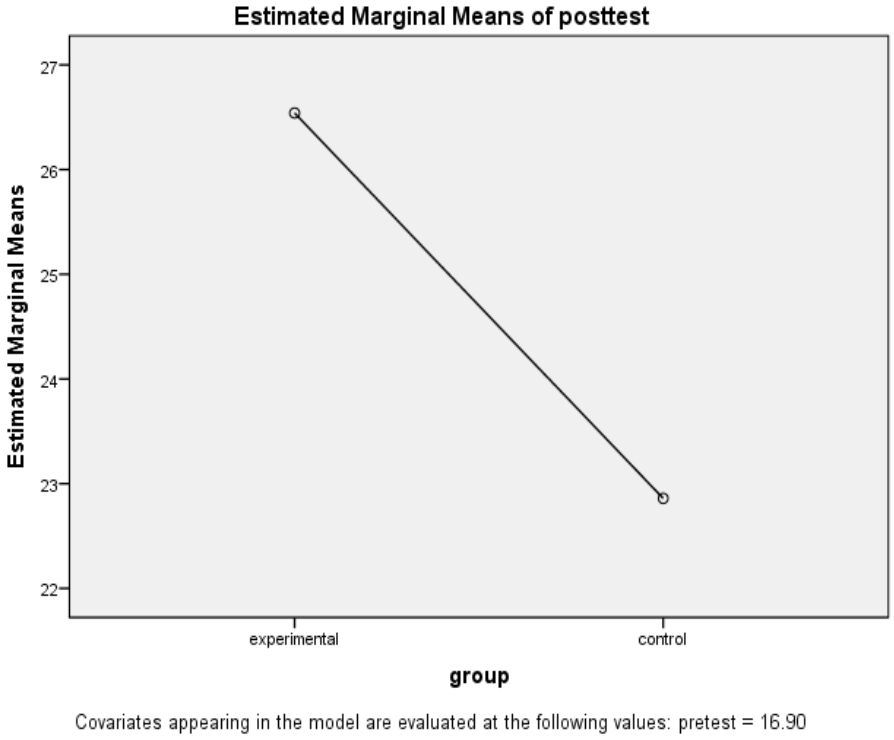

Figure 3**: The exhibition of the status the Groups' Estimated Marginal Means on the Posttest**

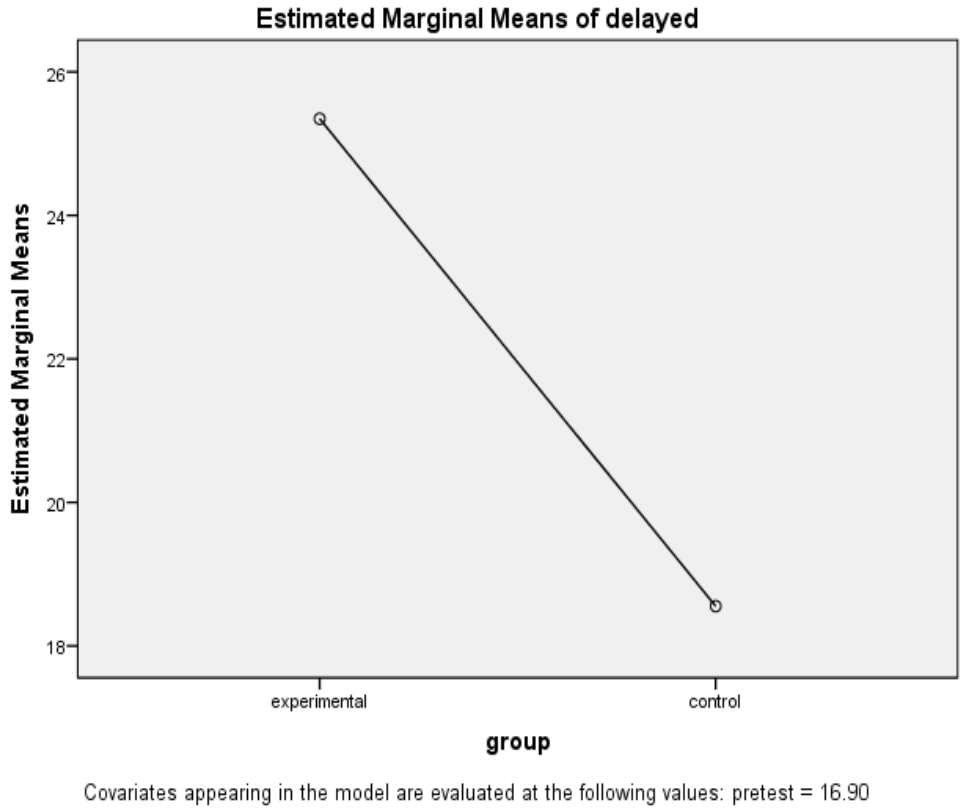

***Figure 4*: The exhibition of the status the Groups' Estimated Marginal Means on the Delayed Posttest**

4. DISCUSSION

The results of data analysis showed that there was difference between the performances of the groups on the posttest [$F_{(1, 37)}$= 105.412, p < 0. 025, Eta = 0.740] and delayed posttest [$F_{(1,37)}$ = 721. 210, p < 0. 025, Eta = 0.951]. That is, the students in the experimental group who received the treatment in the form of mind maps outperformed the control group on the posttests. The decline for the posttest scores to the delayed posttest was less for the experimental group. The experimental group's adjusted mean score was 26.540 on the posttest and it decreased to 25.374 on the delayed posttest. However, the adjusted mean score on the posttest for the control group was 22.860 which decreased to 18.553 on the delayed posttest. So, the main finding of the current study was that teaching English vocabulary through the use of mind maps could help Iranian first-grader high school students learn and remember L2 vocabulary more easily.

This finding may be explained as follow. First, students who used mind mapping strategies in learning EFL vocabulary in the experimental group integrated the newly acquired words with the old previously learned ones. Integrating and relating the new words with the

earlier established vocabulary repertoire promotes the deep level semantic processing and directly fosters the learning, storage, and retrieval of these words (Al-Jarf, 2011; Nation, 2001).

Second, mind maps helped first-grade high school students acquire and retain English vocabulary directly and very strongly because of their 'visual appeal'. The age of grade-one high school students is suitable for vocabulary learning and its retention via pictures, videos, realia, and other visual aids. Many experts in their studies have supported the highly effective role of the visual aids for children and young learners' language acquisition in general and the vocabulary development in particular (Schmidt, 2015). Also mind maps in the present study were colorful and with their colorful structures and three tree diagrams can give the high school adequate motivation to engage with building blocks of these maps, that is, the chain of related words.

Third, the pictorial-verbal combination of words in mind maps used in the present study involved many parts of the grade-one students' brain and provided more cognitive concentration and mental power for learning and memorizing words. The students had their whole brain and mental abilities in acquiring and remembering the foreign or second language words which led to better learning.

Forth, mind maps could help grade-one students store the vocabulary in their long term memory for longer periods of time. So, it can be said that these mind maps had a mnemonic role in vocabulary learning. Mind maps permitted associations and links to be recorded and reinforced in the brains of the students in the experimental group.

Fifth, the used mind maps were a kind of semantic map and had a high potential for helping experimental group students notice the semantic relations between words and their frequent collocations. Mind maps allowed these students directly and indirectly pay attention to the semantic similarities and differences between words.

Yet, the sixth outstanding feature of mind maps which helped better vocabulary learning and its retention for the experimental group students was that vocabulary mind maps were easy to review. Regular review reinforced these learners' memory. And as Ellis (2008) mentioned, the best technique for checking the meaning of a word is reviewing it in the imagination first, then going back and check on those words in the books, glossaries or vocabulary lists.

Another major feature of mind maps which played a positive role in L2 vocabulary development among experimental group students was that they were personalized and individualized on the basis of learners' personality factors, learning styles, and acquisition preferences or tendencies. This study tried to ask EFL students in groups of 3 to 5 members to develop their own mind maps for the words presented in different units in the grade-one high school textbook. Each group could discuss among themselves and try to develop the mind maps by using diagrams, colors, shapes, lines, and directions derived from their learning styles.

The eighth characteristic which is accounted for the superior vocabulary learning and its retention of experimental group students was that fun, entertainment, and joy which was accompanied with drawing mind maps in cooperative learning groups and then drawing these mind maps on the whiteboard for other groups in the class.

The ninth main attribute of using mind maps for teaching vocabulary grade-one high school students in the experimental group was that in most cases it obviated the urgent need for L1 equivalents through translating words. Put it in better words, mind map provided a direct association between a word and its meaning by referring to the co-hyponyms and upper-hyponyms in the structure of the mind maps.

The findings of the present research are consistent with the results of some earlier studies. Tinkham (1993, 1997) was one of SLA researchers who supported the positive role of using mind maps and semantics maps on the vocabulary development and retention of second or foreign language learners. Tinkham (1993) reported that semantic clustering and mind maps could add to the depth and width of second or foreign language vocabulary. He reaffirmed his findings in later studies (e.g. Tinkham, 1997).

In a similar study, Budd (2004) reported a positive effect for the use of different mind-mapping strategies in foreign or second language classrooms to help language learners acquire target language words more effectively and retrieve them more easily. Budd (2004) claimed that the wise use of these mind-mapping strategies and logical sequencing of these strategies can promote learners' quantity and quality of both passive and active vocabulary.

Buzan (2005) reported that mind-mapping exercises and activities are helpful for second or foreign language learners' vocabulary acquisition from different aspects. They make the learning of L2 vocabulary more meaningful and coherent, help learners send the newly acquired words to their long-term memory with a stronger association and more dependable retrieval links, and can help the learners to recall and use the previously mastered words more quickly and more efficiently.

The results of the current investigation are supported by a number of investigations in other EFL/ESL contexts. Regarding the impact of mind maps on the development and retention of L2 vocabulary, Li, Yang, and Chen (2010) studied the use of mind maps as a strategy for vocabulary learning by Chinese university students. They found a positive effect for the use of these mind maps in enhancing Chinese EFL learners' development of a large range of frequent English words, collocations, and idiomatic expressions.

Al-Jarf's (2011) study also indicated that mind maps could help L2 learners develop their target language vocabulary dramatically and recall them more easily and quickly. In addition, Al-Jarf's (2011) asserted that the use of mind maps and other types of instructional maps including concept maps and argument maps can enhance L2 learners' knowledge of different languages skills, in general, and their vocabulary repertoire, in particular.

Furthermore, as the ANCOVA revealed (Table 4.10), L2 students in the experimental group who received the treatment in the form of mind maps outperformed the control group on the delayed posttest. The decline for the posttest scores to the delayed posttest was less for the experimental group. Table 4.10 displayed that the experimental group’s adjusted mean score was 26.540 on the posttest and it decreased to 25.374 on the delayed posttest. However, the adjusted mean score on the posttest for the control group was 22.860 which decreased to 18.553 on the delayed posttest.

Diem-Thanh (2011) investigated the impact of using mind maps and diagrams to teach and recall vocabulary for first year mainstream Vietnamese students at university level. The findings of this study indicated that mind maps and diagrams were applicable and effective to teach vocabulary to Vietnamese university students. Diem-Thanh's research (2011) revealed that mind maps can help EFL learners acquire the target language vocabulary and remember them for longer periods of time.

Torkashvand (2015) also conducted a study on the comparative effect of concept mapping vs. mind-mapping on Iranian EFL intermediate learners' L2 retention. She found that both female and male Iranian intermediate learners who were taught EFL vocabulary through the use different mind mapping techniques learn English vocabulary better than those counterparts who were taught English vocabulary through concept mapping techniques.

Torkashvand (2015) emphasized that concept mapping strategies were also quite effective for teaching English vocabulary and that concept mapping proved its efficiency and suitability, but mind-mapping strategies turned out to be more effective. She also claimed that the application and superiority of concept maps and mime maps for teaching vocabulary to second or foreign language learners depends on the degree of applicability, type of techniques, class time, and some other external and internal factors.

5. CONCLUSION

The researchers have geared this part of the study toward the answer given to the questions and the result of hypothesis testing. The results of data analysis showed that the main effect of the treatment was significant [$F_{(1,37)} = 721.210$, $p < 0.025$, Eta = 0.951]. so, the question raised and the hypothesis formulated was answerd positively and verified respectively.

6. PEDAGOGICAL IMPLICATIONS

The findings of the current study are significant for three groups. First, the results of the present study may be conducive to Iranian language learners, giving them some fruitful insights on the possible alternative ways to learn vocabularies. Second, it would be of significance to language teachers to gain better understanding of the alternative vocabulary teaching's techniques which may facilitate long-term retention and production of lexical items in the minds of the learners. Furthermore, the findings of this study can help material designers to present vocabulary items through suggested technique which arguably fosters students' vocabulary retention.

7. LIMITATIONS

1. The researchers did not have access to some of the needed papers and books for writing the current thesis.
2. The participants only included 40 male high school students who were selected through convenience sampling.

8. SUGGESTIONS FOR FURTHER RESEARCH

The future research can focus on the following topics:

1) the effect of mind-mapping on Iranian EFL learners' acquisition of idioms and collocations and their retention
2) the relationship between the use of different types of mind mapping strategies and Iranian EFL learners' proficiency level
3) the effect of mind-mapping on Iranian male vs. female EFL learners' vocabulary development and retention
4) the relationship between two kinds of mapping strategies (mind mapping, and concept mapping) and Iranian EFL learners' vocabulary development and its retention
5) the relationship between the use of different types of mind mapping and Iranian EFL learners' learning styles and personality factors

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