Image Modalities in Multimedia Vocabulary Instruction: Does Dual Coding of Vocabulary Occur at Different Degrees?

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Abstract

Convictions are strong that multimedia courseware holds great promise for enhancing learning efficiency among learners. This study thus aimed at comparing the effects of the multimedia programs introducing 100 vocabulary items through pictures and streaming video with those of teacher instruction on increasing EFL learners' vocabulary repertoire. A total of 120 subjects were identified as intermediate-level students based on the scores they obtained on the reading and listening sections of an IELTS and were randomly assigned to four equivalent groups. One group served as the pilot group, two as the experimental groups, and the other as the control group. The pilot group participated in the pilot study of the vocabulary test that was designed by the researcher as the pre- and posttest. The two experimental groups received treatment on teaching the vocabulary items through a Motion-Picture Multimedia Program (MPMP) or a Still-Picture Multimedia Program (SPMP). The control group received a treatment on the same vocabulary items through teacher instruction. The results favored the use of the multimedia programs, albeit the multimedia program drawing on streaming video proved to be more effective than the one using still pictures. Therefore, the findings revealed that dual coding of vocabulary might occur at different degrees across different methods of vocabulary teaching, resulting in varying degrees of the learning success.

Keywords: multimedia computer-assisted language learning, motion-picture multimedia program, still-picture multimedia program, dual coding, vocabulary learning

Introduction

Undoubtedly, vocabulary plays a key role in language learning. As Wiig and Secord (1992) argue, word and concept knowledge are considered to be necessary in models of cognition, intelligence, verbal reasoning, and academic achievement. Vocabulary knowledge and reading comprehension

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are highly correlated in such a way that unless students adequately and steadily extend their word knowledge, reading comprehension will be affected (Chall & Jacobs, 2003, cited in Sedita, 2005). There is indeed a robust go-togetherness between vocabulary and reading comprehension, and vocabulary knowledge has always been the "foremost predictor of a text's difficulty" (Stahl, 2003, p. 241). Hence, it is essential that instructors place more emphasis upon finding the most effective approaches to improving and solidifying EFL readers' vocabulary.

Notwithstanding the fact that a variety of vocabulary teaching methods, such as sentence writing, semantic mapping, and ordering have evolved over the past years to enhance the efficiency of vocabulary learning among learners, a good many students, including EFL learners, still fail to develop a rich repertoire of vocabulary. Accordingly, developing effective pedagogical methods for teaching this integral component of language is a must that needs attention and investigation (Iheanacho, 1997). More recently, the Keyword Method has been shown to produce more satisfactory results as compared with other vocabulary teaching techniques (Hulstijn, 1997, cited in Hunt & Beglar, 2005; Taguchi, 2006). Inspired by Paivio's (1971, 1986, 1991) Dual Coding Theory (DCT), the Keyword Method draws on a mnemonic elaboration strategy where the picture or the mental image of an L2 word can help learners remember the L2 word or its L1 translation more readily. In this method, students should first find an L1 keyword sounding like some part of the L2 word to be learned. The next step requires the learners to form a mental image of the L1 keyword that will then interact with the L1 meaning (translation) of the target word to be memorized.

According to Paivio (1971, 1986, 1991), DCT contends that pictures and words activate different visual codes known as *imagens* and verbal codes called *logogens* in visual and verbal memories, respectively. Dual coding might then aid in vocabulary learning, as pictures are more readily retrieved from memory than words and the likelihood of recalling words from verbal memory increases due to their being associated with relevant images in visual memory (Unnava & Burnkrant, 1991; Schmitt, Tavassoli, & Millard, 1993). Many studies (Neu & Stewig, 1991, cited in Bazeli & Olle, 1995; Johnson-Glenberg, 2000) corroborated the view that visuals and mental imagery could significantly aid in the retrieval of information from memory.

Moreover, many textbooks have nowadays moved towards drawing on pictures, illustrations, and other visuals in order to introduce vocabulary. The book, *English Vocabulary Organizer*, by Gough (2001) is probably one of the most striking examples of pictorial vocabulary textbooks that, according to the researcher's personal experience, significantly improve students' vocabulary

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test scores in comparison to other extant vocabulary textbooks that do not use visuals.

There is, nonetheless, a propensity to explore even more effective pedagogical methods to make language learning more efficient. There is a great consensus that the evolution of promising computer-assisted language learning (CALL) approaches over recent years and the emergence of the follow-up multimedia programs have intrigued many ELT enthusiasts to explore the ways by which state-of-the-art technology can be exploited to provide likely remedies for many of the problems students encounter during second language learning. Many experiments (Skinner & Austin, 1999; Williams & Williams, 2000; Egbert, 2002; Cheng, 2003; Strambi & Bouvet, 2003) corroborated the contributions of the Technologically-Enhanced Language Learning (TELL) techniques to the learning of different facets of language. There has been research on Task-Based Computer-Assisted Language Learning (TBCALL) (González-Lloret, 2003), on Computer-Assisted Language Testing (CALT) (Clariana & Wallace, 2002; Maulan, 2004), and on Computer-Assisted Pronunciation Training (CAPT) (Hincks, 2003). There has also been research on the use of computer multimedia (Torres & Ramos, 2003) whose results unanimously corroborated the contributions of Multimedia Computer-Assisted Language Learning (MCALL) courseware to language pedagogy.

Since a good many studies show that visuals and methods drawing on graphics aid in vocabulary acquisition (Hulstijn, 1997, cited in Hunt & Beglar, 2005; Watts-Taffe & Truscott, 2000; Taguchi, 2006) and that the cutting-edge technology may lead to a more efficient learning (Skinner & Austin, 1999; Williams & Williams, 2000; Clariana & Wallace, 2002; Egbert, 2002; Cheng, 2003; González-Lloret, 2003; Hincks, 2003; Strambi & Bouvet, 2003; Torres & Ramos, 2003), it would be intriguing to embed visuals in multimedia environments and then compare the effect of such environments with those of conventional vocabulary teaching-learning on the increase of EFL learners' vocabulary repertoire. Inspired by the DCT, the present study, thus, attempted to investigate the comparative effect of teaching vocabulary by two MCALL programs, the Motion-Picture Multimedia Program (MPMP) and the Still-Picture Multimedia Program (SPMP), and the conventional way, i.e. teacher instruction on EFL learners' vocabulary learning.

The purpose of this research was two-fold: on the one hand, the study investigated whether multimedia programs drawing on visuals could provide a more effective environment for EFL learners' vocabulary learning as compared with teacher instruction. On the other hand, provided that both multimedia conditions appeared more effective than teacher instruction, the

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study would further investigate which of the two types of multimedia programs, that is, the MPMP or the SPMP would be more effective on the vocabulary learning of Iranian EFL learners. Therefore, the present study sought to find an empirically justified answer to the following questions:

Q1: Is there any significant difference between the effect of using the MCALL programs and teacher instruction on increasing EFL learners' repertoire of vocabulary?

Q2: Is there any significant difference between the effect of using the MPMP and the SPMP on increasing EFL learners' repertoire of vocabulary?

Method

Participants

The participants of the study were 120 intermediate-level students who were majoring in English Translation at Islamic Azad University, Rasht. They were chosen from a total of 300 undergraduate first-year students who had taken a proficiency test including reading and listening comprehension items at the beginning of the experiment. The subjects were then randomly assigned to four equivalent groups consisting of a pilot group, two experimental groups and a control group. The pilot group participated in the pilot study that was subsequently carried out on the vocabulary test that was designed by the researcher to be used as pre- and posttest. The two experimental groups experienced vocabulary instruction through MPMP or SPMP and the control group received teacher instruction. The subjects, however, comprised mixed groups of male and female participants. It is worth mentioning that another 30 first-year students also participated in piloting the proficiency test that was used for the selection of the subjects.

Instrumentation

The instruments in the present study fell into three categories: There was an instrument for selecting the participants, there were instruments for applying the treatment, and there was an instrument for assessing EFL learners' vocabulary repertoire. The instrument for choosing the participants comprised a proficiency test based on the UCLES IELTS examination which comprised

80 items in two modules: reading and listening comprehension each with 40 items. The tools for applying the treatment involved two types of MCALL courseware that were used to introduce vocabulary to the experimental groups under study.

The MPMP comprised streaming videos, texts, voices, background music, etc. in order to introduce vocabulary. The SPMP, on the other hand, comprised the same components but used still pictures. Both programs were coupled with special effects to introduce the vocabulary items in such a way that as they appeared on the screen, the terms would start blinking or developing in size or exploding. It was assumed that such stunning visual effects would further sustain students' motivation during the experiment. The special effects, nevertheless, were applied to the vocabulary items at every other frame to avoid students' distraction during the experiment and to divide their attention among different multimedia components. Both programs comprised 10 instructional units, with each unit introducing 10 vocabulary items in a 20-minute session. The passages through which the multimedia programs introduced the vocabulary items were all excerpts taken from the digital encyclopedia *Microsoft Encarta*, as well as other scholarly articles providing a meaningful context for vocabulary learning.

Finally, the instrument used for assessing EFL learners' vocabulary repertoire consisted of a recognition vocabulary test in the multiple-choice format with 100 items that was used as both the pre- and the posttests. The vocabulary items chosen were all concrete words for which a ready video could be found and fell under two themes: animals and tools.

Procedure

Before embarking on the selection of the subjects, the researcher went through the process of software development for the specific purpose of this study which was teaching vocabulary through MPMP and SPMP.

Renowned for its flexibility and simplicity of usage, Sothink SWF Quicker was the main software used by the researcher to author the multimedia courseware under the study. The program comprised a user-friendly interface and a number of layers for inserting different elements, such as videos, pictures, texts, special effects, human voices, background music, etc. Using the program, the researcher assembled the required multimedia components to produce stand-alone outputs. Other software used to develop the multimedia components were as follows:

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1) Nero ShowTime: To take snapshots of streaming videos to produce static graphics required for the development of the SPMP.

2) I'm TOO MPEG Encoder; Sony Vegas: To trim and to convert unsupported video formats, including QuickTime video format (MOV) to the ones supported by SSWFQ (MPEG 1 & 2, AVI, etc.) and to have the trimmed video segments fit the timeline.

3) Microsoft Student with Encarta Premium: To provide meaningful texts and scholarly excerpts through which the vocabulary items could be introduced.

4) RecordPad Sound Recorder: To record human voice in a high quality format and prepare the output for insertion into SSWFQ.

5) WavePad: To apply noise reduction to the recorded voice and to optimize and trim the voice segments to have them fit the timeline.

6) AutoHotkey: To help the researcher write pertinent scripts to automatize the MCALL programs.

7) SWF Encrypt: To encrypt SWF movie files to avoid software piracy.

8) UltraISO Premium Edition: To hide SWF movie files on CD-ROMs.

9) WTM CD Protect: To create dummy files to be burned on CDs to make copying difficult.

In order to build the instructional units, the video segments of the vocabulary items were first trimmed by I'm TOO MPEG Encoder and Sony Vegas and then inserted into the corresponding layers. Relevant scholarly excerpts, providing meaningful texts for the vocabulary items, were taken from *Microsoft Encarta* and other online sources, and these were then inserted into the Vocabs Texts layer. Furthermore, to apply special effects to the vocabulary items appearing on the screen, corresponding frames in the timeline were marked using the chosen effect in the Lexis Special Effects layer.

The next step involved recording the researcher's voices reading the texts and then synchronizing the voices with video. Using RecordPad Sound Recorder, the researcher recorded their voices and then they reduced the noise and optimized the output using WavePad. The optimized output was then inserted into the Vocabs Stream Voices layer.

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In the next step, a series of still pictures was taken from the streaming video using Nero ShowTime to notify learners of the terms to be introduced. Next, by means of Export Projector, all layers were combined to produce a single, stand-alone SWF movie file. Notwithstanding, to play the files sequentially, the researcher used a player called Flash Movie Player, featuring the capability of playing the movie files consecutively for the specified time.

The aforementioned steps were taken to build all the 100 clips for the 10 units of instruction. Likewise, the same procedures were followed to build the instructional units for the still-picture multimedia environment using the snapshots taken by the Nero ShowTime. Both programs were designed in such a way that they would automatically play the movie files once inserted into the CD-ROM drive. Also, the researcher wrote a number of scripts using AutoHotkey to automatize the instruction process.

Since one might have simply decompiled the SWF movie files, through a multi-locking procedure, the researcher encrypted the files using SWF Encrypt to avoid software piracy. He then hid the files on the CD-ROMs using the Advanced Hidden feature of UltraISO. In the final step, to make copying difficult, the researcher burned a number of dummy files on the CD-ROMs using WTM CD Protect.

When the process of software development was completed, a proficiency test comprising 80 items, 40 on the reading comprehension module and 40 on the listening of the IELTS was administered in a pilot study to 30 participants who were first-year students of Islamic Azad University at Rasht and the results were taken into account for item analysis and reliability estimation. For this purpose, an item analyzer known as SIMSTAT was used. The result of the analysis revealed that the test was a standard one, as all items had desirable facility and discrimination indexes ($0.37 \leq IF \leq 0.63$ and $ID > 0.4$).

In the next step, the internal consistency of the test was estimated through Cronbach's Alpha as an indication of the reliability of the test. It turned out to be 0.95 which was acceptable. Afterwards, the construct validity of each of the test modules was established through factor analysis. Using the Principal Components Extraction technique, the program extracted all those hypothetical factors whose eigenvalues were above unity. The result of the analysis showed that for both modules, a large amount of variance was accounted for by a single factor, while other hypothetical factors contributed little or nothing to the total variance of the test. The plots of eigenvalues against the number of factors are demonstrated in Figures 1 and 2 below.
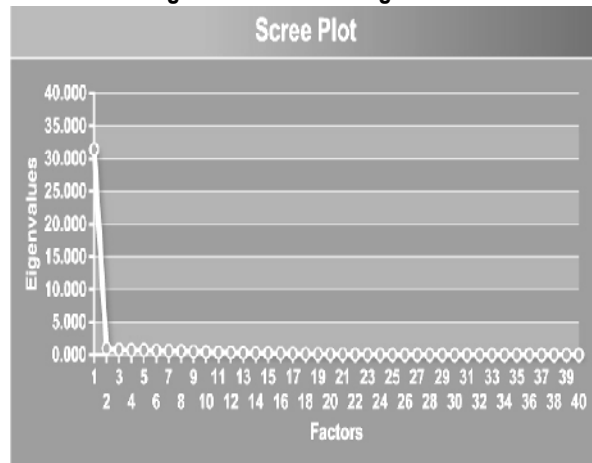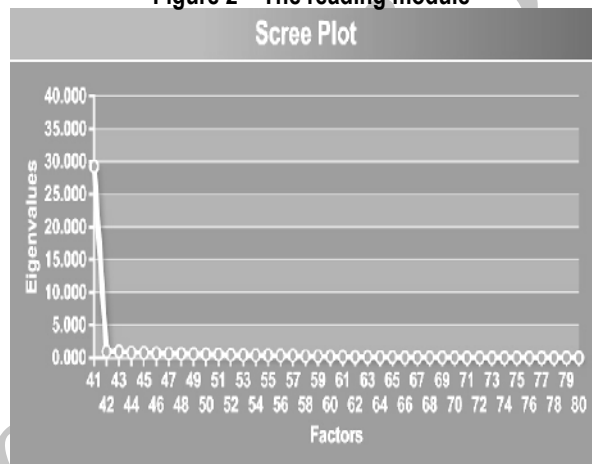
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Figure 1 – The listening module

Figure 2 – The reading module

The "screes" represent all the hypothetical factors involved. The point at which the screes begin to level off can be used as a cut-off point. Since only one scree is placed on the line with a steep slope, it can be contended that the items on the test modules highly correlated with the latent constructs, i.e. listening and reading abilities.

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Once the reliability index of the test was determined, and the construct validity was established, the test was administered to 300 firat-year students of Islamic Azad University at Rasht. Based on the results, 120 participants who obtained a score of five on the test were identified as intermediate-level learners. The participants were chosen based on a rating scheme used in the UCLES IELTS examinations. According to the scheme, all candidates who obtain an overall band score of five are identified as modest users, or those who are at an intermediate-level of language proficiency. These selected participants were then randomly assigned to four equivalent groups of participants involving a pilot group, two experimental groups, and a control group.

In order to randomly assign the participants into the groups under study, the researcher drew on a randomizer called SuperCool Random Number Generator featuring the capability of generating sets of random numbers from within a range. Accordingly, the subjects were first assigned a number from 1 to 120, and the program then randomized the numbers in such a way that the first 30 subjects whose numbers fell under the first column were put in the pilot group, the second and the third 30 subjects in the experimental groups, and the fourth 30 subjects in the control group.

Next, the recognition vocabulary test (see the Appendix) in the multiple-choice format was administered to the pilot group mentioned above. Once the students in the pilot group had taken the test, an alternative item analyzer known as Test Analysis Program (TAP) was used to standardize this pretest. This program, which is authored and implemented at Ohio University (USA), features the capability of identifying and marking those items which are defective.

The result of the analysis revealed that quite a number of the items had low IF and ID indexes which was an indication of the fact that the majority of the participants did not know the vocabulary items, and thus the researcher could consider them for teaching. Three items, however, were shown to malfunction, as they had a high IF index beyond 0.63 and a low ID index below 0.4; these items were thus excluded from the test prior to the actual administration. Subsequently, the Cronbach reliability was estimated which turned out to be 0.79. The next step was to calculate the construct validity of the test. This was established through an exploratory factor analysis. A glimpse at the scree plot (Figure 3 below) shows that only one factor was involved, i.e. word recognition ability.

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Figure 3 – The vocabulary test
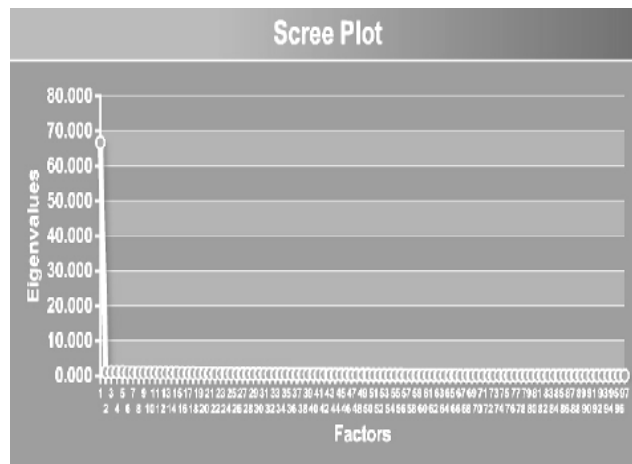
Once the construct validity of the vocabulary test had been established, it was administered to the three target groups under study to determine whether they had any prior knowledge of the vocabulary items and to determine whether they were homogeneous in terms of vocabulary at the beginning of the experiment. The study showed that the three groups were homogeneous and delivered a poor performance on the pretest.

Next, the participants received treatment on the vocabulary items. The first experimental group received treatment through the MPMP, while the second one received treatment on the same items through the SPMP. Both programs comprised 10 instructional units, introducing 10 vocabulary items within 20 minutes. The terms covered in the sessions were not reintroduced in the following sessions, so that any improvement in the students' scores on the vocabulary posttest could be attributable to the initial effect of the treatment rather than repetition.

As mentioned before, the vocabulary items fell under two general themes, animals and tools, and the texts provided useful pieces of information about the subject matter. For instance, as far as the animals theme was concerned, the passages provided information as to the physical characteristics of the animal, its diet, habitat, and even the way scientists managed to conserve the very species. In a similar vein, to introduce terms referring to tools, the passages provided information as to the physical shape of the tool, e.g. what a *rotary sander* was like and when it was normally used. The programs were developed in such a way that the students could follow the texts and the special effects as they appeared on the screen.

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The control group, on the other hand, received treatment on the same vocabulary items through teacher instruction. The vocabulary items and their corresponding pictures were handed over to the learners on sheets of paper. The students were then required to listen to the teacher while viewing the pictures. It should be noted that the verbal pieces of information presented to the control group was based on the same excerpts that the multimedia programs used to introduce vocabulary to the experimental groups. Like the MCALL programs, 10 vocabulary items were introduced in 20 minutes.

The experiment took one month, three sessions per week. At the end of the experiment, the three groups took a posttest on the same vocabulary items which enabled the researcher to measure the participants' degree of vocabulary learning under the three conditions.

Results

The first step of data analysis comprised analyzing the results of the vocabulary test that was administered to the three groups of participants prior to the treatment. The purpose of this analysis was to first check the homogeneity of the three groups and second to ensure that the three groups did not know the vocabulary items that were going to be taught during the treatment period. To check the homogeneity of the three groups with respect to their vocabulary repertoire, one-way ANOVA had to be run on the results of the vocabulary pretest. However, first the researcher had to check the homogeneity of variances, for which the Levene's test of equality of variance was run.

Table 1 demonstrates the results of this test. As it is depicted in this table, the assumption of homogeneity of variances was justified ($\rho = 0.574 > 0.05$). This indicated that running a one-way ANOVA was legitimate. Consequently, it could be claimed that the groups belonged to the same population prior to receiving the treatment.

Table 1 – The results of Levene's test of homogeneity

Levene's Statistic	df_1	df_2	Sig.
.560	2	87	.574

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Table 2 demonstrates the result of the one-way ANOVA on the vocabulary test that was administered prior to the treatment.

Table 2 – The results of the ANOVA on the vocabulary pretest

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	156.156	2	78.078	1.970	.146
Within Groups	3448.167	87	39.634		
Total	3604.322	89			

As it is demonstrated in Table 2, there was no significant difference among the three groups with respect to their performances on the vocabulary test ($F_{(2,87)}$ = 1.97, ρ = 0.146 > 0.05) and thus the three groups were considered to be homogeneous with respect to their knowledge of vocabulary.

The second step in the data analysis comprised of analyzing the results of the performance of the three groups on the vocabulary posttest to statistically test the impact of different treatment conditions on increasing the EFL learner's vocabulary repertoire or to test the null hypotheses of the study.

Table 3 demonstrates the mean scores obtained by the three groups. The lowest mean score was obtained on the vocabulary posttest by the control group (55.27) and the highest mean score was obtained by the first experimental group which underwent the MPMP condition (81.27). The second experimental group that underwent the SPMP obtained a mean score of 69.5 on the vocabulary posttest.

Table 3 – Target groups' means on the posttest

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
1	30	81.267	15.5207	2.834	75.4711	87.062
2	30	69.50	17.4588	3.187	62.9808	76.019
3	30	55.267	17.0191	3.107	48.9116	61.622
Total	90	68.678	19.6588	2.072	64.5603	72.795

1 = the first experimental group, 2 = the second experimental group, 3 = the control group

However, in order to investigate whether the observed differences among the groups were statistically significant or not, the researcher had to run a one-way ANOVA. To this end, first the assumption of homogeneity of variance was checked as demonstrated in Table 4 below.

Table 4 – The results of Levene test's of Homogeneity

Levene's Statistic	df_1	df_2	Sig.
1.288	2	87	.281

According to Table 4, the results of the Levene test demonstrated equality of variances ($\rho = 1.28 > 0.05$); running a one-way ANOVA on the results of the posttest was thus legitimized. The result of the one-way ANOVA is demonstrated in Table 5.

Table 5 – The results of the ANOVA on the vocabulary posttest

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	10170.422	2	5085.211	18.26	.000
Within Groups	24225.233	87	278.451		
Total	34395.656	89			

As demonstrated in Table 5, there was a significant difference among the three conditions, MPMP, SPMP, and teacher instruction ($F_{(2,87)} = 18.26$, $\rho < 0.05$). This indicated that the three conditions did not have equal results in the vocabulary learning of the participants. However, in order to specifically locate the differences among the conditions, a Scheffé Test was used. As shown in Table 6, the means in each comparison set were significantly different. Furthermore, the confidence interval for each set contained no zero. The mean differences between group 1 that underwent MPMP and the control group (d = 26, means of 81.27 and 55.27, respectively), and the one between group 2 experiencing SPMP and the control group (d = 14.23, means of 69.5 and 55.27, respectively) came out to be significant ($\rho < 0.05$). Thus, MCALL programs provided a more effective condition for vocabulary learning as opposed to teacher instruction. This provides an empirically justified answer to the first question.

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Table 6 – Post hoc comparisons of the means scores (Scheffé test)

(I) Target Groups	(J) Target Groups	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.0	2.0	11.76667*	4.30853	.028	1.0363	22.4971
	3.0	26.00000*	4.30853	.000	15.2696	36.7304
2.0	1.0	-11.76667*	4.30853	.028	-22.4971	-1.0363
	3.0	14.23333*	4.30853	.006	3.5029	24.9637
3.0	1.0	-26.00000*	4.30853	.000	-36.7304	-15.2696
	2.0	-14.23333*	4.30853	.006	-24.9637	-3.5029
*. The mean difference is significant at the .05 level.						

Moreover, the difference between the posttest mean score of group 1 experiencing MPMP and group 2 experiencing SPMP came out to be 11.77 and significant (ρ = 0.028 < 0.05). Taking the mean values for these two groups from Table 3, it becomes obvious that subjects in the MPMP group outperformed those in the SPMP group (81.27 and 69.5, respectively). This provided the statistical answer to the second question of the research.

Conclusion

The results of this research study indicated that dual coding of vocabulary might occur at different degrees across different methods of vocabulary instruction, resulting in varying degrees of learning success. The findings demonstrated that multimedia environments led to a more significantly effective dual coding of vocabulary for the sample of Iranian EFL learners who participated in this study. This result might have been due to the effectiveness of such programs in introducing the vocabulary items as well as the fact that such programs might increase learners' motivation and attention more than the teacher instruction of vocabulary. Moreover, since attention and encoding are highly correlated (Spitzer 1996; Astleitner & Wiesner, 2004), it can be contended that the novelty of such environments and the consequent increased levels of motivation and attention in learners might have led to a more effective dual coding of vocabulary, having helped learners better remember words.

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The study further revealed that the sample under investigation benefited more from a multimedia program using streaming video than the still-motion pictures. According to Al-Seghayer (2001), this can be attributable to the potential differences that exist between pictures and streaming videos. He contends that animation might arouse students' curiosity and this might in turn sustain their attention during the experiment owing to the assumption that learners can be intrigued to know what might happen in the next segment thus retaining better the vocabulary items due to longer attention. Consequently, attempts should be made to move towards computerized vocabulary instruction in order to make vocabulary learning a more enjoyable and memorable experience. Multimedia courseware designed to teach vocabulary might have practical applications. They may prove to be useful, particularly in lexicology and reading comprehension courses.

With respect to lexicology, most extant vocabulary textbooks claim to introduce vocabulary in a meaningful context. Nonetheless, introducing vocabulary through such a context devoid of pictures might not necessarily guarantee students' longer retention of words. In other words, while students are likely to learn vocabulary in a context which is rich enough to convey the meanings of words, there is no guarantee that they would necessarily remember those words for quite a long time. The researcher believes that learning of vocabulary per se does not suffice and that learners should also be able to remember words longer. The rationale is that a meaningful context without pictures only provides verbal information on the subject matter (here, the vocabulary item) to be encoded in the students' verbal memory. Since only the verbal representation of the vocabulary item is available to learners, the likelihood of recall might decline accordingly in comparison to the situation when both verbal and visual representations are available. Furthermore, whether or not a textbook draws on pictures to teach vocabulary, it might not necessarily appear as effective as a multimedia environment designed to teach the same vocabulary items through two modes of presentation.

With respect to reading comprehension as the other application of MCALL programs, more effective teaching of vocabulary by means of these programs might also aid in the comprehension of passages in a reading course. Following the traditional methods, many teachers in EFL contexts have learners skim through the reading passage with the assumption that the co-text might help learners surmise the meanings of keywords required to understand the passage. If the learners fail to comprehend the passage completely, they can consult their dictionaries to find the meanings of the keywords. Nonetheless, this does not necessarily guarantee that the words learned in this way can be remembered for a long time. The students might

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soon forget the words, and if the same vocabulary items appear in other passages, the comprehension might decline.

To provide a remedy for the above mentioned problem, it is suggested that teachers first introduce keywords through a multimedia environment in each session and then check students' comprehension of the passages in which the given words have appeared. At the end of the term, they can choose a reading passage for the final exam including a great number of those words introduced through the program. If this method proves useful, and if students readily remember the vocabulary items, they may better perform in answering the comprehension questions.

Finally the findings of this study paved the way for further investigations of the impact of MCALL programs on the vocabulary learning of EFL learners by taking into consideration moderator variables such as gender and language proficiency level to see whether different genders and different proficiency levels benefit from these programs similarly or differently. Moreover, in this research, only concrete vocabulary items were introduced to the participants. Other studies might investigate the impact of MCALL programs on students' vocabulary retention if abstract words are introduced. In addition, only the students' ability in recognizing vocabulary was investigated in this study. One might test the learners' production of vocabulary in different contexts after experiencing MCALL programs.

The present research also focused on introducing words with one meaning and one usage. It might be intriguing to investigate whether homonymous and polysemous words, such as *mole*, *pupil*, *accessory*, *head*, etc. can also be introduced through multimedia programs. Ultimately, the present study focused on introducing single words as if a lexical syllabus only comprised discrete vocabulary items. According to Lewis (1997b), however, a lexical syllabus might also involve other components, including collocations. Elsewhere, he asserts that, "Instead of words, we consciously try to think of collocations, and to present these in expressions. Rather than trying to break things into ever smaller pieces, there is a conscious effort to see things in larger, more holistic ways" (Lewis, 1997a, p. 204). Hence, another possible avenue for research is investigating whether collocations can also be introduced through multimedia environments.

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Appendix A

Sample Vocabulary Test

Your Name: --

Instructions:
You will have 100 minutes to answer the following questions. Please choose the most appropriate option from among the alternatives and write your choice as A, B, C, or D.

Part A: Animals (Questions 1-80)

1) This animal is a creature of hot, dry, sandy environments. It is often seen sitting motionless near ant mounds to hunt them. For defense, it can spray an intruder with blood from the corners of its eyes. This is a ……

    a) Toucan
    b) Meerkat
    c) Puffin
    d) Horned Lizard

2) This animal has a remarkably long, sticky tongue, which darts into the air to catch insects. Whenever frightened, or in response to light, temperature, and other environmental changes, it can change its colors to match its surroundings. This is a/an ……

    a) Otter
    b) Chameleon
    c) Weaverbird
    d) Heron

3) Having an elongated neck, legs and bill, the bird flies with its neck bent in an "S" shape and its head supported between its shoulders. It stands frozen or stalks slowly on long legs before snatching its prey in the scissors grip of its pointed beak. This is a/an ……

    a) Heron
    b) Indri
    c) Petrel
    d) Bream

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Part B: *Tools* **(Questions 81-100)**

81) As a carpentry tool, it has a long metal blade with a sharp edge at the end. It is used for carving and/or cutting a hard material such as wood, stone, or metal. The driving force may be manually applied or applied using a hammer. This is a ……

    a) Chisel
    b) Pliers
    c) Lathe
    d) Saw

82) As a carpentry tool, it is designed primarily for gripping objects by using leverage. It is designed for numerous purposes and requires different jaw configurations to grip, turn, pull, or crimp a variety of things. This is a ……

    a) Drill
    b) Wrench
    c) Pliers
    d) Rotary Sander

83) As a carpentry tool, it is a fastening device to hold or secure objects tightly together to prevent movement or separation through the application of inward pressure. This is a ……

    a) Lathe
    b) Hammer
    c) Screwdriver
    d) Clamp

Appendix B

The researcher drew on the following references in order to choose the vocabulary items and the contexts through which they would be introduced.

1) Microsoft Student with Encarta Premium (2009 Edition) (software - the main reference used)
2) http://www.arkive.org/ (Images of Life on Earth)
3) http://www.junglewalk.com/
4) http://natureviewing.com/
5) http://www.pricegrabber.com/
6) http://www.fotosearch.com/
7) http://www.greenfingers.com/
8) http://www.tooled-up.com/
9) http://www.bobvila.com/Shop/Hand_Tools_Carpentry-Tools.html/
10) http://nhwoodworker.com/