Utilizing Dual Coding Theory and animated images to enhance ESL students' vocabulary learning

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ABSTRACT

This study utilized Paivio's Dual Coding Theory and multimedia glosses to investigate the effects of animated images, when shown simultaneously with verbal information, on ESL students' vocabulary learning. Two groups of low-intermediate adult ESL learners took the target word pretest prior to the experiment. During the experiment, both groups read the same electronic text but the target words were glossed differently, with the Malay translations and animated images for the treatment group, and the Malay translations plus static images for the comparison group. Immediately after the experiment, both groups retook the same test. One week later, the groups took the delayed posttest. Two 2x2 mixed-factorial ANOVAs were run, one using the scores of the immediate postttest, the other using the scores of the delayed posttest, to determine if the scores of both groups were statistically significant. The results showed that the group with access to animated images retained more target words. Further pedagogical implications are discussed.

KEYWORDS: **vocabulary, glosses, CALL, multimedia**

Introduction

Vocabulary is considered to be the most important component in language. Lewis (1993, p.89) states that vocabulary is "…the core or heart of language". Wilkins (1972, pp. 111-112) claims that "…while without grammar very little can be conveyed, without vocabulary nothing can be conveyed". Due to its importance, vocabulary has become the subject of many studies by second language researchers as they attempt to determine the methods of instructions that promote vocabulary learning more effectively.

One of the methods extensively studied is incidental vocabulary learning through reading. This method has been shown to work to some degree (Ellis, 1995; Krashen, 1989; Saragi, Nation & Meister, 1978, cited in Horst, Cobb & Meara, 1998), but many texts lack contextual clues for most words to help readers guess their meanings (Haynes, 1993). To reduce incorrect guessing of word meanings, authors have included glosses in the form of short definitions or synonyms, either in L1 or L2 (Nation, 1983) for unfamiliar words, placed in the side or bottom margin of the texts (Lomicka, 1998). Benefits of glosses have been documented, that they provide accurate meanings of difficult words impossible to guess using contexts (Nation, 2001), and help to limit dictionary consultation that may interrupt the L2 reading process (Bowles, 2004). Several studies have compared the effectiveness of glosses, contextual guessing, and dictionary consultation in improving incidental vocabulary learning through reading, and most found glosses as the most effective (Hulstijn, Hollander & Greidanus, 1996; Watanabe, 1997; Jacobs, Dufon & Hong Cheng, 1994; Rashkovsky, 1999). Rashkovsky (1999) found that students who had access to marginal glosses showed greater incidental vocabulary learning than those who read an unglossed text. Similarly, Hulstijn, Hollander and Greidanus (1996) found that students with access to marginal glosses scored higher than those with access to dictionaries.

In multimedia environment, glosses can be incorporated seamlessly into electronic texts (Yanguas, 2009), and can be displayed by clicking the hyperlinked words. Benefits of electronic glosses have been suggested, that they are appealing, unlike traditional marginal glosses in the printed form (Dais & Lyman-Hager, 1997), they are unintrusive, only made visible when accessed by the readers (Davis, 1989), and they can be shown in more formats than just text, including images, sound, or videos (Chun & Plass, 1996b). Evans (1993, p.214) commented that the usefulness of electronic glosses, or more aptly called multimedia glosses, notes that "the integration of text, sound, and visual data clearly is of great benefit to the learners as this will reinforce comprehension, pronunciation and contextual use in a way that traditional materials are not able to do". Different aspects of multimedia glosses have been studied. Nagata (1999) and Gettys, Imhof, and Kautz (2001) have compared the effect of singl-meaning glosses and multiple-choice glosses on vocabulary learning. De Ridder (2000, 2002) has investigated the typographical effect of glossed words on vocabulary learning. Koren (1999) has compared the effect of glosses and clue-sentences on the retention of words. Hegelheimer (1998) has explored the effects of textual and sentence-level audio glosses on vocabulary learning. Yoshii and Flaitz (2002), Al Seghayer (2001), Chun and Plass (1996), and Velazquez (2001) have examined the effects of single-format glosses and multi-format glosses on vocabulary learning.

Studies by Chun and Plass (1996a) and Al Seghayer (2001) in particular provided the scope for the current study. Chun and Plass (1996a) conducted a study involving English-speaking subjects learning second-semester German. They read an electronic German reading passage containing eighty-two words glosses with pronunciation and L1 translations with some words also glossed with static pictures and video clips. The subjects took immediate and delayed posttests. The results showed that words were remembered with 24.1 percent to 26.5 percent accuracy. The researchers concluded that providing glosses in different modalities resulted in looking up words more than once, thus reinforcing learning. Al Seghayer (2001) conducted a study involving 30 ESL college students in the United States. They read an electronic English reading passage with words glossed with sound, L1 translation, pictures, and videos. Al Seghayer (2001) found the subjects performed the best in the sound, L1, and video condition.

In the above studies, it can be seen that words that were glossed with translations and images together were retained better than words that were glossed with only translations or images. The finding supports Paivio's Dual Coding Theory, which claims that information is easier to retain and retrieve when it is dual coded in verbal and visual form. The theory states that there are two independent systems—verbal and visual—serving human memory and cognition, with each system performing different roles and having dissimilar storage processing attributes and memory components. The function of the verbal system is to process and store linguistic details in the form of words and sentences. In contrast, the function of the visual system is to process and store images and other similar characterizations. The relationship of the two systems leads to positive effects on recall in that when both systems—verbal and visual—are activated concurrently, additive effect is created leading to better memory. Thus, information that is coded in dual forms such as words and images is easier to retain and retrieve (Paivio, 1991).

With dual coded glosses (definition/translations plus images) found to be more effective than single glosses (either definition/translation only or images only), this line of research could be extended by investigating the effect of different formats of visual information, more

specifically the effect of static visuals and moving visuals, when paired with verbal information, on the readers' vocabulary learning. Moving visuals are different than static visuals in that the formers' most obvious perceptual characteristic is the motion attribute (Rieber, 1994). Moving visuals provide the illusion of movement. Examples of moving visuals include videos and animated images. To date there has been little or no related studies. The comparison between the effect of static visuals and moving visuals on vocabulary learning is valid within the context of Schmidt's (1990) Noticing Hypothesis. The hypothesis states that learners must notice a form in the input and show signs of awareness before the input can be processed further. In other words, linguistic input must be noticed for acquisition to happen. In the context of reading texts that supply glosses, interaction occurs when readers read the text and consult glosses to know the meaning of unknown words. It can be argued further that moving visuals enhance the interaction thereby creating more noticing.

The purpose of this study was to determine the effect of two formats of multimedia glosses on ESL students' vocabulary learning. The formats of the multimedia glosses were textual plus static visuals and textual plus moving visuals respectively. Vocabulary learning was measured using vocabulary scores from immediate posttest and delayed posttest. The research questions were as follows:

1. Do ESL learners exposed to translation and animated-image glosses retain more words than those exposed to translation and static-image glosses as indicated by the immediate vocabulary posttest scores?
2. Do ESL learners exposed to translation and animated-image glosses retain more words than those exposed to translation and static-image glosses as indicated by the delayed vocabulary posttest scores?

Methodology

Research Design

Research design used was the non-equivalent group design, where two intact groups, one as the treatment group, another as the comparison group, were compared using pretest and posttest measures. The independent variable was the types of multimedia glosses provided for the two groups. The comparison group had access to glosses in the form of translations and static images. The treatment group had access to glosses in the form of translations and animated images. The dependent variable was the vocabulary posttest scores, measured immediately after the experiment, and again one week later. Data were obtained from immediate and delayed vocabulary posttests, in the form of scores.

The Participants

Participants were a convenience sample of 36 ESL students of low-intermediate level from one of the public universities in the East Coast of Malaysia. They belonged to two intact groups of 18 each, and were taking one of the remedial English courses due to their Band 1 or Band 2 results for the Malaysian University English Test (MUET). The participants were first year students studying different academic programmes. They were Malay males and females, aged between 19 and 21, and came from different states in Malaysia. They were familiar with

multimedia learning programs as they were required to use them in the language laboratory as part of the course assignments.

The Materials and Instruments

In the present study, an electronic text that was specifically developed by the researcher was used. Its development involved five stages: Deciding on a suitable text and target words, obtaining the translations and images (static and animated) for the target words, preparing several comprehension questions, and creating the electronic text as well as embedding the multimedia glosses in the text and designing interactive comprehension questions, and uploading the files to the local server.

As a suitable text could not be found from existing sources, one was composed by the researcher. The requirements were the text must be about 500 words long, it should be comprehensible to low-intermediate ESL learners but must also contain several words whose meaning they did not know, and those several target words must be gloss-able with images, both in static and animated form.

The text was composed based on 13 words adopted from Sutton (1999). Two more words were added by the researcher to have an equal number of words for nouns, verbs, and adjectives. The words were: burglar, brace, centipede, colander, hatchet (nouns), crouch, descend, revive, sneak, sprint (verbs), anxious, combustible, elated, furious, stressed (adjectives). The text was 489 words long, with language suitable for low-intermediate adult ESL learners.

The Malay translations of the target words were obtained from a Malay-English dictionary. The static images and several of the animated images were obtained from various sources – Microsoft Office Clip Arts, Corel Draw software, and Yahoo Images. The rest of the animated images were not readily available elsewhere and therefore were created by the researcher using an image animator software.

The electronic text was prepared using Hypertext Markup Language (HTML), and the multimedia glosses were embedded using Javascript. The glosses were hidden by default and can be accessed by clicking on the target words coloured green. The glosses appeared in a small pop-up window below the clicked words. They contained the Malay translations of the words and static images (Figure 1), or the Malay translations and animated images (Figure 2). To make the glosses disappear, the participants needed to click on the words again. The comprehension questions were designed to be interactive. The interactive feature enabled immediate feedback on the selection made, whether correct or incorrect. If the first selection was incorrect, the participants would be asked to make another attempt. The exercises were included to let the participants think that they were reading the text for comprehension practice and therefore would not make an effort to memorize the target words. The underlying principle behind vocabulary learning through reading is that learners read mainly for comprehension, and vocabulary learned, whether through contextual guessing, dictionary consultation, or gloss consultation, is the by-product of the reading activity (Nation, 1990).
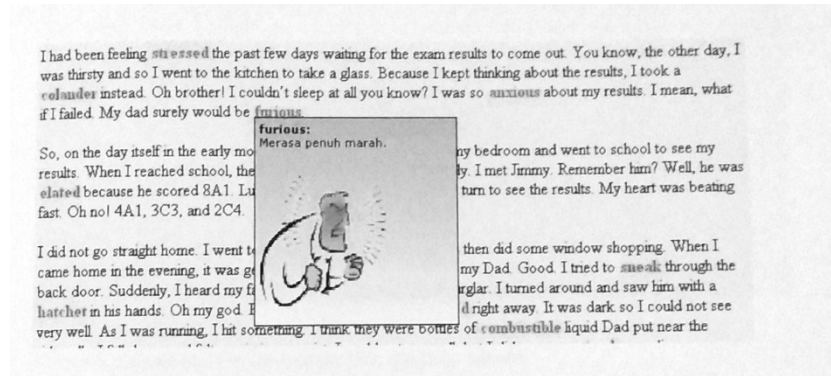
I had been feeling stressed the past few days waiting for the exam results to come out. You know, the other day, I was thirsty and so I went to the kitchen to take a glass. Because I kept thinking about the results, I took a colander instead. Oh brother! I couldn't sleep at all you know? I was so anxious about my results. I mean, what if I failed. My dad surely would be furious.

furious:
Merasa penuh marah.

So, on the day itself in the early mo... ...ny bedroom and went to school to see my results. When I reached school, the... ...ly. I met Jimmy. Remember him? Well, he was elated because he scored 8A1. Lu... ...turn to see the results. My heart was beating fast. Oh no! 4A1, 3C3, and 2C4.

I did not go straight home. I went t... ...then did some window shopping. When I came home in the evening, it was g... ...my Dad. Good. I tried to sneak through the back door. Suddenly, I heard my f... ...burglar. I turned around and saw him with a hatchet in his hands. Oh my god. ... ...d right away. It was dark so I could not see very well. As I was running, I hit something. I think they were bottles of combustible liquid Dad put near the

Figure 1. Translation and static image

very well. As I was running, I hit something. I think they were bottles of combustible liquid Dad put near the sidewalk. I fell down and felt a pain in my wrist. I could not see well, but I did see a centipede crawling near me. But I could not do anything. Then I saw Dad crouch beside me. Next, I did not kno... ...opened my eyes, I was in the hospital. Dad told me I fell and hurt my wrist. That's w... Dad said he thought a burglar tried to enter our house. Dad was worried when I fell ... revive me. Then he called an ambulance and I was taken to the hospital. I told Dad t... me. I thought he was going to use it to kill me. Dad laughed funnily. He said he had t... to cut some firewood, not to kill me. Dad said no matter how I did in my exam, he is... my best. So, cousin Razwil, you have heard my sad story. Now tell me your happy s... hear it. Bye
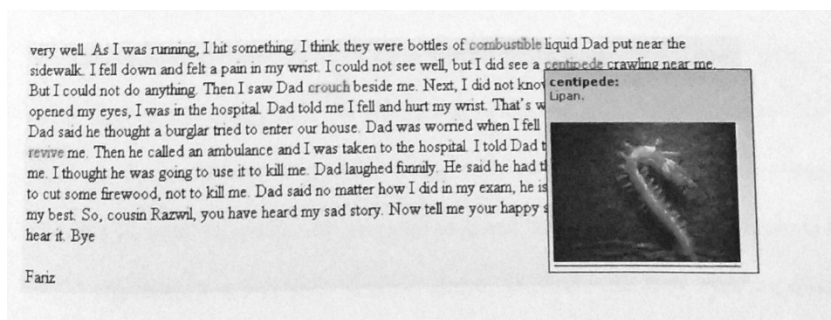
Fariz

centipede:
Lipan.

Figure 2. Translation and animated image

The HTML files and associated images were copied to the local server in the language laboratory. Participants could access the text at their workstations by double-clicking the shortcut icon that was created on the workstations' desktops.

The vocabulary test consisted of the 15 target words that were glossed in the electronic text. The format of the test was multiple choice. For each target word, five incorrect Malay translations were given as distractors, and one correct Malay translation of the word was provided. This arrangement was done to minimize the possibility of predicting the correct answers (Jones & Plass, 2002). The incorrect translations were meticulously chosen to make certain that the distractors were not clearly wrong. The mark given for a correct answer was 1 and the most mark obtainable was 15. The students took the test once before the experiment and twice after the experiment. The aim of the pretest was to determine the students' prior knowledge of the target words. In addition, if the pretest scores differed statistically between the two groups, the scores would be included as covariates during the analysis of variance. The posttest was given immediately after the experiment and one week after the experiment.

The Procedures

The experiment was conducted in the language laboratory during the participants' regular class hours. The experiment was completed in two sessions, one for each group, because the two groups had a different timetable. The second group completed the experiment four days after the first group had done so. In both experiments the procedures were the same. In the first experiment, the multimedia glosses provided were the Malay translations and static images, and in the second the Malay translations and animated images.

Two days before the experiment, the participants were informed by their instructors that they would participate in an experiment to test a new multimedia program. On the day of the experiment, the computer stations in the language laboratory were turned on. The researcher also made sure that the electronic text could be opened without any problem. After the participants had arrived, they were asked to sit at any of the computer stations that were already turned on and wait for further instructions. Next, the participants were given a vocabulary test. Before they answered the test, the researcher informed them that for any words with meaning they did not know they could ignore the question without attempting to guess the answer. The pencil-and-paper test took four minutes. Upon completion, the test scripts were collected to be marked. The subjects were then told about a new multimedia program that they were about to evaluate. They were asked to look at the LCD projector in front and watch a demonstration on how to open the program and display the multimedia glosses in the reading text. After the subjects had understood, they were allowed to use the program for thirty minutes to read the text and answer comprehension questions. They were not informed of the immediate vocabulary test to be given at the end of the session because if they knew about the test they would consciously try to learn the target words. Students who had completed the task earlier than the others were asked to exit the program and wait for the others to finish.

The subjects were then given a vocabulary posttest having similar format and content with the pretest they took prior to the experiment. They had four minutes to answer the posttest. The researcher reminded them that for any words with meaning they did not know they could ignore the question without guessing the answer. The tests were collected and the students were allowed to leave.

One week after each experiment, an unannounced delayed posttest was given to the subjects after they came to the language laboratory for their regular class session. The test was administered by their instructors. The format and content of the test were similar to the those of the immediate posttest. Likewise, the time given was four minutes. The test was then collected.

Results

The scores of the vocabulary pretest, immediate posttest, and delayed posttetst were computed manually. The scores then were inputted into Microsoft Excel to be analysed using the Analysis of Variance (ANOVA) method. The ANOVA results were examined to determine if the mean scores of the tests for the two groups differed significantly.

To obtain the answer to research question 1 (Do ESL learners exposed to translation and animated-image glosses retain more words than those exposed to translation and static-image glosses as indicated by the immediate vocabulary posttest scores?), a 2x2 mixed-factorial ANOVA, with groups as between-subjects factor and time (pretest-posttest) as within-subject factor, was run to investigate the effect of animated images on the immediate vocabulary posttest scores. The ANOVA results are presented in Table 1.

Table 1. The 2x2 mixed-factorial ANOVA results on the immediate post-test scores

Source	SS	Df	MS	F	P
Between Subjects	171.82	35			
Treatment Groups	56.37	1	56.37	16.58	0.000263
Subjects within Groups	115.45	34	3.4		
Within Subjects	2055.5	36			
Time	1932.35	1	1932.35	740.36	<.0001
Group x Time	34.44	1	34.44	13.2	0.000914
Time x Subjects within Groups	88.71	34	2.61		
TOTAL	2227.32	71			

The results from the ANOVA showed that the group with access to the translation and animated-image glosses scored significantly higher than the group with access to the translation and static-image glosses, $F_{(1,34)}=13.2$, $p=0.000914$.

To obtain the answer to research question 2 (Do ESL learners exposed to translation and animated-image glosses retain more words than those exposed to translation and static-image glosses as indicated by the delayed vocabulary posttest scores?), a 2x2 mixed-factorial ANOVA, with groups as between-subjects factor and time (pretest-posttest) as within-subject factor, was run to investigate the effect of animated images on the delayed vocabulary posttest scores. The ANOVA results are presented in Table 2.

Table 2. The 2x2 mixed-factorial ANOVA results on the delayed post-test scores

Source	SS	Df	MS	F	P
Between Subjects	223.5	35			
Treatment Groups	61.3	1	61.3	12.85	0.001045
Subjects within Groups	162.2	34	4.77		
Within Subjects	1728	36			
Time	1530.89	1	1530.89	327.81	<.0001
Group x Time	38.32	1	38.32	8.21	0.007095
Time x Subjects within Groups	158.79	34	4.67		
TOTAL	1951.5	71			

The results from the ANOVA showed that the group with access to the translation and animated-image glosses scored significantly higher than the group with access to the translation and static-image glosses, $F(1,34)=8.21$, $p=0.007095$.

Discussion

Based on the results from the ANOVA of the immediate posttest scores that showed the group with access to the translation and animated-image glosses scored significantly higher than the group with access to the translation and static-image glosses, it can be suggested that animated images, when presented concurrently with verbal information to adhere to the Dual Coding Theory, contributed to the learners retaining more words after the exposure compared to static images. As there have been no similar studies, it is impossible to compare the finding of the present study with existing literature. The finding however can be compared to a similar study by Al Seghayer (2001) and it was found to be consistent with the latter in that moving visuals such as videos and animations helped learners retain words more effectively. To continue the discussion, the findings can be analysed within the context of Schmidt's Noticing Hypothesis discussed earlier. It can be argued that animated images lead to more noticing of the linguistic input because of their motion attribute that creates an illusion of movement. This movement can be claimed to create more interaction as it forces the eyes to focus more and longer on the animated images and forces the brain to process more information, making the words more retainable.

Based on the results from the ANOVA of the delayed posttest scores that showed the group with access to the translation and animated-image glosses scored significantly higher than the group with access to the translation and static-image glosses, it can be suggested that animated images helped learners to retain more learned words long after the exposure compared to static images. The results again can be analysed within the context of Schmidt's Noticing Hypothesis. It can be claimed that animated images led to increased interaction of the linguistic input and hence more noticing, which in turn make the words more effectively retained.

Conclusion

Given the importance of vocabulary in language education, researchers have been studying different methods of vocabulary instructions to determine those that could enhance the rate of vocabulary learning, one being incidental vocabulary learning through reading. It has been shown that glosses help reduce incorrect guessing and improve vocabulary learning. In multimedia environment, researchers have been investigating the effect of different modes of

electronic glosses, or more aptly called multimedia glosses, embedded in electronic text, on incidental vocabulary learning. This study took on a new experiment where it attempted to determine if moving visuals would help learners remember words better than static image. The argument was valid within the context of Schmidt's Noticing Hypothesis where it can be argued that moving visuals would demand more interaction between the readers and the linguistic inputs due to their motion attributes and hence more noticing, which in turn would lead the learners to learn the words. In addition, this study was conducted on the agreement that dual-coded inputs have been found to be more effective in helping learners to retain information. Therefore, moving visuals were paired with verbal information in the form of textual L1 translation. In this study, it was found that the group that read the electronic text containing words glossed with translations and animated images performed significantly better than the group reading the same text but containing words glossed with translations and static images, both in the immediate posttest and in the delayed posttest. It can therefore be argued that animated images were more effective in helping learners to retain new words they encountered, more so when presented as part of dual-coded inputs together with the verbal information.

To improve the present study, several suggestions have been outlined. The first suggestion involves the size of the participants. This experiment utilized two intact groups having eighteen participants in each group; the number may be considered small although meeting the requirement. Increasing the number of participants in each group will improve the representativeness of the population. The next improvement can come from the reading texts in terms of their quantity. Participants need to be given a few reading texts focussing on various genres to resemble the actual reading activities in life. Another enhancement concerns the choice of the target words. In this experiment, only concrete words were used that could be represented visually. Future studies can incorporate abstract words to examine the effect of animated images. The task may be challenging but the results may be valuable.

The fourth improvement pertains to how the experiment was designed. Here the experiment took place once and lasted thirty minutes, which was similar to other related studies. In most cases, the number and the length of the experiments were dictated by the characteristics of the studies. For example, repeating the experiment several times may give less reliable results as participants will become more aware of the experiments, which will affect the outcomes of the following experiments. Also, carrying out the experiments on separate days tends to increase the likelihood of the results being influenced by other confounding variables. However, multiple experiments should be conducted if possible to allow for improved research validity. But confounding variable issues need to be dealt with before that.

The final recommendation for improving the study deals with the independent variable. This study investigated one form of independent variable, which was the format of the images used. Future studies should attempt to incorporate other variables including learning style, English proficiency level, gender, and age. These variables have been found to have moderating effects.

Pedagogically, the present study provides several implications and recommendations. On a broader scale, the finding suggests that the addition of visuals, whether in static or moving forms, to language instructions can potentially enhance any components of language learning, not just vocabulary. Therefore, the finding provides empirical grounds for incorporating

visuals in a CALL environment. This task is feasible given the current state of technological advancement.

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