

The Effectiveness of Computer Technology in Vocabulary Development

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Abstract

This paper examines the potential contribution to vocabulary development of computer technology involving audio and visual aids, hyperlinks, and flexibility. I then report on a small empirical study with some suggestions for vocabulary learning in CALL. In the study, I investigated how vocabulary learning in CALL may influence learners' motivation and achievement in terms of short-term and long-term retention.

Introduction

Vocabulary knowledge is an essential element in second language acquisition. Learning vocabulary assists in developing writing and reading skills. The importance of vocabulary in reading and writing can be seen in the following statements by researchers in the field:

1. Learners need to learn a wide range of vocabulary words to acquire writing skills in order to express their ideas or state arguments (Zhan-Xiang, 2004).
2. Vocabulary acquisition and reading ability are closely linked together (Aarnoutse & Van, 1998).
3. By acquiring new vocabulary words, students can increase their reading ability in their second language (Al-Jarf, 2007).
4. The range of students' vocabulary knowledge is the critical element in improving their text comprehension (Laurence, 2007 and Ahmad & Asraf, 2004).
5. Learners should retain more than 7000 words to successfully comprehend academic texts (Groot, 2000).

According to Leki & Carson and Sheorey & Mokhtari, not only researchers, but also "second language learners themselves think that vocabulary is very important, and they are very eager to learn as many words as they can" (1994; 1993, as cited in Tozcu & Coady, 2004, p. 476). There is no doubt that vocabulary acquisition should be focused on in second language learning.

However, describing this process is more complex than it might seem to be at

first. Stahl suggested three levels of vocabulary acquisition: (a) "*association processing* (which involves introducing a synonym for the new word or showing how it relates to a particular text)," (b) "*comprehension processing* (which helps students demonstrate their understanding of a new word through activities)," and (c) "*generation processing* (which involves using a word in a novel way that reflects deep understanding of its meaning)." (Stahl, 1985, 1986, as cited in Wood, 2001, p. 169) Thus, word acquisition should involve not just students reciting definitions. Rather, students should have deeper understanding of meanings in order to understand or use words in the appropriate context.

Computer Assisted Language Learning (CALL) has been proven by many researchers to facilitate vocabulary acquisition. Tozcu & Coady (2004) showed that computerized vocabulary instruction led students to significant improvements in vocabulary knowledge. Al-Jarf (2007) also demonstrated that students who worked with CALL programs could retain more vocabulary words than those who worked only with printed texts.

This paper will examine the potential that computer technology has for vocabulary development, more specifically, the technological features of audio and visual aids, hyperlinks, and flexibility. I will also report on a small empirical study and make some suggestions for vocabulary learning with CALL.

The Potential Contribution to Vocabulary Development by Computer Technology

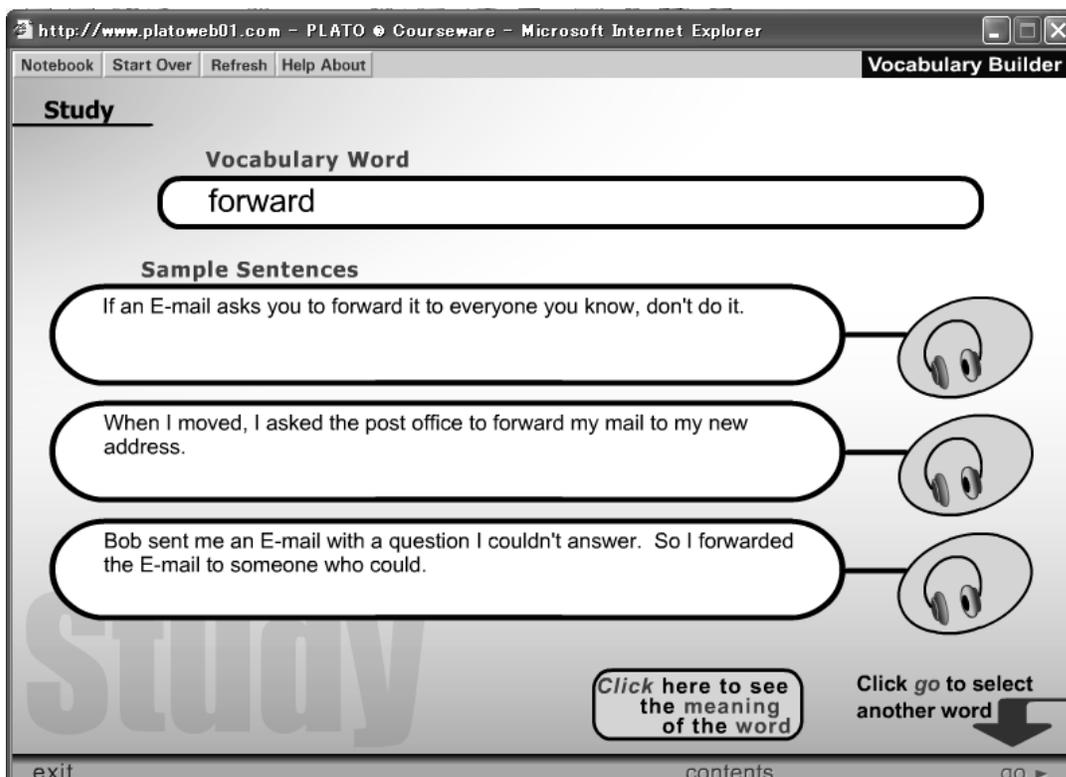
Audio aids

Audio aids stimulate students' vocabulary acquisition in CALL. "Devices that allow users to click on words to hear them pronounced, and sometimes defined, can enhance understandings about new words" (Wood, 2001, p. 182). It is very important for students to learn vocabulary with correct pronunciation through audio aids because students often get the wrong pronunciation when self-studying. Another advantage of audio aids is that the combina-

tion of modalities (text image and sound) facilitates recall and retention (Al-Seghayer, 2001, p. 211).

Plato (http://www.platoweb01.com/pathways/pway_iis.dll/login.plato) is a good example (Figure 1). By clicking on words with the mouse, students can listen to the pronunciation of these words and can listen to the narrator read sample sentences aloud. Students can also view the definitions and origins of words. This courseware is useful for learning vocabulary with its definition, related word forms, sample sentences, and correct pronunciation.

Figure 1. Screen shot of the "Vocabulary and reading information" section in *Plato* (showing audio aids)



Visual aids

Computer technology makes the use of visual aids, such as pictures and video clips, much more efficient than in the past. Many researchers supported the idea that visual aids are more effective than text-only

learning for vocabulary acquisition based on the following evidence and claims:

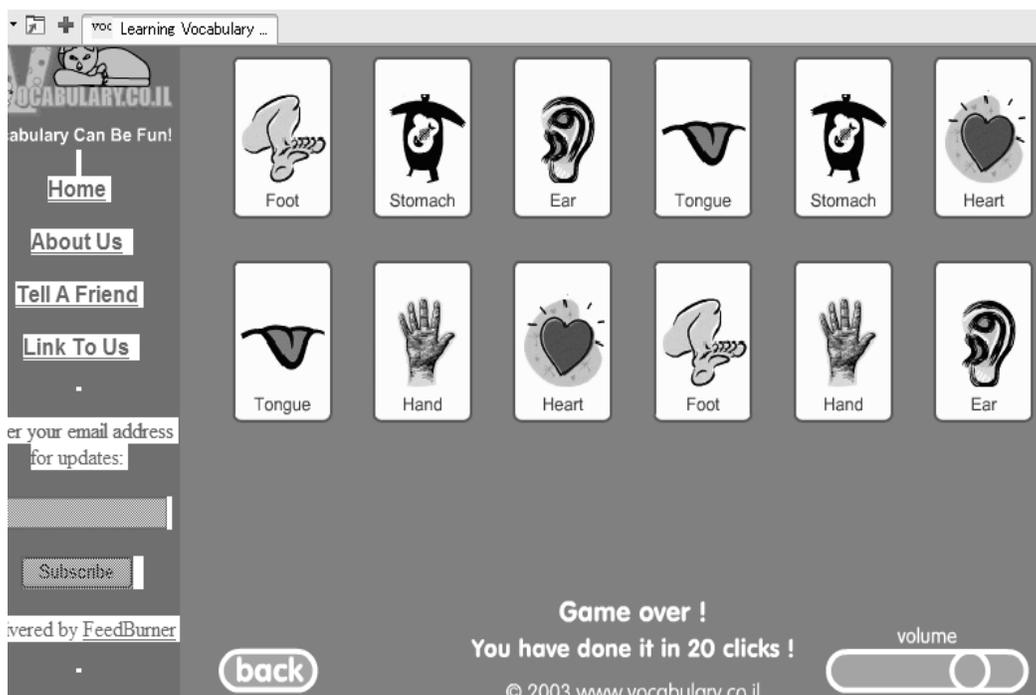
1. The students who learned vocabulary words with visual aids outperformed the students who learned with text-only (Al-Jarf, 2007).

2. Visual information made it easier for learners to understand complicated concepts. Visual aids enabled learners to visualize what words mean and related the words to actual objects (Wood, 2001, p. 179).
3. Visual aids were effective in aiding comprehension and retention of vo-

cabulary because they aided in linking language form to meaning (Duquette & Painchaud, 1996, as cited in Al-Seghayer, 2001, p. 210).

Vocabulary.co.il, for example, is an effective internet site for learning vocabulary with visual aids (Figure 2).

Figure 2. Screen shot of “Match Game” from Vocabulary.co.il (showing the integration of visual aids in vocabulary teaching)



This site is made especially for children, but even basic or low-intermediate adult students would probably find it fun and useful. Students can learn basic vocabulary words with a variety of quizzes and games with pictures and animation. As Wood (2001) suggested, “game-like formats can be more effective at capturing students’ attention than textbooks and workbooks; they provide external stimulation, rich graphics and online rewards” (p. 180).

Hyperlinks

Hyperlinks can provide students immediate access to a vast amount of additional material, which is an important benefit of using computer technology. In contrast to a tradi-

tional book format, hyperlinks enable students to access a wealth of related information (Davis, 1989, p. 42). “Hyperlinks can offer students rich opportunities to encounter new words by allowing them quick access to texts and graphics” (Wood, 2001, p. 180). This immediacy of access enables students to learn vocabulary words more efficiently and effectively (Al-Seghayer, 2001, p. 211).

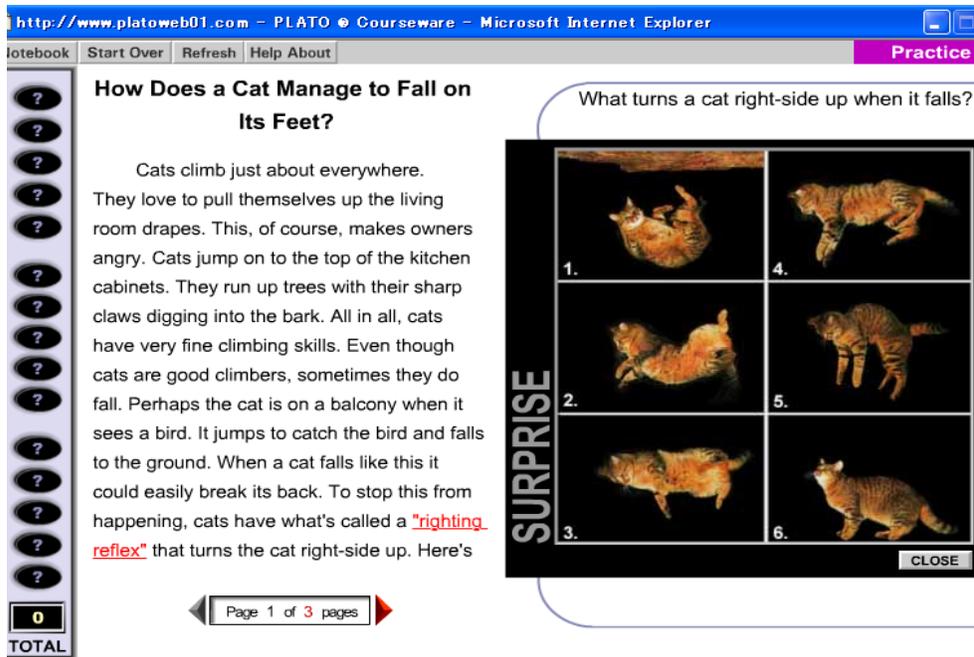
According to Groot (2000, p. 61), intermediate and advanced students should study a wide range of vocabulary words in an intensive period of time because essential vocabulary does not occur often enough in typical L2 instructional materials. Hyperlinks can help solve this problem by providing

students a great number of new words in a relatively short period of time. By clicking on as many words as they wish to learn, students can encounter a vast number of words in a much shorter period of time than by consulting a dictionary.¹

Hyperlinks are often seen in online texts such as *Wikipedia* and *Plato*. In *Plato*,

students first learn the target vocabulary by using the site, and then practice reading comprehension by using the acquired target words. While doing their comprehension practice, students can learn about the meaning of more new words, words that are possibly beyond their current level, with pictures by clicking on the hyperlinks (Figure 3).

Figure 3. Screen shot of “Vocabulary and Reading information” in *Plato* (showing hyperlinks)



Flexibility

Another advantage of vocabulary learning in CALL is its great flexibility. Many researchers touted the virtue of flexibility in computer-assisted vocabulary development. Their arguments are as follows:

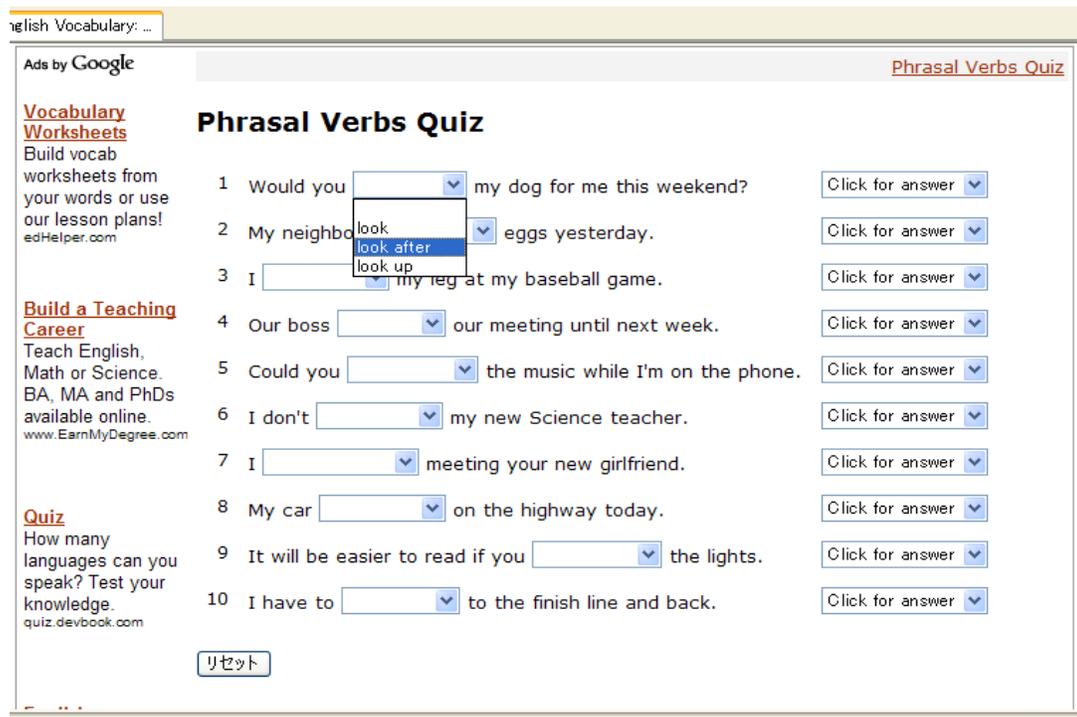
1. Many online vocabulary instructions enable learners to pause, repeat and replay their learning (Wood, 2001, p. 180).
2. The flexibility of on-line instruction enables students to learn vocabulary anywhere, anytime and as many times as they want as long as the Internet is available (Al-Jarf, 2007).
3. Vocabulary learning in CALL has been proven to provide students a sufficient amount of repetitions of a target word, which is hardly possible

in traditional in-class learning. This repetition of vocabulary learning in CALL is an essential factor for students to acquire long-term retention (Ghadirian, 2002, p. 158).

4. Repeated exposures to a new word in language input can reinforce vocabulary learning (Al-Jarf, 2007, Laufer & Hill, 2000, and Tozcu & Coady, 2004).

In *Englishclub.com* (Figure 4), students can take vocabulary quizzes online. Unlike the situation with most written quizzes, students can practice the same quiz repeatedly, for their self-study, by logging onto the site as many times as they want. By repeatedly practicing a quiz with sample sentences, students can also become more familiar with the use of the target words in sentences.

Figure 4. Screen shot of a vocabulary quiz at Englishclub.com



The features of computer technology described above not only enhance vocabulary acquisition but also have a positive effect on students' motivation (Al-Jarf, 2007).

Student motivation is very important in vocabulary learning. It appears that students can acquire more vocabulary when they are motivated and enjoy learning. In a study conducted by Al-Jarf (2007), students who most enjoyed the experience of vocabulary learning with CALL made the highest gains in vocabulary. When students become motivated toward vocabulary learning, their test performance improves, which in turn leads to an improvement in their self-esteem.

Davis and Lyman-Hager (1997) showed another effect of CALL on students' motivation. They said that student motivation promoted more self-learning and better understanding of the target language. This critical feature of CALL enables students to become independent learners. Even if classes are taught in computer classrooms, where students have little interaction with each other, they seem to be relaxed and comfortable which also has a positive effect on motivation. Finally, motivation also has a

great influence on improving relationships between teachers and students and students among other students. According to Al-Jarf (2007), the fun feature of vocabulary learning with CALL motivated students to create a warm climate with their instructor and among themselves. Once students and instructor build a strong positive rapport, classroom learning becomes more active and effective.

Summary

So far I have reviewed five major ways computer technology can enhance vocabulary learning:

1. Audio aids help students to acquire correct pronunciation. The combination of text image and sound facilitates recall and retention.
2. Visual aids enable learners to visualize what a word means and link language form to meaning. This facilitates comprehension of vocabulary words.
3. Hyperlinks provide students immediate access to a vast amount of related information.

4. The flexibility of CALL enables students to study vocabulary anywhere, anytime and as many times as they want, which reinforces long-term retention.
5. The fun features of CALL vocabulary learning can increase students' motivation.

Next, I will report on a preliminary study in which I attempted to gauge the effectiveness of CALL for vocabulary learning compared with traditional methods.

The Study

In this small-scale study, I investigated how vocabulary learning with CALL influenced learners' motivation and achievement in terms of short-term and long-term retention.

Methodology

Subjects. The subjects in this study were five Japanese adult learners who live in Japan. All of them have B.A. level of English competence from Japan colleges. At the time of the study, they had studied English in Japan for 8 to 10 years. The subjects were selected as representative samples of non-native learners in an EFL setting. All of them have earned a Pre-2nd grade certificate of *EIKEN* within the past ten years. *EIKEN* is an English proficiency test that is widely used in Japan. According to *EIKEN*'s website (<http://steppeiken.org/benefits/comparison-toefl.shtml>), the subjects' English proficiency level is considered to be equivalent to a 32- TOEFL iBT score or a 400 TOEFL PBT score. In other words, their estimated English level was between intermediate and low-intermediate.

Materials. The subjects were asked to complete two vocabulary tasks measuring how well they could memorize 20 items. The first task was to memorize a list of 20 vocabulary items using a traditional paper and pencil technique (See Appendix A), and the second was to memorize another 20 vocabulary items using the on-line program, *Plato* (See Appendix B). All the vocabulary items on the two tasks were selected from the same vocabulary site in *Plato*. The target vocabulary words were categorized as grade

3 level of difficulty on the site. For the first task, the subjects memorized the target words and their definitions by reading a printed task sheet. For the second task, the subjects were asked to listen to and understand each word's pronunciation, definition, and sample sentences using *Plato* (See Appendix C). After finishing the tasks, the subjects completed two types of post tests; one was administered immediately after the experiment to check short term memory and the other was administered two weeks later to check long term retention. The post tests were presented in a slightly different format (they were both matching exercises but are presented in different forms) but had the same content with 10 words from each list (see Appendix D and F). The subjects were then asked to write comments on their experience learning new words in the given condition.

Procedure. The tasks were sent to the subjects by e-mail. Before working on the tasks, the subjects were asked how many words they already knew in both lists, and known words were then discarded from the study. The subjects printed out the first task sheet and studied the remaining words by themselves over a period of five days. For the second task, using *Plato*, they were given the site's web address and password, and they worked on the site at their home computers. On the fifth day, the first post test was sent by e-mail. The subjects had two days in which to complete the test and write a few comments onto an electronic questionnaire sent to them by e-mail. Two weeks later, the second post test was sent by e-mail. On both the first and second post tests, the subjects were required to complete the tests on an electronic sheet and return them by e-mail. Alpha value was set at 0.05 (that is, the difference between sets of scores was considered statistically significant when $p \leq 0.05$).

Data Analysis

The data were analyzed quantitatively and qualitatively.

Quantitative analysis

Pre-task self-assessment. As indicated in the self-assessment, for the first task, all of

the subjects already knew the words, *guideline* and *bacteria* because they are commonly used in Japan. Two additional words, *creative* and *ability*, were also relatively familiar to several of the subjects. As for the second task, all of the subjects already knew the words *pressure*

and *balcony* for the same reason as above. The additional words *emotional*, *search engine* and *process* were also relatively familiar to some of the subjects. Table 1 summarizes the results.

Table 1
The Number of Words Previously Known to the Subjects

	from the first task word list	from the second task word list
Subject 1	3	4
Subject 2	3	4
Subject 3	4	4
Subject 4	4	3
Subject 5	2	2
Average	3.2 / 20	3.4 / 20

On average, the subjects were relatively familiar with about three words in each task. The similar number of familiar words in both lists suggests that the tasks were indeed at approximately the same level of difficulty (Grade 3 in *Plato*). These familiar

words were then eliminated from the test items that each subject received.

Post tests. Table 2 summarizes the results from the first post test.

Table 2
Post-test 1: Number of Correct Responses for Words Taken from the Two Tasks

	Number of correct responses for words taken from the first task	Number of correct responses for words taken from the second task	Total score
Subject 1	6	8	14
Subject 2	6	9	15
Subject 3	9	9	18
Subject 4	6	9	15
Subject 5	5	7	12
Average	6.4 / 10	8.4 / 10	14.8 / 20

As presented in Table 2, the subjects got a relatively better score on memorizing word definitions which were presented in the second task (*Plato*) than in the first task (text only). The average score in answering the word definitions presented in the second task (8.4) was significantly higher than that of the score in the first task (6.4) ($p = 0.02$). Some subjects said that they felt more familiar with the words in the on-line task. One reason, they said, was they felt that

knowing the correct pronunciation of those words was helpful. Another reason was they knew how to use those words in sentences because *Plato* provided three sample sentences per word with audio. By using *Plato*, the subjects could read and listen to the sample sentences as many times as they needed, while this option is not provided in the paper-based task.

Table 3 summarizes the results from the second post test.

Table 3

Post-test 2: Number of Correct Responses for Words Taken from the Two Tasks

	Number of correct responses for words taken from the first task	Number of correct responses for words taken from the second task	Total score
Subject 1	4	7	11
Subject 2	4	7	11
Subject 3	7	8	15
Subject 4	5	8	13
Subject 5	4	5	9
Average	4.8 / 10	7.0 / 10	11.8 / 20

As presented in Table 3, all of the subjects got a better score on memorization of word definitions which were presented in the second task (*Plato*) than those in the first task and the difference between the results of the two tests was significant ($p = 0.01$). In terms of retention, I can say that vocabulary learning with CALL could be more effective

than just studying with paper-pencil techniques.

It is worth mentioning that the total scores of the second post tests were lower than those of the first post tests. Table 4 compares the overall results from the two post tests.

Table 4

Comparison of the Total Scores of the First and Second Post Tests

	Total score on the first post test	Total score on the second post test
Subject 1	14	11
Subject 2	15	11
Subject 3	18	15
Subject 4	15	13
Subject 5	12	9
Average	14.8 / 20	11.8 / 20

All the subjects got a lower score on the second post test which was administered two weeks after the first post test and this difference was in fact significant ($p = 0.001$). One of the main reasons would probably be that the subjects did not continue studying or encountering the same words after the first post test. Some subjects said they totally forgot some of the words which were presented in the paper task. Two of the subjects said they could not identify some words which were presented in the on-line task but they still remembered the pronunciation of those words. This suggests that CALL with audio aids can help second language learning students with vocabulary acquisition to some extent.

Qualitative data

Almost all of the subjects commented that the first task was tiring and they could not maintain their level of motivation for five days. One wrote, "It was a painful experience. I had a headache just by looking at the paper task all written in English." Two said that they felt depressed and lost their motivation by just seeing the list.

In contrast, all of the subjects found the second task, learning words with *Plato* to be fun. Since it was their first time to utilize CALL, they enjoyed exploring the site and learning with native-speaking pronunciation models. One said, "I wish I could have used online-instruction when I was a high school student." Many of them said they got motivated by using CALL and spent much more time studying the second task than the first.

They also said that it was easy to understand the word definitions because they were provided three example sentences for each word and could see the actual use of each word.

Limitations

The following are several limitations in my study which should be considered if it is to be replicated.

1. The post tests were administered by e-mail, so there is a limitation in the reliability of the scores. Although I asked all the subjects not to use a dictionary and to do the tests alone, the reliability of the test depended entirely on their self-reporting in this regard.
2. I tested only word recognition. To have more understanding about vocabulary acquisition, an examination of the students' production skills would be necessary.
3. A larger number of subjects and test items would be necessary to make the data more reliable.
4. Post tests with longer delays should be implemented to check students' long-term word retention.
5. There was a difference in the quality and quantity of input in the two tasks. In the paper task, students received only the words and their definitions. In the online task, students received not only the words and their meanings, but also example sentences showing how the words are used in context. This difference in input alone could have explained the higher achievement by the online task group.

Summary of Study

In this small study, I found that using CALL for vocabulary learning allowed learners to acquire vocabulary with more ease and enthusiasm. One of the reasons is that using CALL for vocabulary learning motivated learners and promoted greater opportunities for self-learning. Students were exposed to the target vocabulary in many formats and media, which may have led to the successful retention of the voca-

bulary. Furthermore, learning example sentences with audio meant that learners were able to understand the target vocabulary with its correct pronunciation and in context. Therefore, CALL helped the students gain a deeper understanding of the vocabulary. Understanding how to use words in actual context is very important for the acquisition of vocabulary.

Learning vocabulary with CALL for a short period is not sufficient to ensure long-term retention. Long-term vocabulary retention requires continual learning. Therefore, to maintain students' motivation for continual vocabulary learning, it would be beneficial for teachers to keep encouraging their students to use on-line instruction.

Suggestions for Implementing CALL in Vocabulary Development

Based on previous research as well as the results of my empirical study, I would like to make some suggestions for vocabulary teaching using CALL. When teachers implement CALL for vocabulary learning, they should pay attention to the four points discussed below.

In order to promote CALL for vocabulary learning and in order for students to take the on-line learning seriously, administrative support is required (e.g., making on-line teaching a mandatory part of vocabulary instruction). It is sometimes difficult to make students serious about CALL learning because of the fun feature of CALL. As Al-Jarf (2007) said, some students think that online instruction is used for entertainment, not for serious studying. Therefore, it would be necessary to communicate to the students that on-line learning is a crucial element in their learning process.

To prevent students from thinking that vocabulary acquisition in CALL is not just for fun, it is also important for teachers to select relevant vocabulary which are necessary and related to course objectives. If students know the reason why they have to learn those words, their attitude toward learning would be greatly improved.

To encourage all the students to participate and promote their progress, teachers should keep monitoring and guiding stu-

dents' behavior. One example suggested by Al-Jarf (2007) is that teachers should make clear rules for using online tools. Another example is utilizing post-tests or additional worksheets as was done in the empirical study above. In these ways, teachers can guide their students' behavior and monitor their progress. These suggestions are very important because the promotion of independent learning in CALL may be counter-productive for students who are not self-motivated.

It is necessary for teachers to integrate a variety of CALL and non-CALL exercises for vocabulary learning. Wood (2001) warned that some CALL software might not be informative enough to help learner's deep learning (p. 186). CALL vocabulary exercises

such as matching words with definitions, answering multiple choice questions, and filling in blanks may not lead students to deep processing of new words because they develop only recognition skills. To solve this problem, Al-Jarf (2007) showed that utilizing different types of vocabulary instructions and learning activities were effective in developing students' vocabulary with CALL. Chun and Plass (1996) also said that integrating different types of media promoted retention of target vocabulary words.

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Notes

¹ The loss, of course, is the training to quickly find something in alphabetical order, which is offered by the affordances of a paper dictionary but not with an electronic dictionary.

Appendix A

Table 1: Word list for the first (paper) task, taken from Grade 3 of *Plato*

<Word List>

	英単語 / word	意味 / definition		英単語 / word	意味 / definition
1	Lather	to cover with foam	11	behavior	the way someone acts
2	Bacteria	tiny small things that some-time make you sick	12	criticize	to say that something is wrong or bad
3	Cram	to stuff in a small space	13	paralyze	to make unable to move
4	Courteous	polite	14	adjust	to adapt to a change
5	guideline	general rule for doing something	15	conquer	to gain total control of something
6	confident	strongly believing in one-self	16	stutter	to repeat the first sound of the word
7	ability	the skill to do something	17	deserve	to be worthy
8	touchy	easily upset	18	avoid	to escape
9	creative	able to make new things	19	tuition	a fee for school classes
10	tend	to be likely to act in a certain way	20	achieve	to finish something that is hard to do

Appendix B

Table 1: Word list for the second (computer) task, taken from Grade 3 of *Plato*

1	process	11	balcony
2	squash	12	hoax
3	contract	13	forward
4	bulk	14	search engine
5	tempt	15	kidney
6	pressure	16	plausible
7	victim	17	foundation
8	franchise	18	saga
9	isolation	19	embarrassing
10	emotional	20	treatment

Appendix C

Figure 1. The screen shot of a word list in *Plato*

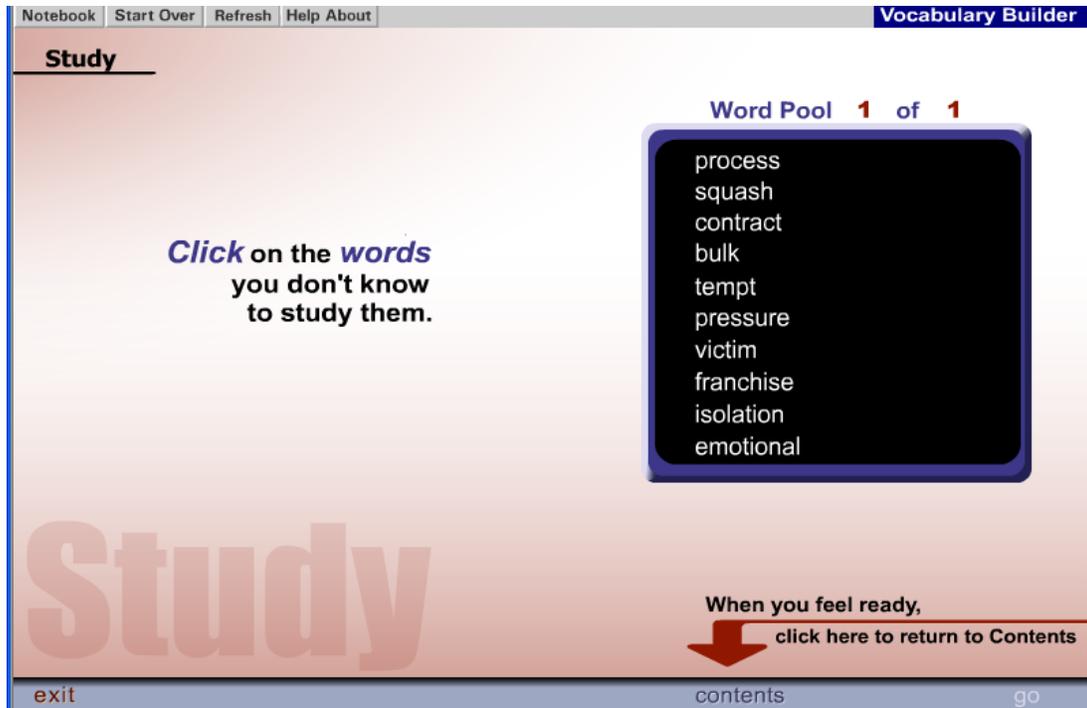


Figure 2. The screen shot of a vocabulary word with sample sentences in *Plato*

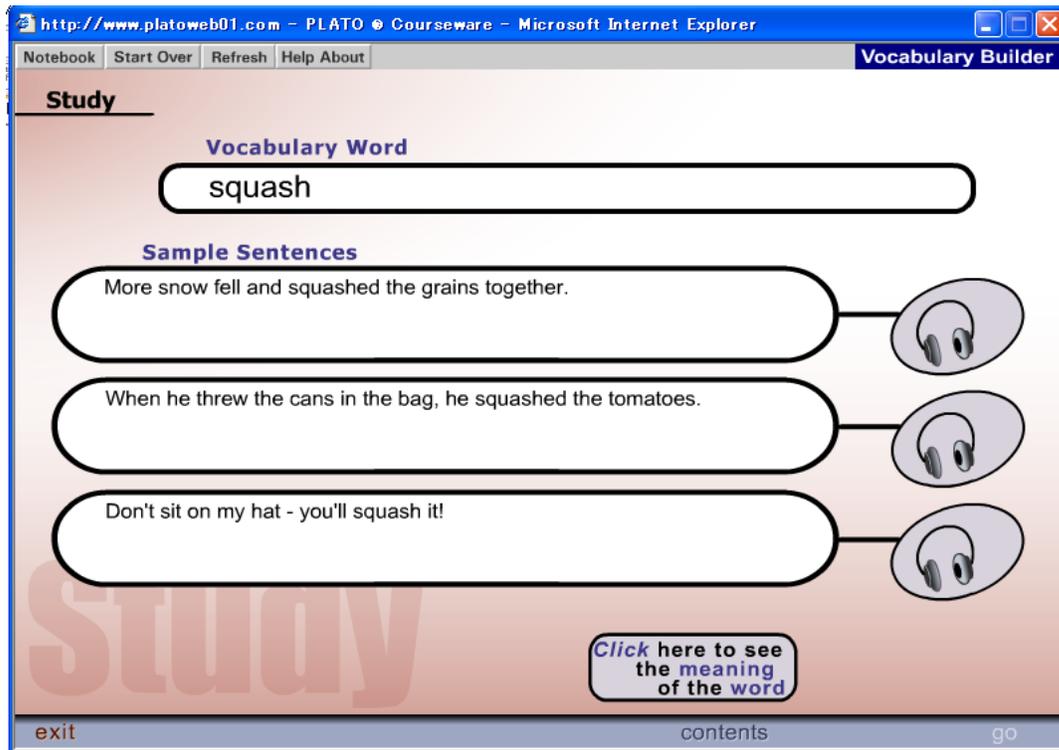


Figure 3. The screen shot of the definition of a word and related information in *Plato*

The screenshot shows a web browser window with the address bar displaying <http://www.platoweb01.com> - PLATO Courseware - Microsoft Internet Explorer. The page title is 'Vocabulary Builder'. The main content area is titled 'Study' and 'Vocabulary Word and Definition'. It features a large rounded rectangle containing the text 'squash -- To crush or squeeze'. Below this, there are six categories, each with a rounded rectangle: 'Prefix' (empty), 'Root' (containing 'squash'), 'Suffix' (empty), 'Synonyms' (containing 'crush'), 'Memory Jogger' (empty), and 'Antonyms' (empty). At the bottom, there are two buttons: 'Click here to see sample sentences' and 'Click go to select another word' with a red arrow pointing down. The footer contains the text 'exit', 'contents', and 'go ►'. A large, semi-transparent 'Study' watermark is visible in the background.

Appendix D

The First Post Test

Match the word and its definition. 単語の意味を下から選び、記号で答えてください。

1	squash		11	bulk	
2	lather		12	behavior	
3	embarrassing		13	stutter	
4	criticize		14	kidney	
5	cram		15	adjust	
6	plausible		16	courteous	
7	tuition		17	saga	
8	conquer		18	victim	
9	hoax		19	paralyze	
10	tempt		20	contract	

a trick that makes people believe something that is not true

sounding as if it could be true

an organ in the body that helps get rid of waste

a long story

making a person uncomfortable

to crash or squeeze

a large amount

someone who has been hurt by a person or thing

to lead someone want something

a legal agreement

to cover with foam

to say that something is wrong or bad

polite

to stuff in a small space

to adapt to a change

to repeat the first sound of the word

a fee for school classes

to make unable to move

the way someone acts

to gain total control of something

Answer key

1	squash	F	11	bulk	G
2	lather	K	12	behavior	S
3	embarrassing	E	13	stutter	P
4	criticize	L	14	kidney	C
5	cram	N	15	adjust	O
6	plausible	B	16	courteous	M
7	tuition	Q	17	saga	D
8	conquer	T	18	victim	H
9	hoax	A	19	paralyze	R
10	tempt	I	20	contract	J

Appendix E
The Second Post Test

Choose the word to match its definition.

意味に合う様、下から適切な単語を選び、記号で答えてください。

a fee for school classes ()
 a trick that makes people believe something that is not true ()
 to repeat the first sound of the word ()
 an organ in the body that helps get rid of waste ()
 to stuff in a small space ()
 making a person uncomfortable ()
 a large amount ()
 polite ()
 someone who has been hurt by a person or thing ()
 to make unable to move ()
 sounding as if it could be true ()
 a legal agreement ()
 to cover with foam ()
 to crash or squeeze ()
 to lead someone want something ()
 to say that something is wrong or bad ()
 to adapt to a change ()
 a long story ()
 the way someone acts ()
 20. to gain total control of something ()

A: stutter B: squash C: kidney D: victim E: tuition F: hoax G: embarrassing
 H: behavior I: criticize J: conquer K: adjust L: contract M: bulk N: courteous
 O: plausible P: lather Q: tempt R: cram S: paralyze T: saga

Answer key

1	E	11	O
2	F	12	L
3	A	13	P
4	C	14	B
5	R	15	Q
6	G	16	I
7	M	17	K
8	N	18	T
9	D	19	H
10	S	20	J

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