Three Types of CALL Courseware Developed for Teaching Vocabulary to Japanese College Students

Junko Takefuta
Graduate School of Science and Technology, Chiba University

1. INTRODUCTION

Paribakht and Wesche (1997: 174) stated, "The long-neglected issue of vocabulary acquisition is currently receiving attention in second language pedagogy and research - reflecting the importance always accorded it by learners." However, they continue to say, "But it is still far from clear how learners acquire or how it can best be taught." In fact, many teachers and researchers know that there are many difficult problems that remain unsolved in the area of effective EFL or ESL vocabulary teaching and learning. For example, Krashen (1989: 450) stated that vocabulary learning is at best boring and at worst painful. While, Brown and Perry (1991: 655) argued that students learning English for higher education face a formidable task, extrapolating that an ESL student learning academic English would have to learn an average of more than 3,000 words per year. Acquiring the amount of necessary vocabulary for successful communication takes a great deal of time (Nation, 1990: 12), especially when words are learned incidentally, by reading books or listening to others speaking (Huckin and Haynes, 1993: 295; Coady, 1993: 3).

To complicate matters, some words learned after long and tedious study are quickly forgotten (Kamioka, 1982; Meara, 1989). Furthermore, some methods which were reported to have been developed for effective teaching of vocabulary are used only for teaching a specific category of words (Ellis, 1995: 12). It is also said that many of the words learned and remembered cannot be used in practical communication: in speaking, listening, reading, or writing (Nagy, 1988: 4; Schmitt, 1995: 34).

We began our study in an attempt to develop a vocabulary teaching system, which might solve, or at least, alleviate some of the problems mentioned above.

2. PURPOSE OF THE STUDY

The purpose of our study was to develop and compare the functions of three types of courseware to be used in a CALL system to teach vocabulary effectively to Japanese college students. The final goal of our research was to develop courseware for learning vocabulary with the following characteristics:

1) Vocabulary learning tasks that are enjoyable,
2) Vocabulary learning tasks that are effective,
3) Vocabulary learning tasks that promote learning of a large number of words,
4) Vocabulary learning tasks that are not limited to certain lexicon,
5) Vocabulary learning tasks that yield high retention rates over long periods of time, and
6) Vocabulary learning tasks that facilitate the learning of words that can be used in

practical communication.

3. RESEARCH DESIGN

3.1. Development of courseware

In order to develop a vocabulary teaching system featuring the characteristics stated above, we decided to introduce a personal computer as a means of instruction. We felt that the use of a personal computer might resolve some of the challenges presented in vocabulary study and acquisition. Vocabulary learning using a personal computer might turn tedious, arduous study into an enjoyable task like the entertainment found in video games. Schreck & Schreck (1991: 472) suggested this possibility:

> Viewed as a new resource to help promote, enhance, and facilitate learning, the computer has fostered high expectations of more effective, more relevant, more motivating, and more innovative new learning experiences.

On the other hand, we were fully aware of the fact that the state of vocabulary teaching could not instantly be improved by simply introducing personal computers to an English class. Levy (1997: 5) affirmed that, "a number of CALL projects have not been driven directly by theory", such as instructional design, language teaching, or knowledge of the applicability of the technology. Thus, we decided to take a three-step approach in introducing personal computers to our class, by developing three types of vocabulary teaching courseware, one after another.

First, the personal computer was used with a traditional method of drill and practice (Vocabulary Courseware 1: VC-1). Secondly, game-like activities were incorporated in addition to the drill and practice (Vocabulary Courseware 2: VC-2). Finally, we developed the vocabulary teaching tasks further, introducing activities suggested by theories of learning or information science, and utilizing multimedia presentation (Vocabulary Courseware 3: VC-3). Each structure of the courseware is described in the next section.

3.2. Structure of the courseware

3.2.1. The drill and practice courseware: VC-1

The features of this courseware can be summarized as a simple drill and practice, text-only single-medium type, within the context of information processing activities on the part of the learners. The following are the steps of learning activities to be done with VC-1.

Step 1 A simple sentence, which contains at least one target word, appears on the screen.

Step 2 Three words, including the target word, together with the Japanese equivalents appear on the screen.

Step 3 A simple sentence with three blanks appears on the screen.
The learner fills in the three blanks with the appropriate words.
The correct words appear in the blanks when the return key is pressed.

3.2.2. The task-based courseware: VC-2

VC-1 was expanded to create VC-2 which was composed of a six-step learning activity. First, the target words were classified by topic into 8 groups of 11 to 12 words each. The words in each group were studied as a unit. Then, a chunk, or contextualized phrase containing the target word, and a simple sentence were given in order to give a short-and-easy-to-remember context for each target word. The task that the learners seemed to enjoy the most was that of typing the spelling of each word (Step 4). They spent more time on this task than any other task. This might have been enjoyable because instant feedback as to the correctness of an answer was given to the learner.

The six steps of learning activities to be involved in with VC-2 are as follows:

Step 1 A list of 11 to 12 target words (with the Japanese equivalents) is presented on the screen.

Step 2 The target words are presented in chunks, together with the Japanese equivalents of the chunks.

Step 3 The target words are presented in sentences, together with the Japanese equivalents of the sentences.

Step 4 The learner types the spelling of each of the target words after the Japanese equivalent is presented. The computer checks, and gives feedback immediately after he or she types the answer. The learner can also check the correct spellings without typing them.

Step 5 The learner tries to retrieve the meanings of the target words presented on the screen. The learner can check the Japanese equivalent by pressing the return key.

Step 6 Target words are presented in chunks for the learner to review how the words can be used.

3.2.3. The multimedia courseware: VC-3

VC-3 is an expanded version of VC-2, which is composed of a 12-step learning activity. Students were given opportunities to manipulate information with regard to different aspects of a word, in a variety of ways. Although, all the tasks in VC-3 were relatively simple to perform, they were introduced in logical sequence in keeping with established activities considered effective in 'theories of learning,' 'systems science,' and 'information science.'

With VC-3, the students were given ample opportunity to process information about the target words in terms of their visual and acoustic properties (Steps 1, 2, 3, 5, 10, and 11). Such tasks, in turn, may have helped the learners' processing of information on a deeper semantic level by relating the target words to their existing cognitive structures. Other tasks should have helped the students to directly process information on the semantic level.

The following series of 12 steps in four stages are the learning activities to be engaged in with VC-3.

STAGE I GIVING MOTIVATION FOR THE STUDY

Step 1 A picture which is considered to be the most appropriate for the meanings of a set of 10 words grouped to be taught in one session is presented on the screen. The pronunciation of all the words are presented one after another while viewing the picture on the screen.

STAGE II PRESENTATION OF THE TARGET WORDS

Step 2 Ten words (spellings and Japanese equivalents) in the set are presented together in one frame of the screen. The learner confirms the pronunciation of each word by choosing the word and pressing the space bar.

Step 3 Each target word is presented in the context of three chunks. Learners can hear the pronunciation by pressing the space bar. The meaning of the chunk is presented on the screen approximately two seconds after the pronunciation. The reason for this delay is to avoid overloading the learner's perceptive effort and activity, and also to allow the learner to think actively about the meaning of the chunk before it is given.

Step 4 The definition or meaning of each word, as described in monolingual dictionaries, is given on the screen. Descriptions of the definitions are divided into two groups of five and presented in two frames so that the learners are not overwhelmed by too much information in one frame.

STAGE III TASKS FOR LEARNING

Step 5 Learners retrieve the target words from the definitions that are presented on the screen. Learners can confirm the spelling of the target word by pressing the return key. The pronunciation is also presented two seconds later.

Step 6 Learners retrieve the meaning for each target word presented on the screen and can confirm the Japanese equivalent by pressing the return key.

Step 7 Learners retrieve the spelling for each Japanese equivalent presented and can confirm the spelling by pressing the return key.

Step 8 Learners write all the target words and chunks in their notebooks twice.

Step 9 The context of the target words is presented in English sentences in conjunction with their Japanese equivalents. A blank in parentheses is provided for the target word. If the learner presses the space bar, the target word appears in the blank. Six frames are used for this activity, presenting five chunks in each frame. The chunks for each target word are arranged so that they appear in different frames.

STAGE IV CONFIRMATION AND REVIEW WORK

Step 10 The same as Step 2 described above.

Step 11 The same as Step 1 described above.

Step 12 Learners are requested to generate and write one sentence for each target word in their notebooks.

Subjects were instructed to study one set of words through the 12 steps in this order. However, they were allowed to repeat any or all the steps within the time allotted.

3.3. Materials

3.3.1. Words taught

VC-1/VC-2: 89 business-related words selected from *Business English Master,* e.g., deduction, itinerary, transaction, premium, deal.

VC-3 : 140 words selected from a TV sitcom, a college-level lecture, and a movie, e.g., confiscate, prudent, vulgarity, shrewd, violate, impede.

3.3.2. Chunks taught

The chunks were extracted from the transcriptions of the resource used for collecting the target words. See 3.2.2. for the explanation of chunks.

VC-1 : No chunks were taught.

VC-2 : Examples of chunks taught in VC-2 were as follows:

(annual)	to finish the annual report
(petition)	A petition has been filed.

VC-3 : Examples of chunks taught in VC-3 were as follows:

(provocative)	They are provocative.
	his provocative words
	He is just being provocative.
(violate)	violate the students' right
	They violated my privacy.
	violate the peace

3.3.3. Grouping of target words

VC-1/VC-2: Eighty-nine words were randomly divided into 8 sets, 11 to 12 words each.

VC-3 : One hundred and forty words were classified into 14 sets, 10 words each. Ten words in each set were selected according to the topic category to which they were considered to belong.

3.4. Instrumentation

VC-1/VC-2: 17 sets of personal computers (NEC PC-9801 DS)

VC-3 : 17 sets of personal computers (NEC PC-9821 Ce2)

3.5. Time Spent for Teaching

VC-1/VC-2: 4 weeks, 200 minutes in total

VC-3 : 8 weeks, 500 minutes in total

3.6. Number of Teaching Sessions

VC-1/VC-2: 4 sessions (The subjects were allowed to stop studying when they were convinced that they had learned all the target words of the session.)

VC-3 : 8 sessions (The subjects were also allowed to stop studying when they were convinced that they had learned all the target words of the session.)

3.7. Experimental Subjects

VC-1/VC-2: 17 students of Chiba University who were majoring in TESOL (mostly juniors and seniors)

VC-3 : 17 students of Chiba University who were majoring in TESOL (mostly juniors and seniors)

3.8. Teaching Schedule

VC-1/VC-2: Eight sets of target words were taught in 4 sessions: the subjects learned 2 sets in each session.

VC-3 : Fourteen sets of target words were taught in 8 sessions: the subjects learned 2 new sets in each session. In order to teach 140 words in the 8 sessions through the principle of spaced practice, the following schedule was designed.

One session was composed of three sub-sessions: an achievement test session, a review session, and a study session. We introduced a technique called 'spaced practice,' the practice of studying various skills in short intervals interspersed with study sessions on other topics (Anderson, 1980), and distributed the three sub-sessions as presented in the table below.

Session	Achievement test	Review	Study
1			set 1
2	set 1	set 1	**sets 2, 3**
3	**sets 2, 3**	**sets 2, 3**	sets 4, 5
4	sets 4, 5	sets 4, 5	**sets 6, 7**
5	**sets 6, 7**	**sets 6, 7**	sets 8, 9
6	sets 8, 9	sets 8, 9	**sets 10, 11**
7	**sets 10, 11**	**sets 10, 11**	sets 12, 13
8	sets 12, 13	sets 1~13	set 14

3.9. Methods of evaluation

VC-1/VC-2: A pretest, an immediate posttest with an intervening task added, and a delayed (5 weeks) posttest were administered. Four types of tests were employed in the delayed posttest: a) Definition test, b) Identification test 1, c) Identification test 2, and d) Gap-filling test (multiple choice type).

Two types of questionnaires were administered to elicit the learners' impression of using the courseware: one, free-response questions, and the other, response-selection questions.

VC-3 : A pretest and two delayed (9 and 11 weeks) posttests were administered. Four types of tests were employed: a) Recognition test (multiple choice type), b) Identification test, c) Definition test (multiple choice type), and

d) Gap-filling test (multiple choice type).

Two types of questionnaires were also prepared. The first questionnaire employed free-response questions; the second consisted of response-selection questions.

Sample test items used for VC-1, VC-2 and VC-3 are presented in Appendices 1 and 2.

4. RESULTS

4.1. Test Scores

The results of experimentally teaching vocabulary by using VC-1, VC-2, and VC-3 are summarized and presented in Tables 1, 2, and 3. The data of Tables 2 and 3 are also presented in Figures 1 and 2 respectively. The data collected by questionnaires are presented following the presentation of the data in Tables and Figures.

The raw scores of the uncorrected proportion of the multiple choice tests were corrected to obtain the data shown in Tables 1, 2 and 3. The correction was made by referring to the table developed by Guilford (1954: 421) for deleting the portion of the score attributable to chance success.

Before the VC-1 and the VC-2 subjects started to learn the target words, their average score in the identification type pretest was 16%. After the subjects learned 89 words in 4 sessions, the results of the immediate posttests were compared between VC-1 and VC-2. Each of the immediate posttests was given only in the first three sessions, after an intervening task. The effect of teaching in all four sessions was examined in the delayed posttest. The difference in the mean rates of immediate posttests of 79% (VC-1) and 92% (VC-2) was statistically significant (Table 1). On the other hand, the difference of 33% and 34%, which was observed in the delayed posttest between VC-1 and VC-2, was not statistically significant (Table 2 and Figure 1).

Table 1. The rate of immediate recall as observed after each of the three study sessions respectively

	1	2	3	Mean
VC-1	71(%)	86	81	79
VC-2	92	92	91	92
t	2.887*	0.828	2.150*	2.572*

*$p<0.05$

Table 2. Retention rates observed after teaching with VC-1, VC-2, and VC-3 respectively

Courseware	Elapsed time (weeks)											
	0	1	2	3	4	5	6	7	8	9	10	11
VC-1	79(%)	–	–	30	32	33	–	–	–	–	–	–
VC-2	92	61	–	41	40	34	–	–	–	–	–	–
VC-3	–	98	97	99	99	97	98	97	96	96	93	93

Note: – No data collected

Before the V-3 subjects started to learn these target words, their mean score in the

identification type pretest was 31%. They learned 140 words in 8 sessions. They spent an average of 3.6 minutes per word, which was 1.6 times more than the time the subjects spent with VC-1 and VC-2. However, the retention rate for the VC-3 students was considerably better. After one week of study, the students were able to recognize and recall 98% of the target words. Further, in an unannounced delayed posttest given 11 weeks after the first study session was administered, the retention rate remained 93% (Table 2 and Figure 1).

In order to examine whether the target words of VC-3 were learned deeply enough so that the subjects could use them in practical communication, we administered a battery of 4 types of test (see 3.9 and Appendix 2) developed locally. The data in Table 3 and Figure 2 show that the learners were able to score higher than 85% on all 4 tests of the delayed posttests, and a small variance could be seen among the rates on the 4 tests.

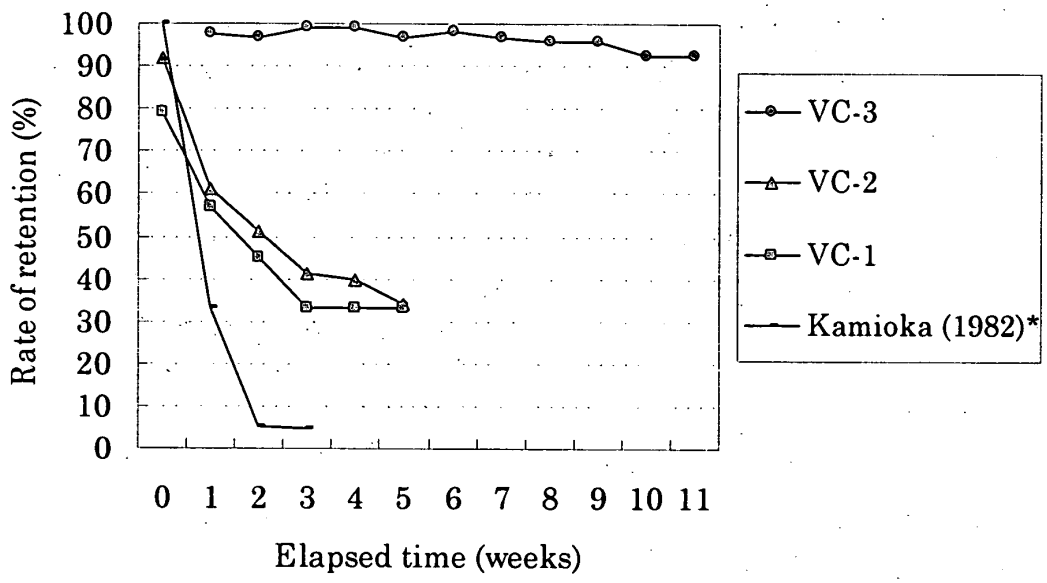

Figure 1. Retention rates observed after teaching with VC-1, VC-2, and VC-3

* The data from Kamioka (1982) are added for reference. Kamioka reported that students remembered 33% of the words they had learned one week earlier. Three weeks after they had originally learned the words, they remembered 4.8%.

Table 3. Retention rates (VC-3: 10 & 11 weeks) as observed respectively by 4 types of vocabulary tests

Test type	Elapsed time (week)		Mean
	10	11	
Recognition test*	99(%)	100	99.5
Identification test	93	88	90.5
Definition test*	85	88	88.0
Gap-filling test*	95	94	94.5

*multiple choice test (4 alternative choices)

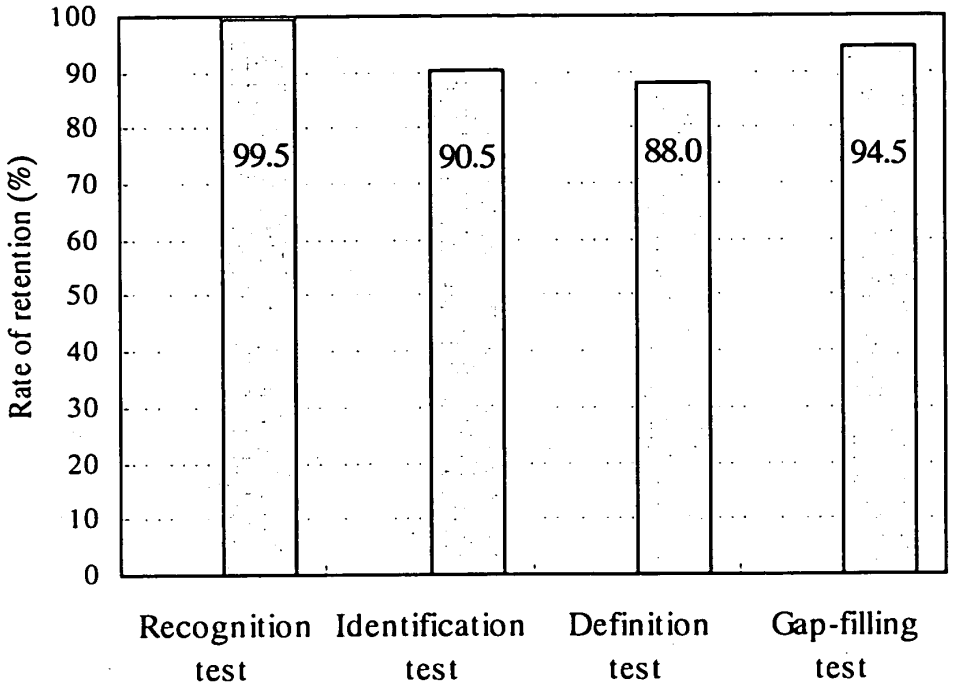

Figure 2. Mean rates of 10 and 11-week retention rates as observed respectively by 4 types of vocabulary tests

4.2. Questionnaires

After the VC-1 and VC-2 study sessions were completed, we conducted the follow-up questionnaires and asked which of the courseware the subjects would prefer to use. It was revealed that all of them preferred the VC-2 system. They were further asked why they preferred VC-2 to VC-1, and the typical responses were as follows:

I do not want to have VC-1 because:

- I felt sleepy while I was studying with it.
- It was not easy to learn vocabulary with it. On the other hand, it was easy to forget the words which I learned with it after a hard work.

I want to have VC-2 because:

- I could learn words from a variety of points of view.
- I could remember chunks better than longer sentences which we saw in VC-1.
- I think I can use words in the chunks I learned.

These data imply that there is a difference in learners' affective response to the VC-1 and VC-2, although this was not evident in the quantitative data of Tables 1 and 2.

The VC-3 learners responded to the following response-selection questions after studying with it:

	Yes	No
Did you enjoy the vocabulary learning?	88(%)	12
Do you want to learn more words with VC-3?	100	0

Two of the typical responses to the free-response questions given to the VC-3 subjects are presented below.

> While I was learning new words with VC-3, I was tempted to read an English newspaper which I had never thought I could. I was so happy when I found that I could understand the main article on the first page.

> When I was listening to economic news on BBC, I found surprisingly many words we learned in class, and I could understand the news much better than before.

5. DISCUSSION

As stated at the beginning of this paper, the final goal of our research was to develop vocabulary teaching courseware which had six characteristics. Data analyses are reported for each of the characteristics.

1) Vocabulary learning tasks that are enjoyable.

It was clear from the results of the questionnaires, conducted after the subjects studied with VC-3, that the experimental subjects enjoyed learning vocabulary, and also they were motivated to study longer and to study more words with it.

2) Vocabulary learning tasks that are effective.

The learners spent 3.6 minutes, or 1.6 times more time, in learning one word with VC-3 than the time needed to study with VC-1 or VC-2. However, they scored the highest retention rate, 93 %, with VC-3, and, in addition, this 3.6 minutes is 10 percent less than the time needed to learn vocabulary by incidental learning, which is reported to be 4.0 minutes (Krashen, 1989: 449). Thus, if we also take such additional facts as the following into consideration that incidental learning has many drawbacks and limitations, it may be said that the learners studied vocabulary effectively with VC-3. Among others, researchers have expressed such drawbacks as the following in the vocabulary instruction via incidental learning: students don't know enough vocabulary to acquire vocabulary incidentally through extensive reading (Coady, 1993: 7), the process by which "incidental" acquisition through reading occurs is slow ... and there is no way to predict which words will be learned, when, nor to what degree (Paribakht & Wesche, 1997: 174), progress is slow and haphazard, and meaning-based language use activities are not necessarily sufficient for internalization of all the lexico-semantic-syntactic features and relationships that underlie accurate production in the L2 (Paribakht & Wesche, 1997: 175).

3) Vocabulary learning tasks that promote learning of a large number of words.

Most of the experiments on vocabulary instruction conducted by other researchers dealt a limited number of only 30 or 40 words (Kamioka, 1982; Ellis, Tanaka, & Yamazaki, 1994; Knight, 1994; Aizawa, 1996; Duquette, Renie & Laurier, 1998). In contrast, in 500 minutes of this study with VC-3, we taught 140 words. A follow-up study further showed that 3 sets of VC-3 could be used to teach 374 words and idioms over a period of 4 months. Accordingly, we concluded that we could develop a vocabulary teaching system that promotes learning of a large number of words.

4) Vocabulary learning tasks that are not limited to certain lexicon.

A broad selection of words could be taught via VC-3. Words to be taught were not limited by methodology as it was in keyword method or in incidental learning. The target words in this study were selected from a variety of materials including a college-level lecture, a TV sitcom, and a movie, and students acquired most, if not all of the target words.

5) Vocabulary learning tasks that yield high retention rates over long periods of time.

The data presented in Table 2 and Figure 1 show that the retention rate of words learned with VC-3 were fairly high, in keeping with the fifth characteristic listed in our proposed process of vocabulary teaching.

6) Vocabulary learning tasks that facilitate the learning of words, that can be used in practical communication.

The data presented in Table 3 and in Figure 2 are the basis to support the conclusion that vocabulary learned with the VC-3 system is likely to be used appropriately in practical communication. In the four types of test, subjects were tested on their ability to produce the words in addition to recognize them, and the words were presented orally as well as visually. Moreover, the subjects were tested on the knowledge of how the words are used in contexts. Consequently, the fact that there was a relatively small variance among the average scores obtained in the four types of test indicates that the VC-3 system as vocabulary teaching courseware may help learners improve, not only their knowledge of words, but also their communicative proficiency.

Another follow-up study conducted recently at Center for Foreign Languages of Chiba University also supports the supposition. In the experiment, it was found that VC-3 could replace one of the two sets of courseware which had effectively been used in improving their students' English proficiency (Listening and Reading Courseware: LRC), without lowering their efficiency as a teaching system. This means that, by using VC-3, in place of one of the LRCs, teachers can increase the flexibility of the choice of vocabulary they want to teach more easily than if they have to use two sets of LRCs which had been developed for improving students' English proficiency in general.

6. CONCLUSIONS

The objective of our study was not to observe or compare the efficacy of introducing some of the new techniques or elements into a vocabulary teaching system. Rather, it was to observe the functions and compare the effects of using three sets of courseware, the drill and practice courseware (VC-1), the task-based courseware (VC-2), and the multimedia courseware (VC-3), which were developed one after another as total systems of vocabulary instruction.

As a total teaching system, VC-3 was found to be by far the best of the three sets of courseware developed in this study. VC-1 was structurally simple and was easy to develop. However, the learners could not learn words as well as they did with other systems. They did not enjoy learning with it, either.

The learners could learn words more thoroughly with VC-2 than with VC-1, and they also enjoyed using it as a teaching system. Nevertheless, the retention rate of the words they learned with VC-2 was not as high as we expected.

The structure of VC-3 was not simple and the teaching schedule for using it was also relatively complex. Therefore, the learners spent more time in learning words with it than with other systems. However, the learners enjoyed studying with it, could learn a large number of various kinds of words deeply, and scored a high retention rate. Moreover, they not only learned the target words well with VC-3, but they could also improve their English proficiency.

After comparing the significantly different results obtained by using three vocabulary teaching courseware, we concluded that, 1) the use of a computer itself was not a solution to the improvement of teaching and learning vocabulary, 2) manipulation of a text, or only learning the spelling and the meaning (Japanese equivalents) of a word, was not effective for teaching vocabulary, and, 3) presenting information via multimedia on a CALL system significantly enhanced vocabulary learning, provided it did not overload the learners' information processing capacities for each task.

The results of using VC-3 for teaching English vocabulary to Japanese college students led us to conclude that, 1) a number of the propositions of theories of learning, if systematically combined, could be used for increasing efficiency in teaching vocabulary, 2) many kinds of words, and also a large number of words, could be taught effectively by the innovative use of multimedia facilities in the CALL systems, and, 3) spaced practice helped considerably to improve the retention of effectively learned vocabulary.

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REFERENCES

Aizawa, K. 1996. Tadoku niokeru Goi Shutoku (in Japanese). The Proceedings of the JACET 35th Annual Convention. 317.

Anderson, J. 1980. Cognitive Psychology and Its Implications. San Francisco: W. H.

Freeman and Company.
Brown, T & Perry, F. 1991. A Comparison of Three Learning Strategies for ESL Vocabulary Acquisition. TESOL Quarterly. 25 (4). 665–670.
Coady, J. 1993. Research on ESL/EFL Vocabulary Acquisition: Putting It In Context. In T. Huckin, M. Haynes, and J. Coady (Eds.). Second Language Reading and Vocabulary Learning (pp. 3–23). Norwood: Ablex Publishing Corporation.
Duquette, L., Rehie, D. & Laurier, M. 1998. The Evaluation of Vocabulary Acquisition when Learning French as a Second Language in a Multimedia Environment. Computer Assisted Language Learning. 11 (1). 3–34.
Ellis, N. 1995. Vocabulary Acquisition: Psychological Perspective and Pedagogical Importance. The Language Teacher. 19 (2). 12–16.
Ellis, R., Tanaka, Y. & Yamazaki, A. 1994. Classroom Interaction, Comprehension, and the Acquisition of L2 Word Meaning. Language Learning. 44 (3). 449–491.
Fairbanks, G. 1966. Experimental Phonetics: Selected Articles, Urbana: University of Illinois Press.
Guilford, P. 1954. Psychometric Methods (2nd ed.) New York: McGraw-Hill Series in Psychology.
Huckin, T. and Haynes, M. 1993. Strategies for Inferring Word Meaning in Context: A Cognitive Model, In T. Huckin, M. Haynes, and J. Coady (Eds.). Second Language Reading and Vocabulary Learning (pp. 153–178). Norwood: Ablex Publishing Corporation.
Kamioka, M. 1982. *Eitango ha gakushu sareta ato, donoyouni wasurerarete ikuka* (in Japanese). The English Teachers' Magazine. 31 (8). 42–47.
Knight, S. 1994. Dictionary Use while Reading: The Effects on Comprehension and Vocabulary Acquisition for Students of Different Verbal Abilities. The Modern Language Journal. 78 (3). 285–299.
Krashen, S. 1989. We acquire vocabulary and spelling by reading: additional evidence for the Input Hypothesis. The Modern Language Journal. 73 (IV). 440–464.
Levy, M. 1997. Computer-Assisted Language Learning: Context and Conceptualization. Oxford: Oxford University Press.
Lewis, M. 1993. The Lexical Approach, Hove: Language Teaching Publications.
Lindsay, P. & Norman, D. 1977. Human Information Processing (2nd ed.) Orlando: Academic Press, Inc.
Meara, P. 1989. Matrix Model of Vocabulary Acquisition, AILA Review, 66–74.
Nagy, W. 1988. Teaching Vocabulary to Improve Reading Comprehension. USA: ERIC Clearinghouse on Reading and Communication Skills.
Nation, P. 1990. Teaching and Learning Vocabulary. Boston: Heinle & Heinle Publishers.
Paribakht, S. & Wesche, M. 1997. Vocabulary enhancement activities and reading for meaning in second language vocabulary acquisition. In Coady, J. & Huckin, T. (Eds.). Second Language Vocabulary Acquisition (pp. 174–200). Cambridge: Cambridge University Press.
Schmitt, N. 1995. A Brief Perspective on Vocabulary. The Language Teacher. 19 (2).

34–35.
Schreck, R. & Schreck, J. 1991. Computer-Assisted Language Learning. In Celce-Murcia, M. (Ed.). Teaching English as a Second or Foreign Language (2nd ed.) (pp. 472–485). Boston: Heinle & Heinle Publishers.
Shannon, C. & Weaver, W. 1964. The Mathematical Theory of Communication. Urbana: The University of Illinois Press.
Takefuta, J. 1997. "Development of Courseware for Teaching Vocabulary to Japanese Students of English", Unpublished MA Thesis, Chiba University.
Takefuta, Y. 1997. Eigo Kyouiku no Kagaku (in Japanese). Tokyo: ALC Press.
Toya, T. (Ed.). 1980. Business English Master. Vol. 1, 2, 3. Tokyo: Britannica Japan, Inc.

APPENDIX 1 Sample test items used for VC-1 and VC-2

The following are the examples of the test items used for VC-1 and VC-2.

a) Definition test

Definitions quoted from an English dictionary are presented. The learners recall a word which matches each of them.

(1) to carry out, especially a piece of business or trade [ ]
(2) a payment made to buy insurance [ ]

b) Identification test 1

English words are presented. The learners read the word and give the Japanese equivalent for each English word.

(1) affiliate [ ]
(2) purchase [ ]

c) Identification test 2

Japanese are presented. The learners read the word and give the English equivalent for each Japanese.

(1) 金銭を返済する [ ]
(2) 取り引き [ ]

d) Gap-filling test

Sentences, each with one blank space are presented. The learners choose one word from the 22 words listed below to fill the blank.

(1) Advertising [ ] the sale of products.
(2) Many of us remember the great [ ] of the 1930s.

promote, surplus, depression, ... , profit

APPENDIX 2 Sample test items used for VC-3

The following are the examples of the test items used for VC-3.

a) Recognition test

Words recorded on an audiotape are presented and the learners choose the best

Japanese equivalent for each word presented from the 4 alternative choices listed.

(1) (prudent)　慎重な　熱心な　頑固な　刺激的な

(2) (pursue)　説得する　支払う　追求する　主張する

b) Identification test

Words recorded on an audiotape are presented and the learners recall and write down the best Japanese equivalent for each word presented.

(1) (confiscate)　[　　]

(2) (tuition)　[　　]

c) Definition test

Definitions quoted from an English dictionary are presented. The learners choose an appropriate word from each of he definitions from four alternative choices presented.

(1) the act of measuring and recording the details of something

contract　survey　profit　discrete

(2) to declare something to be wrong or untruthful

contradict　expel　uphold　impede

d) Gap-filling test

Sentences, each with one blank space are presented. The learners choose one word from the four words listed below each sentence to fill the blank.

(1) The government [　　] the use of chemical weapons.

confiscated　banned　nurtured　attributed

(2) Discover the hidden [　　] in each child.

outcome　validity　branch　potential