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Improving access to target vocabulary using computerized bilingual dictionaries

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Abstract

This study aims to compare various computerized bilingual dictionaries (henceforth CBDs) for their relative effectiveness in helping Japanese college students at several language proficiency levels to access new English target vocabulary. Its rationale was based on several observations and research claims (see Atkins & Knowles, 1990; Bejoint & Moulin, 1987; Laufer & Hadar, 1997) that bilingual and bilingualized dictionaries in general, as well as electronic dictionaries in particular appear to be much more rapid and effective than monolingual book dictionaries for the acquisition of new L2 vocabulary by language learners. The author has been testing and analyzing various CBDs in four major categories for the past two years. These include (i) portable electronic dictionaries (PEDs); (ii) software CBDs; (iii) online dictionary websites; and (iv) optical character recognition/translation (OCR/OCT) devices, both portable handheld 'Reading Pens' (e.g. Quickionary/Quicklink) and also flatbed OCR scanners (Logo Vista) bundled with translation programs. His research started over ten years ago, however, culminating in a dissertation entitled 'Developing and testing vocabulary training methods and materials for Japanese college students studying English as a foreign language' (Loucky, 1996; or summary thereof, Loucky, 1997). This dissertation studied the pre- and post-test vocabulary, comprehension, listening and total reading levels of over 1,000 Japanese college students at six institutions. Since then the author has devised a simple yet practical Vocabulary Knowledge Scale (VKS), helping to more clearly define and test the differences between passive or receptive understanding vocabulary and active or productive use vocabulary. Computerized technology has now made possible multimedia programming with the benefits of interactive processing and immediate feedback. Modern CAI/CAELL along with well-made CBDs, either online or off, can already be found to scan, pronounce and translate for us in any direction of the four language skills. This study examined Japanese college students' use of four kinds of CBDs for more rapid accessing and archiving of new L2 terms, recommending integration of their use into a more systematic taxonomy of vocabulary learning strategies.

1 Introduction

Despite the rather obvious benefits of using rapid access CBDs, only a minority of Japanese college students is yet using them: only 6/43 or 14% in this study had their own portable devices. Few studies of their benefits have been done as yet in Japan so that teachers, parents and language learners are mostly still in the dark about their great potential as an aid in promoting more effective language teaching and learning. Perry's (1997) study only covered monolingual electronic learners' dictionaries (ELD CDs).

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This study helps to begin to fill this huge gap, and is especially needed in Japan, where vocabulary levels (both required and actual) have been falling steadily at many schools.

2 Research gaps and questions to be answered

Among the research questions on which this study could help to shed more light in order to improve current knowledge and instruction in the field of foreign language vocabulary acquisition are:

1. How can the advanced, high-speed functions of these CBDs be most effectively applied to language teaching and learning?
2. How much more efficient are they in terms of speed, or less accurate and adequate in terms of completeness of definitions offered than comparable bilingual book dictionaries (BBDs)?
3. Are some types of CBDs more effective than others, and if so, what particular technological features and functions are most helpful in the L2 lexical teaching-learning process?
4. Does higher English language proficiency tend to make CBD use more useful, or can they benefit lower proficiency level students equally?
5. Do CBDs help to enhance learners' interest, interaction and motivation levels, and thus help to contribute to higher levels of vocabulary retention?

3 Statement of the problem

The short-term problem of this study was to determine the effectiveness of various bilingual tools in helping Japanese language learners to *access and record (archive)* new, unknown target vocabulary. Our long-term research aim has been to also determine how different CBDs can be used to help maximize lexical acquisition, since one's vocabulary level has long been known to be one of the most fundamental components of language development in all four communication skill areas. Alderson (2000: 99), for example, reports that "tests of vocabulary are highly predictive of performance on tests of reading comprehension. In studies of readability, most indices of vocabulary difficulty account for about 80% of the predicted variance. In short, vocabulary plays a very important role in reading tests. Clearly vocabulary is important to text comprehension, and thus to test performance."

It now appears that various kinds of CBDs can be used to better facilitate the acquisition of both 'Receptive Recognition' L2 vocabulary and also 'Active Recall' L2 vocabulary. Among the tools considered in this initial study were CBDs offering single word translation, compared with some full translation software, and finally with the latest OCR scanning Quickionary Reading Pens. The final goal of this study was to consider whether the latest assistive reading technology present in such products as the new Quickionary Reading Pens and CBD software may in fact be among the most efficient tools yet available for second language learning. If so, developing and teaching more efficient use of such multifunctional CBDs may well be a hidden 'Rosetta Stone,' and one of the best answers many have been waiting for to help give language learners a way to quickly confirm their guesses of unknown words. Additionally, some CBDs may

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even be used by students to archive, print, and review new meanings bilingually, as well as to rapidly access pronunciation of these new terms in their Target Language (L2).

4 Overall Purposes of this researcher's studies

Initially a Vocabulary Knowledge Scale was devised for better assessing Japanese language learners' English vocabulary levels in terms of both passive recognition and active production abilities. Standardized reading tests were also used to compare class averages. They may also be used to show group and individual gains over the course of one academic year.

The basic purpose of this study was to ascertain short-term gains in both *passive recognition* and *active productive vocabulary* when various groups of EFL students were allowed to use a range of different meaning-accessing tools: (a) Traditional bilingual English-Japanese book dictionaries, versus (b) portable CBDs, (c) computer translation and dictionary software and (d) OCR-scanning Quickionary Reading Pens. This study was limited to short-term measurements of (a) students' *self-reported assessment* of L2 vocabulary knowledge by a VKS, and (b) *combined accessing and archiving (recording) speeds.* In the future it is hoped that the Quickionary can be compared with Logo Vista's Reading Translation Pen, and also with Palm Pilot's use of E to J and J to E EDICT dictionary files for rapid access and archiving.

It was hoped that focusing on a comparative study of L2 *vocabulary assessment, accessing*, and archiving would help to better isolate the vocabulary skills and strategies needed for further successful language development, and more clearly delineate the potentially enhancing role that CBDs and translation software might play in finding a route to more rapid and effective second language vocabulary development. In fact, these studies have helped to generate a tentative model or 'Cyclical Taxonomy of Vocabulary Learning Strategies.' As shown in Appendix II, its eight-fold steps to more rapid, CBD-enhanced lexical learning are these: (i) *Assessing*, (ii) *Accessing* (with various CBDs), (iii) *Archiving*, (iv) *Analyzing*, (v) *Associating*, (vi) *Activating*, (vii) *Anchoring*, and (viii) *Reassessing, Recycling* or *Reviewing*.

5 Procedure and participants

Comparative studies using various types of CBDs to enhance English language vocabulary learning were done at three Japanese colleges with four class sub-samples, for a total of 43 students from several different majors and proficiency levels. Two types of Target Language (TL) word accessing were measured:

1. Two Engineering classes compared *the average number of minutes for each student to access and record ten unknown new FL terms*. These were first determined to be 'unknown' by use of an author- designed Vocabulary Knowledge Scale during previous classes.
2. Two other classes, one of English and another of Computer majors, compared various dictionaries by measuring *how many words they could find and record within ten minutes.* Surveys were also given to help determine students' opinions and degree of satisfaction using these various means for accessing new foreign

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language vocabulary. Time constraints made it necessary to test the two engineering classes at the same institution one month after tests were done at two other schools with Computer and English majors. Only six students in total were using their own CBDs (6/43 or 14%).

This study included a total of forty-three (N=43) freshmen participants, who were at four levels of English proficiency as follows:

1. Thirteen Intermediate level engineering students;
2. Eight students at a Lower Intermediate level at a vocational electronics junior college);
3. Nine Upper Intermediate level English majors at a women's junior college; and finally
4. Thirteen Pre-Advanced level engineering students.

They all had a full or partial standardized reading test, the *Gates McGinite*, Form C, given at the beginning of this first school year, which was used to determine their English vocabulary grade levels relative to native reader norms in America. Ninety percent of all students in sub-samples 1, 2 and 4 were male students. No significant differences were found between male and female student responses. At each school students were first given a VKS, in which they indicated the words they did not know. From International Christian University's list of '100 Recommended EAP List' words (Mizoguchi, *et al*., 1992), those that were unknown by each student were recorded. Then students used at least three kinds of CBDs and one bilingual book dictionary to access ten unknown words by each media method. The times that it took for each student to find and record ten of these definitions using each of the assigned tools and methods were recorded. Students were taught how to use and compare various types of bilingualized dictionaries using a different type of CBD for each set of 10 words

6 Results

Essentially what this researcher suspected was found to be true with the more advanced language learners. Pre-advanced engineering students did in fact access words in the order that he expected and predicted:

1. Quickionary being the fastest, averaged 5.2 minutes for accessing ten unknown words;
2. Laptop Brother translation software was second fastest, averaging 5.56 minutes;
3. Electronic dictionaries were third, at 5.9 minutes;
4. Portable phones using online bilingual dictionary access was next at 5.2 minutes; and finally
5. Traditional book dictionaries were the slowest for these more advanced students. These Pre-advanced students averaged 7.2 minutes for accessing ten unknown words when using bilingual book dictionaries (L2 BBDs). Monolingual dictionaries (L1 BBDs) would be even slower, since it naturally takes more time to process, understand and record definitions that are not in one's own native language.

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In addition, Pre-advanced students had an average vocabulary level of 5.18, as determined by a standardized native reading test (*Gates McGinite, Form C*). When replicating Laufer and Hadar's (1997) study, students' *average passive recognition vocabulary* level was 76%, and similarly their *average active productive vocabulary* level was 77%. This is a rather remarkable finding, given the fact that these were all very low-frequency words, and students had only about 30 minutes exposure to them. This shows that advanced and pre-advanced students near or above about a fifth grade vocabulary level, or 5,000 word vocabulary in Laufer's (1997) definition, are capable of learning from various dictionary types and applying that new learning to both comprehension and productive tasks.

Intermediate engineering students also were close to expectations, except that their use of bilingual book dictionaries came in third place. These students accessed words in the following order:

1. Laptop *Brother Translation* software was their fastest mode for accessing ten unknown words, averaging 5.83 minutes;
2. Electronic dictionaries were second at 6.06 minutes;
3. Book dictionaries came in third;
4. Quickionaries were fourth fastest, accessing ten words in 6.78 minutes on average; and finally
5. Portable phones using online bilingual dictionary access were last among this group, with these students taking an average of 10.5 minutes to access ten words by this means.

From these results it appears that higher proficiency students can process new FL vocabulary faster using CBDs than lower proficiency students, as was the case for each of the types tried by these two classes. The average speed of both classes when using book dictionaries was practically the same, 7.2 minutes for the Pre-advanced class, and 6.6 for the Intermediate class.

The number of words accessed and recorded by many classes working for only forty to fifty minutes during one class using various CBDs was quite remarkable. Most of these students were amazed at the very sizeable volume of new L2 vocabulary accessed, recorded and at least passively recognized as to their initial meanings when they were exposed to four different kinds of CBDs. Average results were:

A. Lower Intermediate level classes: averaged 61.25 words, or about 1.5 words per minute, using three CBD methods/media versus bilingual book dictionaries for ten minutes each. If this rate were maintained weekly throughout the school year, an amazing 1,800 words could be introduced at least. This would be about equal to the total number of all junior and senior high school English vocabulary words required over their entire six years of secondary school!
B. Upper Intermediate classes: averaged 43.5 words per class.
C. Pre-advanced class: averaged 40 words, 50 for those who also used portable phone CBD.
D. Intermediate class: averaged 40 words, and 50 for those who also used portable phone CBD.

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No gender differences were seen in retention rates on an unannounced productive test one week after students used computerized bilingual dictionaries to access and record ten unknown terms, assessed as such by a VKS. Nine Engineering students using CBDs averaged 100% in their retention and productive use of these ten new word meanings. Eight English majors, on the other hand, averaged only 40% retention on the same productive use test in which they were asked to use these ten target words in sentences demonstrating knowledge of their meanings. Possible reasons for this disparity in retention are given in the discussion below.

7 Discussion and interpretation

Forty-three Japanese college students at three institutions were tested from several different proficiency levels, ranging from Pre-advanced to Upper and Lower Intermediate, as determined by a standardized reading test (*Gates MacGinitie, Form C*) Both individual and average vocabulary levels for these classes are shown in category G of Appendix I, "Class Average Vocabulary Grade Level (by Native Norms)." As shown by this test, classes were quite homogeneous in terms of their average language and vocabulary proficiency level. The average number of words accessed in ten minutes is shown for the first two classes. The average time taken to access ten unknown words is shown for the later two classes, both of which compared two distinct classes of students at different average proficiency levels as shown. Finally, during this study and in other informal surveys, generally only about 20% of the students regularly carried book dictionaries. Many did not like their weightiness or slowness, noting that two books would be needed to access vocabulary in both directions. Almost no students carry both. Category F asked students about which CBD or book dictionary they preferred using; category H asked them to discuss dictionary use habits; categories I-K students told which CBD they would prefer as a gift, which they thought would be best for Japanese children to use for learning English, and finally reasons for their preferences.

Comparing and assessing various types of dictionaries in this way produced some interesting findings. One can see that monolingual dictionaries alone clearly do not fit the needs of most EFL learners in Japan, since even most college students are well below the so-called 'threshold level' (See Laufer, 1997) necessary for the effective use of solely monolingual dictionaries. Regardless of their simplification in the form of 'Learner's Dictionaries,' studies such as Laufer and Hadar's (1997) and this replication thereof are now showing that English language learners really seem to benefit most from fully bilingualized dictionaries, having both L1 and L2 definitions. The *rapid access immediate feedback* available when using CBDs, and their *ability to be bi-directional* may well give foreign language learners the edge they need to make more rapid progress in vocabulary acquisition. Lower proficiency level language learners in particular can benefit most by learning how to use various easy-access, computerized bilingual glossing tools, by being able to quickly clarify and confirm their guesses as to the meanings of new, unknown or confusing vocabulary.

Once these facts and principles are recognized, the next logical step is to encourage more research such as this writer's comparison of 25 English-Japanese bi-directional CBDs (Loucky, 2002), which compares vocabulary learning rates using various CBD tools.

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Turning to the five research questions listed under section 2 (above): in regard to the first three CALL technology-related questions, the following insights were gained. After doing a replication of Laufer and Hadar's (1997) comparison of dictionary types, in this study the researcher tried to determine which kinds of CBDs or translation software would offer Japanese students the most language learning benefits. These include such educational factors as:

1. better learning rates;
2. faster speed of access;
3. greater assistance in accuracy of comprehension and pronunciation;
4. providing learner satisfaction with ease of use, or user-friendliness, and
5. complete enough meanings to be adequate for understanding in various literary and situational contexts.

So far, this research done with three different majors at several Japanese colleges seems to show that Quickionary Pens using assistive reading technology may meet these required language learning conditions the best. They were the fastest CBDs for pre-advanced students, and second fastest even for the lowest proficiency level students. If Quickionaries can be made available at a more reasonable cost, such 'Reading Pens' could become much more popular, especially in the light of students' very positive response to trying them. A high percentage of students in each class (44–100%) said that they would most like to receive a Quickionary of all of the types of dictionaries tested, an average of 70% in all four classes.

Secondly, portable electronic dictionaries are becoming more prevalent due to their compact size, convenience of use and economical price. PC translation software, on the other hand, has not been installed in most school computers yet in Japan. This is a huge loss of opportunity for its children and youth. There is inexpensive software available that by all means could and should be installed and used on every computer in any school anywhere in Japan if this country really wants its youth to become more internationally minded, communicatively competent, and linguistically proficient to meet the needs, demands and opportunities of world citizenship in this 21st Century.

Objectively, CBDs were found to be more efficient than book dictionaries in terms of speed, and the Quickionary was observed to offer more accurate and adequate definitions than other types of CBDs. Whereas some hand-held pocket dictionaries have archiving and word history search functions, quite useful for later review and practice, many cheaper models do not. Of CBDs tested, only the PC Brother Tsuyaku software could both archive and print new TL bilingual definitions. This would be a great asset to any language student anywhere, not only for vocabulary learning, but also for help in learning spelling, pronunciation, dictation, listening, and in grammar activation and vocabulary review. Portable pocket CBDs, the most commonly owned by students, were the second most effective method used by Lower Intermediate computer students, and fastest media used by Intermediate level engineering students.

Research question four asked whether English proficiency levels were related to the degree of effectiveness of CBDs. Of these four levels tested, as one would expect, higher proficiency students could process new FL vocabulary faster using CBDs than lower proficiency students, for each of the devices tried by these classes. This initial study showed the clear benefits of using CBDs for more rapid accessing of new target

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vocabulary. It also points out the need for further study of archiving, and other lexical processing steps to investigate the combined effect of how much computers can enhance overall lexical and language development when used more intelligently and systematically at each stage of SL/FL vocabulary learning. Regular use of CBDs certainly does help to stimulate vocabulary learning, which many college students find out unfortunately too late, at the end of their English learning career in Japan. While English majors tend to be more likely to use CBDs more often, they can help all students to process new expressions much more rapidly and effectively. Their ability to use them effectively to expand both their receptive and productive language abilities does seem to depend on both frequency of use, quality of instruction (there is almost none given at present in most schools), and upon a learner's own initial level of language proficiency, particularly his or her L2 vocabulary level.

Two major findings, which can clearly be seen from the comparative chart in the Appendix, are these. First, despite being one full grade level higher in their vocabulary level, *English majors (C) were outperformed on all CBDs by Computer majors (D)*. This shows that *familiarity with computerized equipment is a very important type of literacy* to consider and develop when using CBDs for language learning. Secondly, when looking at just Engineering majors in columns (A) and (B), where computer exposure would be comparable, those '*Pre-advanced' students with a higher average vocabulary level consistently outperformed the 'Intermediate Level' students in use of CBDs*. One can only surmise that most of this better performance can be attributed to their much higher average vocabulary level, grade 5.18 versus 3.28. Only their use of bilingual book dictionaries was comparable, 7.2 versus 6.6.

A more difficult question in need of further exploration was the fifth and final question: "Do CBDs help to enhance learners' interest, interaction and motivation levels, and thus help to contribute to higher levels of vocabulary retention?" Especially computer and engineering majors appeared to have increased levels of interest, social interaction and motivation when using CBDs, a natural expectation given their related majors. English majors, while less familiar with the computer technology, seem to require more instruction, monitoring and assistance, but also reported enjoying the use of PC dictionary and translation software in particular. An 'Informal CBD Survey' was given to assess these attitudes, and the amount of each student's familiarity and use of portable CBDs in particular.

The question of vocabulary retention is in need of further study. However it can be reported that one Engineering class was given a productive post-test (unannounced) after one week on ten formerly unknown words, accessed by means of their portable CBDs, in which all ten students got perfect scores.

By contrast, the English majors given the same test only averaged 40% retention. There seemed to be two reasons for this disparity: (i) Engineering majors given the test averaged about 1.7 grades higher in their English vocabulary proficiency, and (ii) Engineering majors seemed to be more interested in and familiar with computerized dictionary use than the lower proficiency level English majors. These findings show the crucial importance of both basic vocabulary and computer literacy skills for such language learning.

8 Conclusions and recommendations

Not only have CBDs been shown to be extremely helpful for the Japanese context, but it

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also becomes clear that students need much more guidance in maximizing each particular CBD software, website or electronic device's effectiveness by learning how to use their various functions to help at each stage of processing new words, while using different essential lexical processing strategies as briefly outlined in the above taxonomy. Teachers and students need to become more familiar with the various features and functions available in each type of CBD, in order to make maximum use of them for more effective language learning. This writer concluded a brief preliminary report on this study saying that:

> Regular use of CBDs appears to help stimulate vocabulary learning. CBDs can help all students process new expressions very rapidly and effectively. Students' ability to expand both receptive and productive language abilities does seem to depend on frequency of use, quality of instruction, and the learner's own initial level of language proficiency, particularly on one's level of known and used L2 vocabulary, meaning those words a learner can not only understand and recognize receptively, but also use productively in their own actual expressions. (Loucky, 2002: 132)

By using proven portable devices, multimedia software and well-designed, interactive websites, language learning can be made much more interesting and well-balanced. Language teachers should stress better development of each communication skill, facilitated by using innovative technology as well as more emphasis on active production (or 'pushed output,' as shown by Swain, 1985; de la Fuente, 2002), and on interactive task-based language learning.

The vast potential of CALL and Web-based instruction for both native and foreign language development must be more widely recognized and used by language teachers as much as possible to improve instruction, motivation and learning. From this study it does appear that both learners' initial computer and TL vocabulary proficiency levels seem to be factors that would strongly affect how much more effectively they could use various computerized dictionaries and software made available to them. Therefore these factors need to be more carefully considered and developed, as well as the specific features and functions of each type of CALL software or dictionary, and how they can be used more effectively to help with individual student's vocabulary and language learning needs, as well as how to best integrate them into whole classroom instruction. Free website translation sites (Appendix IV), for example, can easily be used to enhance the teaching of mass media or second language reading and writing courses.

Based on previous studies of CBD use at three Japanese colleges (Loucky, 2002) several conclusions were drawn, which apply directly to this whole area of reading software versus textbooks only: (i) Firstly, CBDs and by natural logical extension CALL reading software appear to be *both more technologically expedient* (providing more rapid access to unknown word meanings), and *more cognitively efficient* in terms of helping to speed up lexical processing and recording in the L2 mental lexicon. (ii) Secondly, computer and engineering majors seem to be able to learn to use these computerized dictionaries and software more rapidly for more effective word accessing than English majors, at least for those in this limited study. But this would probably depend more on each learner's initial English language and vocabulary levels and amount of prior exposure to computers rather than one's major. (iii) Thirdly, foreign language

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learners with higher L2 vocabulary levels or language proficiency can be expected to not only use computerized tools more effectively, but also to learn new target language vocabulary more rapidly than students of lower vocabulary level or proficiency. These conclusions were made after reviewing ten types of reading software and thirty different types of CBDs available in Japan, as to the relative advantages and disadvantages of using electronic dictionaries and reading software (Loucky, 2003).

Future studies should explore how much more effective multi-functional CBDs are, such as those mentioned earlier which have 'Word Search History,' 'Word Challenge Review Game,' and similar educational functions built-in, as compared with those cheaper models that do not. Naturally students need to be trained in how to maximize the use of these functions to help improve their foreign language learning and vocabulary acquisition. While CALL software and CBDs (See recommendations in Table C: Comparative Computerized Bilingual Dictionary Chart for Japanese-Studying English; and Table D: Text to Speech/Speech to Text Programs) are extremely helpful for the Japanese context, students clearly need much more guidance in maximizing the application of each particular software, website or electronic device by learning how to use their various functions to help them at each stage of processing new words when using different essential lexical processing strategies as briefly outlined in the above taxonomy. Teachers and students need to become more familiar with the various features and functions available on each type of CALL software or dictionary, in order to make maximum use of them for enhancing all four communication skills, including comprehension as well as receptive and productive vocabulary skills to support more effective and enjoyable foreign language learning. The following are helpful guidelines and goals to examine when seeking to combine new insights and innovations from CALL in the field of foreign language reading and vocabulary development. As Sokmen (1997: 257) advised, there are three main lexical areas most in need of further systematic research.

1. The first challenge is to systematize the vocabulary (teaching, learning and research) of English… Once we know more about the system and the metalanguage to discuss it, teacher training programs will be better able to prepare L2 instructors to teach vocabulary in a principled and systematic way.
2. Secondly, more research on the effectiveness of methods of vocabulary instruction is necessary. Three crucial areas are semantic elaboration, ways to productively learn collocations and lexical phrases, and computer-assisted vocabulary activities.
3. Finally, we need to take advantage of the possibilities inherent in computer-assisted learning, especially hypertext linking, and create software which is based on sound principles of vocabulary acquisition theory. At present, a good deal of vocabulary software is decidedly lacking in variety of exercises and depth of processing. There is a need for programs which specialize on a useful corpus (such as EAP, technical or medical vocabulary), provide the expanded rehearsal, and engage the learner on deeper levels and in a variety of ways as they practise vocabulary. There is also the fairly unchartered world of the Internet as a source for meaningful vocabulary activities for the classroom and for the independent learner.

In light of the research findings, recommendations and conclusions from the software

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Table 1. *Relative advantages and disadvantages of electronic dictionaries and reading software* LEP= Low English Proficiency learners*

Advantages	Disadvantages or Comments
Light, compact, portable	Often more expensive than books
Many volumes together	Can break or wear out
Can move from one volume to another easily.	Need batteries or plug
Many special useful features	May not as comprehensive?
Can help to enhance more rapid, CBD-enhanced lexical learning, especially with these functions:	May be more complicated to use?
May be easier to use to teach & practice essential Foreign language learning strategies (VLS).	Many students lack basic English book dictionary skills.
CBDs with Word Challenge Games can be used to assess and practice at various difficulty levels.	Accessing in another language and alphabet takes time which interprets learner's train of thought & memory.
Rapid bilingual access seems best for many LEPs*	Advanced learners can handle monolingual dictionary.
Archiving is often automatic.	Various types exist.
Some have word origin, grammar/parts of speech & pronunciation notes, with many examples. Not all.	Word backgrounds and meanings may be more complete in books.
Computers can help learners to learn by related groups of words by using Jump & Memo functions.	Active practice can be done right away using Memos/Word Search Histories of each student alone or in groups.
Anchoring into long-term memory is encouraged by referring back to memos & adding own notes to them.	Students can look up same words in books many times before remembering them. No clear way to review or recall them.
Use of CAI/CALL is often found to be more interesting & motivating to students, especially for non-English majors.	
Easy to use CBDs for Recycling or Reviewing of new TLV (Target Language Vocabulary).	
Can test oneself using either word searches/memos, or with some having Word Challenge Games.	Reassessing own learning is often hard for students to do by themselves with books.
Learners can *Re-meet for Relearning* those words not yet remembered by repeating this cycle again.	Use of book dictionaries often fails to adequately increase exposure/depth of processing target language vocabulary.
Hot potatoes http://web.uvic.ca/hrd/hotpot	Shareware Test Creator useful for language learning games
Oxford's Genie dictionary software (2002 release)	Instant access monolingual glossing with exercises
Web-based Vocab Profiler (Nation/Cobb's)	http://www.er.ugam.ca/nobel/r21270/cgi-bin/webfreqs/web
CabSoftware	http://www.cabsoft.com/ vocab.html
Catch a Wave print & online youth magazine	Bi-weekly; 5000 Yen per year. Full glossary provided

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and websites examined above, a specific five-point plan can now be proposed to help advance research and better maximize foreign language vocabulary development.

1. First, software and websites that provide fully bilingualized help seem to be most effective and helpful, especially to learners with limited English proficiency (LEP). Ideally, fully bilingualized computers, offering students immediate access to both L1 and L2 glosses and explanations along with both audio and visual helps seem to best promote language learning and retention. Use of computerized bilingual dictionaries such as Brother Tsuyaku, Oxford's monolingual Genie, and Rikai.com should be examined when used systematically as shown.
2. Secondly, CALL webmasters, teachers and publishers should seek to provide language learners with more low-intermediate level reading and listening materials, both on and offline. The use of Text-to-Speech should be further investigated, as well as other multimedia approaches, to help enhance reading comprehension and speed, as well as learners' enjoyment of language learning software and websites.
3. Teachers should encourage both deeper and more active lexical processing and use.
4. Teachers should also encourage multiple lookups, and systematic lexical processing via use of a simple, memorable framework, such as that outlined above, which includes these essential learning steps:
    i. *Assessing* known versus unknown L2 vocabulary, using some kind of vocabulary evaluator or VKS. Use both student self-assessment of language input and teacher-assessment of output.
    ii. *Accessing* new TL vocabulary as rapidly as possible, with computerized assistance.
    iii. *Archiving* new terms – Students should be urged to record new receptive understandings, and also to generate and record their own productive expressions whenever possible.
    iv. *Analyzing* new words in various ways – by word parts, origins, and in different sets or groups.
    v. *Anchoring* new terms into short-term memory by using various mnemonic devices, especially when L1 words with similar sounds or shapes can help to build such 'mental hooks, cues or triggers.'
    vi. *Associate* – by teaching them to systematically organize new TL vocabulary learning. Use a combination of structured approaches, such as the Semantic Field Keyword Approach, along with various individual and social learning styles, strategies and preferences to enhance learning and long-term retention. Encourage and demonstrate the use of various visual graphic organizers and representations, such as Concept Trees, Word Maps, and other Semantic Field grids, scales, and categories to help stimulate and strengthen LT memory.
    vii. *Activate* new TL vocabulary in both speaking and writing, both individually and socially.
    viii. *Anticipate* – help learners to build up their predictive skills by use of more cloze exercises, in both listening and reading, including the use of songs as well as prose.
    ix. *Reassess* – Re-evaluate amount of TL vocabulary learned, comparing

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both receptive understanding and productive use gains.

x. *Relearn* by systematic, delayed recall – Recycle and Review any words or phrases missed by carefully planned repeated encounters.
Strengthen associative memory neural networks by building up both receptive and active memory traces, using both (a) CAI/CALL multimedia assistance, and (b) social communicative interactions. 'Re-meet to relearn' and recycle or revise again as often as needed, following the principles of systematic, delayed review to help maximize long-term retention and build up learners' automatic sight word recognition skills. The deeper new TL vocabulary is processed, across a wider variety of both receptive and productive contexts, the more learners' cognitive memory will be freed up for higher level critical and creative reading and reasoning skills.

5. Finally, since language learning is a combination of (a) Language Acquisition; (b) Recognition; (c) Prediction, and (d) Production (Loucky, 1996), students need regular, systematic practice in each of these essential processing areas. Teachers should help learners to integrate their development of all four communication skills, both on- and off-line, by prioritizing the most essential common core vocabulary, phrasal verbs, and collocations. A system for helping most learners of English to at least double their TL vocabulary using a computer-assisted, bilingual Semantic Field Keyword Approach can be found along with many useful links to essential high frequency vocabulary lists and profilers at the author's website http://mx7.tiki.ne.jp/~jloucky/. Teachers need to be able to scale their vocabulary learning activities from those that require easy and shallow processing for their lowest level students, to activities that require deeper and more complex lexical processing for more advanced language learners.

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Appendix I

Comparative Study of Japanese College Students' Computerized Bilingual Dictionary Use (Dual Study of 2 Parallel Groups A vs. B and C vs. D were done. PR=Passive Recognition vs. AP=Active Production)

PROFICIENCY LEVEL/ SCHOOL/MAJOR: Class Average Access: (#words by means of:) Total N=43	A. Pre-Advanced (KIT Period 1) Average Time to Access 10 Words: (n=13) Engineering	B. Intermediate Level; (n=13) (KIT Per 2) Engineering Average Time to Access 10 Words:	C. (Women's Jr College) Upper Intermediate Average # Words Accessed in 10': (English Majors) (n=9)	B. Lower Intermediate Average # Words Accessed in 10': (Computer School) (n=8)
A. QUICKIONARY USE: words accessed	5.2'	6.8' Average; 4th Fastest this Group	10	17.25 (Ranked 2nd)
B. PORTABLE CBD DICTIONARY USE (Electronic/Phone)	5.9' 6.25'	6.06' 2nd Fastest for this Group; Phones 10.5' Av for 12; 5th	8.25	19 (Ranked lst)
C. PC CBD SOFTWARE USE	5.56' PC Brother's Tsuyaku/Korya 98	5.83' Fastest Means for this Group	9 (DiTonic on PCs); 9 (Brother Trans); 9 MacJ Dictionary	11.14 (Ranked 4th)
D. BOOK DICTIONARY USE	7.2' (Slowest for this Group: 5th)	6.6' Average 3rd Fastest Means	10	16 (Ranked 3rd)
E. TOTAL WORDS Accessed Per Class:	40-50 Words (two also could use I-Mode Portable Phones: 6.25' Ave. 10 Words)	40-50 Wds (12 also used Portable Phones: 10.5' Ave. to access 10 Wds (Wds=Words Accessed)	43.5 Average	61.25 word average (about 1 word/min.)
F. FAVORITE DICTIONARY USED	A. 16.7% Book D. B. 33.3% PC Dicty. C. 33.3% Elect D D. 25% Quicky E. None 4 Phone	A. 31% Book BBD B. 19% PC Dicty C. 37.5% Elect D D. 6.25% Quicky E. None 4 Phone	100% would like CBD; 75% Bilingual Book Dictionary Users	50% preferred Quickionary (Quicky) over all CBDs
G. Class Average Vocabulary Grade Level (Native Norms)	Grade 5.18 Average PreAdvanced Level VKS PR 75.84%; VKS AP 77.07%	Grade 3.28 Average Lower Interm Level VKS PR 61.58%; VKS AP 72.74%	Average Vocabulary Level Grade 3.5 Upper Intermediate English Majors	Average Vocabulary Level Grade 2.5 Computer School
H. DICTIONARY USE HABITS:	A. 31% Book Dicty. B. 1 Elect– 8% C. 2 Phone CBDs 15.4% (Online)	A. 31% Book Dict B. 1 Elect-- 8% C. 1 Elect-- 8% D. 3 Phone CBDs 23% (Online) (Loaned to Others)	Only 1 Regularly Uses Portable CBD	3 Regularly Use Portable CBD, 1 for 5 years; 2/3 Chinese Used English-Japanese Dictionary

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PROFICIENCY LEVEL/ SCHOOL/MAJOR: Class Average Access: (#words by means of:) Total N=43	A. Pre-Advanced (KIT Period 1) Average Time to Access 10 Words: (n=13) Engineering	B. Intermediate Level; (n=13) (KIT Per 2) Engineering Average Time to Access 10 Words:	C. (Women's Jr College) Upper Intermediate Average # Words Accessed in 10': (English Majors) (n=9)	B. Lower Intermediate Average # Words Accessed in 10': (Computer School) (n=8)
I. PREFERRED AS POSSIBLE GIFT: (If you could receive any of these as a free gift, which would you most prefer?)	A. Book—None B. PC Soft—25% C. Elect--25% D. Quicky—58% E. Phone CBD--0	A. Book—None B. PC Soft—19% C. Elect--31% D. Quicky—44% E. Phone CBD--0	100% would like to own a Quickionary	78% would most like Quickionary as a Xmas present
J. BEST FOR KIDS? Some Engineering students thought both Bilingual Book and PC Dictionaries are needed by children to learn English better.	Engineering class 1: A. 75% said Book B. 17% PCs C. 8.3% Elect Ds D. 0% Quicky E. Phone CBD: 0	Engineering class 2: A. 37.5% said Book B. 62.5% PCs C. 37.5% Elect Ds D. 25% Quicky E. Phone CBD: 0		
REASONS WHY PREFERRED: Quicky=Quickionary Reading Pens	Students saw Quickion-ary as fast & easy to use. Several said PC Translation Software was fast & easy to find typing. PC was also said to be good for kids' IT	Quickionary was preferred by 58% over others as a gift. Said to be easiest to use since no typing entry is needed. Also desired for its Pronunciation ability.	Found Quickionary to be the Fastest Way to Find New Words; Portable Electronic CBDs were #2 in student preference. Some were new owners. Dicty=Dictionary	3 Used to Portable CBDs; 50% most enjoyed using fast Quickionary: found it amusing/learned most new words. One preferred more detailed Book Dicty. explanations

Appendix 2

Applying Taxonomy of Vocabulary Learning Steps, Skills and Strategies

1) Assessing (Pre-Test)	2) Accessing--	3) Archiving--	4) Analyzing--
Assessing Vocab. Level by VKScales; Number of Headwords or Standard Native Reading Test	MEANING-FOCUSED Accessing Definitions: L1/L2; L1 & L2 (Rapid Access & Recall)	Record Definitions with Means to Recall/Study (Rapid Recording Best)	ROOTWORD-CENTERED Word Analysis of Base, Affixes/Suffixes
Use EAP VKS Sample	"Bilingual is Best"	Quickionary OCR/CBD	Word Origins/Grammar
5) Associating—by Semantic Field Keyword Approach= Categorizing by Related Classes by Keywords	6) Activating—USE- FOCUSED (New Words/Phrases Activated by Productive, Expressive Use	7) Anchoring—in one's short-term memory (ST) until it becomes fixed in Long-Term Memory. Use Mnemonic Devices.	8) Reassessing, Reviewing and Recycling --Measure Vocabulary Growth/ Change by #1 Post-Test

Appendix 3

Comparative Computerized Bilingual Dictionary Chart

CBD Name/Type SOFTWARE:	Cost/Benefits	Features/Functions:	Advantages/Applications for Language Study
Learnout & Houspie's Power Translator PRO7	$100 for English, Japanese & 5 European	Translate Full Sentences	Multilingual Use Interface Seamless Integration
Learnout & Houspie Easy Language 61 ("See, Hear, Say it")	$150 for 61 Languages, Pronounces 125,000 words/21,000 phrases	Voice Print Technology Interactive; Essential Vocabulary Focus	Interactive Learning Games; Multimedia Video Photo Tours
Universal Translator	$250 for full suite	Translates 40 Languages Text to Speech & Self-Read Voice Translation	Seamless Integration; Spell Check 35 Languages Poor quality for Japanese
Brother Tsuyaku	10,000 Yen	Full phrase translation ability	Excellent quality for reasonable price
Ditonic (East Joy)	About $50; Very rapid access	Uni-directionality, only English to Japanese	Enhanced grammar study of various word forms
MacJ Dictionary	Shareware	Rapid access English, Japanese, Korean	Rapid search functions
System Jisho (Mac)	System Shareware	Clear & User-friendly	Bi-directional searches
Pocket Transer : Mac/PC	20,000 Yen	Full Translation; Save & Print Functions	Excellent rapid access; archiving & printing
Atlas, V7	$450/Expensive	Limited English to Japanese only	
Unico Sura Sura Series	Pricy separate OCR & Translation Packs	6 Languages Available for OCR/Translation	

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CBD Name/Type SOFTWARE:	Cost/Benefits	Features/Functions:	Advantages/Applications for Language Study
Honkaku Tsuyaku (Sourcenext)	5,500 Yen; Expensive Add-on Tech. Lexicons	Bidirectional with Voice Translation	
Soiku Hayawaza JET	14-20,000 Yen 2 Versions	Choice of 6 Technical Vocabulary Areas: Add-on ESP Lexicons Extra	High-speed translation (Ad: "Translates 14 pages in 29 seconds!")
Tsuyaku Ichiban (Souiku)	8,000 Yen	Uses Pocket Transer translation engine as its database	
Tsuyaku no Tetsujin	3,500 Yen	Uses Pocket Transer as its database (ASCII)	Disadvantage: EJ & JE are sold separately
Tsuyaku Pikaichi, V3	7,000 Yen	Bi-directional: Works in Office XP/2000, Word	Translates PowerPoint
Tsuyaku Office	6,000 Yen	Translates ME/95/98 or NT4/2000 Documents	
Tsuyaku Ohsama, V4	6,000 Yen	Internet/E-biz Aim: for All platforms/ Java	Works with Linux, Lotus Notes, etc.
Translator Korya 98 Ippatsu Tsuyaku & Loga Vista X	$200 Logo Vista OCR/ $100 Translator only. 8 Available Languages.	Reads Text to Speech, Translates Spoken or Written Input: 8-14 man	Translates most MS Office & 2000 Pro Documents as well as Websites/Email.
Quickionary Reading Pens	$2-250 US	OCR Handheld Scanner Very fast 1' CBD	L1 translation & L2 pronunciation capabilities
Eijiro	$4-500 US	Very fast	With sound
Ippatsu Tsuyaku	Comes w. some Fujitsu		
Rakuchin	Fujistsu system soft	Bi-directional	With sound
Bookshelf	Shareware; Must have CD to use s	Several data base	Word, grammar, people, proverbs, grammar
Portable Hand Held Devices			
Cannon 300 PED	7,000 Yen	3 Archiving Functions	Idioms, Related Phrases
EZ-Word PED	4,000 Yen	No Archiving	
Seiko II PED	3,000 Yen	Limited English Meanings	
Sony DD-S25	slower, easier to damage, most expensive	primarily useful for specialists (translators)	voice function has fairly good quality and is of limited value
Casio XD-S3000	many useful learning aids that a standard dictionary does not provide	Longman is a particu-larly helpful addition	good for students serious about English study

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CBD Name/Type SOFTWARE:	Cost/Benefits	Features/Functions:	Advantages/Applications for Language Study
Casio XD-1500; Seiko 7200 & 8000	Some have Word Game programs such as Word Challenge at various levels for vocabulary practice	These all look promising, particularly for English study	
Free Online Translation			
ALIS Gist in Time	http://www.alis.com/cgi-bin/transdemo.pl	10 Languages Available	Free Service
InterTran	http://www.tranexp.com:2000/InterTran		Free Service
Language Engineering Corporation	http://www.lec.com/demo/frame.html		Purchasing Fee
Amikai Web Translation Engine	http://www.amikai.com/	Used by various sites Can do 24 Language Pairs including URL	Free Service; Excellent quality for news, etc. Printable quality
AltaVista Babel Fish Translation	http://world.altavista.com/tr	Systran Internet World Keyboard	Free Text or Website Translation of 12 Languages
Eijiro	http://www.alc.co.jp/		
Excite Japan	http://www.excite.co.jp/world	Uses Amikai Engine	
@nifty Global	http://www.02.so-net.ne.jp/~suyama/	Uses Amikai Engine	
Cafeglobe	Cafeglobe.com/café/wotg/index.html	Requires Members	Website Translation
Rikai.com (Great for News)	http://rikai.com/cgi-bin/HomePage.pl?Language=Ja	Single word choices	Trilingual Reading Development (Archives)
Babylon	http://www.babylon.com/		
Monolingual Sites		Best for Advanced Language Learners	(Those beyond Minimum Threshold Level, Laufer)
Oxford English Dictionary	http://www.oed.com/public/welcome/		
Merriam- Webster	http://merriamwebster.com/		
The American Heritage Dictionary	http://www.bartleby.com/61/		
Specialized Dictionaries			
Semantic Rhyming Dictionary		http://www.rhymezone.com/	
Signals: A Dictionary of Communicative Expressions		http://www.eco.mhon-u.ac.jp/~natusch/index.htm	
Contact Author at: For collaboration, questions, articles	http://ww7.tiki.ne.jp/~jloucky Email: jloucky@mx7.tiki.ne.jp	Call/Fax: (093-583-5748)	

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Appendix 4

Text to Speech/Speech to Text Programs

Dragon	info@dragonsys.com	Mobile, Desk & Teen Versions	$55-150 US
iSpeak	http://www.acuvoice.com/products/ispeak/	$70 from site; Can create MP3 files with speech	Reads any text and emails
Magooli			
MBROLA (Belgian-based)	http://tcts.fpms.ac.be/synthesis/mbrola.html	Multiple languages; Free	Over 20 platforms
Microsoft	http://www.microsoft.com		
Speakeasy	http://members.ncbi.com/computerwise/speakeasy/index.htm	Microsoft made; READS KANJI JAPANESE!	Free Download; Requires Copy & Paste to work
32 Other Sites! Software for Speech Production	http://dmoz.org/Computers/Speech_Technology/Speech_Synthesis/	Some for specific languages	Most for PCs

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