

A COMPARISON OF COMPUTER-ASSISTED VOCABULARY INSTRUCTION
AND
TEACHER-LED VOCABULARY INSTRUCTION

Master's Thesis

By

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July 2005

To my sister Semra and my husband Kürş

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AND
TEACHER-LED VOCABULARY INSTRUCTION

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I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Teaching English as a Foreign Language.

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ABSTRACT

A COMPARISON OF COMPUTER-ASSISTED VOCABULARY INSTRUCTION AND TEACHER-LED VOCABULARY INSTRUCTION

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June 2005

This study aims to determine whether the learning of foreign language vocabulary would be better for students who study and revise the vocabulary instruction material in a computer environment compared to students who learn and revise the same vocabulary instruction material in a classroom environment with their teachers. Additionally, the study explored the strengths and weaknesses of the computer-assisted vocabulary instruction.

Three groups of students participated in this study. One group was the control group, other groups were the teacher-led vocabulary instruction group and the computer-assisted vocabulary instruction group. The teacher-led group learned and revised the target words using spaced repetition via teacher instruction, the computer group learned and revised the target words using spaced repetition via computers, and

the control group learned the target words via teacher instruction while they revised vocabulary massively at one time and did not use spaced repetition.

Key words: Vocabulary acquisition, Computer-assisted language learning, Computer-assisted vocabulary instruction, spaced repetition

ÖZET

BİLGİSAYAR DESTEKLİ KELİME ÖĞRETİMİNİN VE ÖĞRETMEN TARAFINDAN YAPILAN KELİME ÖĞRETİMİNİN KARŞILAŞTIRMASI.

Ayşe Tokaç

Yüksek Lisans, Yabancı Dil Olarak İngilizce Öğretimi Bölümü

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Bu çalışma, bilgisayar ortamında kelime öğrenen ve tekrar eden öğrencilerin, sınıf ortamında öğretmen yardımıyla kelime öğrenen ve tekrar eden öğrencilerle karşılaştırıldığında kelime öğreniminde daha başarılı olup olmadığını incelemiştir. Bu çalışma, ayrıca, bilgisayar destekli kelime öğretiminin güçlü ve zayıf noktalarını da incelemiştir.

Çalışmaya üç grup katılmıştır. Bir grup kontrol grubu olmuştur. Diğer iki grup da öğretmen grubunu ve bilgisayar grubunu oluşturmuştur. Öğretmen grubundaki öğrenciler, hedef kelimeleri sınıf ortamında öğretmenleriyle birlikte öğrendi ve hedef kelimeleri ayrılmış-tekrar yöntemiyle tekrar ettiler. Öte yandan, bilgisayar grubundaki öğrenciler, hedef kelimeleri bilgisayar ortamında öğrendi ve hedef kelimeleri ayrılmış-tekrar yöntemiyle tekrar ettiler. Kontrol grubu ise hedef kelimeleri sınıf ortamında öğretmen yardımıyla öğrendi fakat hedef kelimeleri yekpare-tekrar yöntemiyle tekrar etti.

Grupların kelime edinimlerini belirlemek için, bir kelime hatırlama sınavı öntest ve sontest olarak bütün gruplara uygulandı. Öntest ve sontest sonuçlarından elde edilen veriler üç adet ANOVA testi ile analiz edildi. Gruplar arası analiz bütün grupların kelime edinimleri arasında istatistiksel açıdan önemli bir farkın olmadığını göstermiştir. Bu yüzden, bilgisayar destekli kelime öğretiminin öğretmen yardımıyla kelime öğretimi kadar etkili olduğu görülmüştür.

Bilgisayar destekli kelime öğretiminin güçlü ve zayıf noktaları ile ilgili olarak, kelime öğrenme programında görsel öğelerin bulunması öğrenciler tarafından bilgisayar destekli kelime öğrenimini en etkili özelliği olarak algılanmıştır. Bilgisayar destekli kelime öğretiminin zayıf noktaları ise bilgisayar tarafından sağlanan geribildirim yetersizliği ve öğrencilerin zamanlarını etkili bir şekilde kullanamamaları olarak belirlenmiştir.

Anahtar kelimeler: Yabancı dilde kelime edinimi, bilgisayar destekli dil öğrenimi, bilgisayar destekli kelime öğretimi, ayrılmış tekrar.

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CHAPTER 1: INTRODUCTION

Introduction

The use of computer and information technologies in language learning and teaching has led to computer assisted language learning becoming a research field on its own. Language teachers and students are becoming increasingly familiar with the use of computers for language learning purposes. One of the sub fields of computer assisted language learning (CALL) is computer assisted vocabulary instruction (CAVI). Researchers interested in CAVI try to find effective ways for language learners to learn and practice second language vocabulary by using technological aids. Electronic dictionaries, concordancers, hypertext, glosses, computerized exercises and the Internet offer students exciting and innovative vocabulary learning experiences. When properly designed based on sound educational principles, CAVI tools can be effective mediums of vocabulary instruction.

In recent years the development of computer assisted language learning has created the need and opportunity for investigating the effects of multimedia on vocabulary acquisition. Thus far, numerous studies (Groot, 2000; Cobb, 1999; Goodfellow, Laurillard , 1994; Hulstijn et al.,1996; Chun , Plass ,1996; Lomicka, 1998; Roby, 1999) have shown that computerized media and a multimedia environment can be helpful for learning foreign language vocabulary. In these studies, however, the paper-based vocabulary instruction material and the computerized vocabulary instruction material were compared in terms of their

effectiveness. No studies have compared computer assisted vocabulary instruction with teacher-led vocabulary instruction. Additionally, although the idea of spacing the repetition of target vocabulary in a conventional learning environment has been the topic of several studies (Baddeley, 1982; Bahrick et al, 1993; Ellis, 1995; Schmitt, 2002), no studies have explored the effectiveness of spaced repetition through computerized exercises in multimedia environment. The encouraging results of the studies on the effects of multimedia annotations and of spaced repetition on second language vocabulary acquisition have prompted the present study.

This study investigates the effects of computer assisted vocabulary instruction through multimedia annotations embedded in an authentic reading text. It also investigates the effectiveness of revising newly-studied words through spaced repetition procedures with computerized matching, cloze-test and crossword exercises. This study aims to determine whether the learning of foreign language vocabulary would be higher for students who studied and revised the vocabulary instruction material in computer environment compared to students who learned and repeated the same vocabulary instruction material in a classroom environment with their teachers.

Background of the Study

Foreign language vocabulary is viewed as an essential factor in successful communication and in proficient-level reading comprehension (Ellis 2001; Krashen 1989; Nation & Waring 2001; Schmitt 2000). Reading is generally seen as the most important vocabulary-enlargement activity both for L1 and L2 (Krashen 1989). Reading-based vocabulary enlargement or generally refereed as incidental vocabulary

acquisition is typically associated with inferring meaning of words by using contextual clues in a reading text without consulting a dictionary and annotations (Nation, 2001).

However, numerous studies examining and comparing the effectiveness and the practicality of guessing the meaning of words from context with the use of a dictionary or annotations (paper-based or computerized) seem to provide data in favor of dictionary and gloss use during reading for meaning (Chun, Plass, 1996; Davis, 1989; Groot, 2000; Hulstijn, Hollander, Greidanus, 1996 ; Lomicka, 1998; Lyman-Hager, Davis, Burnett, Chennault, 1993 cited in Lyman-Hager, Davis, 1996). Dictionaries and annotations are helpful where contextual clues for inferring meaning of words are insufficient and misleading or when language learners' proficiency level is low (Wesche, Paribackht, 2000). Dictionaries and annotations also provide an opportunity for language learners to verify their self-generated meanings from the contextual clues (Wesche, Paribackht, 2000).

Furthermore, research on vocabulary acquisition through reading appears to indicate that reading-based vocabulary enlargement can be enhanced through classroom vocabulary exercises or generally referred as the intentional vocabulary learning activities such as deliberate study of the constraints on use (Nation, 2001), analyzing parts of words, matching, cloze test, multiple choice, and semantic mapping exercises (Schmitt, Schmitt, 1995; Wesche, Paribackht, 2000).

Research also indicates that reading-based vocabulary activities provide language learners with a better opportunity to study several specific aspects of words such as their relations to other words and their appropriate use in context (Krashen,

1989; Wesche, Paribackht, 2000; Zahar, Cobb, Spada, 2001). The vocabulary knowledge also involves knowing a word's relations to other words, its use in appropriate contexts as well as knowing its meaning, pronunciation and spelling (Nation, 2001). This complex knowledge implies a need for multidimensional vocabulary acquisition approach, in which both incidental and intentional vocabulary acquisition approaches are accommodated (Nation, 2001; Schmitt, Schmitt, 1995; Wesche, Paribackht, 2000; Zahar, Cobb, Spada, 2001).

Another consideration related to vocabulary acquisition is retention fragility of lexical knowledge. Lexical knowledge is more subject to forgetting than grammatical knowledge as it is composed of relatively more discrete units compared to grammatical knowledge (Ellis, 1995). This more fragile knowledge type implies a need for deep level of processing or more mental effort (Schmitt, Schmitt, 1995; Wesche, Paribackht, 2000). Activities for deep level of processing include changing grammatical category of the words, matching definitions with words, multiple choice cloze or open cloze, and semantic mapping exercises (Wesche, Paribackht, 2000).

Apart from deep processing, an effective way to foster retention is repetition of the newly learned vocabulary (Schmitt 2002; Ellis, 1995). According to some research on memory and repetition (Baddeley 1982; Bahrick H., Bahrick L., Bahrick A., Bahrick P. 1993), extending the space between successive repetitions gradually fosters retention. In other words, practicing items massively at one time does not result in better learning and retention. Although the spacing effect has been proved to be an effective phenomenon in experimental psychology (Baddeley 1982; Bahrick H., Bahrick L., Bahrick A., Bahrick P. 1993), revising vocabulary through spaced

repetition seems to be ignored in vocabulary acquisition (Schmitt 2002; Ellis, 1995). Ellis (1995) and Nation (2001) suggest that spaced repetition can be implemented via computers better than with classroom teachers, as computers can operate more precisely while distributing the space between each successive repetition.

With respect to CAVI's role in vocabulary learning, computer assisted vocabulary instruction programs have been criticized as being based on what computers can do rather than on the pedagogic principles of language learning. Although this criticism is partly true, the trends in CAVI research and software design are in line with current general vocabulary acquisition theories and models of lexical knowledge processing. Numerous CAVI researchers design software programs that accommodate both intentional and incidental vocabulary approaches to provide language learners with rich vocabulary learning experiences (Van de Poel , Swanepoel, 2003; Goodfellow 1994).

Reading texts are generally used as an ideal medium of presenting vocabulary to students in context. CAVI tools such as concordance, on-line dictionaries, and annotations in the form of hypertexts embedded in authentic texts provide students with definitions, example sentences, explanations, pictures and videos. The findings of empirical studies indicate that hypertext annotations and online dictionaries are effective CAVI tools (Chun and Plass 1996; Cobb 1999).

Although the generally cited previous research (Cobb,1999; Chun, Plass,1996; Lyman-Hager, Davis, 1996; Roby, 1999) has generally supported the idea that CAVI programs facilitate L2 vocabulary acquisition, for the effective use of CAVI at

schools, practicing educators need to integrate CAVI into the curriculum (Nation, 2001; Gé Stoks 1993). CAVI need to be carefully located in a given vocabulary curriculum to complement the other curricular elements and classroom-based vocabulary practices. Furthermore, language educators need to ground their decisions on the positive findings from CAVI research. Thus, more studies on CAVI are needed to enable the educators to make well-informed choices for language learners.

Statement of the Problem

Numerous studies (Groot, 2000; Cobb, 1999; Goodfellow, Laurillard , 1994; Hulstijn et al.,1996; Chun , Plass ,1996; Lomicka, 1998; Roby, 1999) have shown that computerized media and a multimedia environment can be helpful for learning foreign language vocabulary. In these studies, however, the paper-based vocabulary instruction material and the computerized vocabulary instruction material were compared in terms of their effectiveness. No studies have compared computer assisted vocabulary instruction with teacher-led vocabulary instruction. Additionally, although the idea of spacing the repetition of target vocabulary in a conventional learning environment has been the topic of several studies (Baddeley, 1982; Bahrick et al, 1993; Ellis, 1995; Schmitt, 2002), no studies have explored the effectiveness of spaced repetition through computerized exercises in multimedia environment.

The implementation of CAVI at Selcuk University School of Foreign Languages may improve the quality of the education offered to approximately 2000 hazırlık students studying English for academic purposes. Hazırlık students at Selcuk University have only one year to learn English, and the content of the curriculum is

very intensive. Unfortunately, as a result, teachers may not pay enough attention to vocabulary in the classroom. CAVI can offer the students a chance to study the target vocabulary beyond and within the classroom systematically. However, before implementing such an instruction type, it would be wise to test whether computerized instruction of vocabulary is effective and suitable for the students at Selçuk University.

Research Questions

- 1- Is computer assisted vocabulary instruction more effective in subjects vocabulary gain than classroom instruction?
- 2- Does spaced repetition through computerized exercises and spaced repetition in the classroom have a differential impact on students' vocabulary gain?
- 3- What are the weaknesses and strengths of computer assisted vocabulary instruction?

Significance of the Study

This study seeks to investigate the effectiveness of computer assisted vocabulary instruction. Using computers to enhance the learning process has benefits for language teachers and students. Language teachers have numerous responsibilities such as presenting language items, helping students practice language items learned earlier, and providing opportunities for students to improve reading, listening, speaking and writing skills in the target language. Teachers have to allocate sufficient time for all phases of the learning process to be able to create an optimum language

learning environment. Because of teachers' heavy workload, computers can help teachers in certain areas such as vocabulary learning and revision. Students can be presented vocabulary items in reading text with multimedia annotations in a computer environment and can use CALL centers to revise learned items in computerized tasks distributed based on the principles of spaced repetition. If computer programs teach passive aspects of vocabulary, teachers may then be able to allocate more time for teaching communicative aspects of target language and target vocabulary. Furthermore, language programs may make effective use of vocabulary software and classroom instruction in a complementing fashion.

From my point of view, language teachers with basic software design skills and software authoring tools will benefit from the study as the study may provide useful insights about the strengths and weaknesses of computer assisted vocabulary instruction. Furthermore, the program designed for this study may be a basic model in terms of design format as the program was designed using easily-available resources and software authoring tools. In this respect, this study may provide useful guidelines for CAVI material design by classroom teachers.

Computer use in language education is becoming more common in Turkey. But, many institutions, including Selcuk University, have not identified an effective use of computer assisted-language learning and have not integrated computers into the curriculum. This study may suggest useful insights into ways of teaching and learning language with computers.

Selçuk University (SU), which is the test site of the research study, has a newly-constructed computer center. It is expected that this study will be a step toward activating the computer center. Currently, it is mostly used for Internet access, although it has adequate technology for computer assisted instruction. Findings of the study may guide instructors working at SU School of Foreign Languages in putting the computer center into use for language learning purposes. The study may also suggest new ways of language teaching and learning experiences in Selçuk University.

Key Terminology

Computer assisted vocabulary instruction (CAVI): Practices involving the use of computers for vocabulary learning and instruction purposes.

Spaced Repetition: Spaced repetition is a learning technique in which subsequent repetitions of learning material are separated by increasing intervals of time (Baddeley, 1982).

Annotation: An additional note giving explanations about a word (Oxford Advanced Learner's Dictionary of Current English, 2000).

Multimedia Annotations: Extra information about the words and the lexical phrases in a reading text presented through multiple forms of media.

Media: All the tools that are used for storing and transmitting information. Media includes texts, photos, drawings, audio, and video. (Pusack, Otto, 1997)

Multimedia: Materials comprised of different types of information in computer environment. Computers allow combining various media into a single environment such as audio, video and text.

Hypertext: A computer-based system for creating and accessing nonlinear texts and multimedia.

Hypermedia: Hypermedia are computer-based applications that combine various form of media by using hypertext technology in a nonlinear way.

Tracking tool: Software embedded in educational-purpose software that records the language learner's learning behaviors while using the educational software.

Vocabulary revision: Reviewing newly-learned vocabulary.

Conclusion

In this chapter, the background of the study, statement of the problem, research questions, significance of the problem and key terminology that will frequently be used have been discussed. The next chapter is the literature review which will present the relevant literature on second language acquisition, spaced repetition, computer assisted vocabulary instruction and multimedia annotations. The third chapter is the methodology chapter which explains the participants, materials, data collection procedures and data analysis procedures of the study. The fourth chapter is the data analysis chapter which includes the data analysis, the tests that were run and the results of the analyses. The last chapter is the conclusions chapter in which the findings, pedagogical implications, limitations of the study and suggestions for further research are discussed.

CHAPTER 2: LITERATURE REVIEW

Introduction

In the field of second language acquisition, numerous efforts have been made to facilitate the complex process of L2 vocabulary acquisition. One way to enhance vocabulary acquisition is with computer-assisted vocabulary instruction. Although computers are increasingly being used for vocabulary instruction, there is not yet solid understanding of how this technology can be effectively used in the area of L2 vocabulary instruction. The present study compares the effectiveness of computer-assisted vocabulary instruction with teacher-led vocabulary instruction and the effectiveness of spaced repetition both in teacher-led vocabulary instruction and computer-assisted vocabulary instruction. This chapter reviews relevant studies conducted on L2 vocabulary acquisition in both classroom and computer contexts.

First, aspects of vocabulary knowledge will be presented. Second, the importance of vocabulary in second language learning will be discussed. Third, the nature of the vocabulary acquisition process will be discussed. The fourth section will be allocated to approaches of vocabulary acquisition while fifth section will be allocated to vocabulary retention. The sixth section will deal with multimedia and learning. This section will be followed by a discussion of computer-assisted vocabulary instruction in relation to theory, practice and software design principles. The last section will discuss the benefits and the challenges of multimedia annotations.

Aspects of vocabulary knowledge

Words are not discrete units in a language; they have strong and complicated features (Schmitt, 2002; Wesche & Paribakht 2000). Learners may think that learning a word involves only learning its pronunciation, spelling and meaning. However, a single word is composed of different aspects which go beyond its pronunciation, spelling and meaning. In order for the learners to say they know a word, they have to have knowledge about a particular word's pronunciation, spelling, word parts, meaning, grammatical properties, collocations, and contextual factors effecting its appropriate use (Nation, 2001).

Knowing a word's pronunciation means being able to recognize the word when it is heard and also being able to produce the spoken form. Spelling knowledge refers to learner's knowledge of a word's written form. Knowing the written and spoken form of words helps learners understand what they read and hear.

Another important aspect of vocabulary knowledge for language learners is a word's its meaning. The meaning of a word constitutes the relationship between the word and a concept. In language, the spoken form and written form of a word correspond to a concept in the real world. Learners need to connect the written and spoken forms of words to the concepts successfully in order to communicate an intended message. The strength of this connection determines how effective language learners can remember the meaning of words when they encounter and use them in written and spoken language. Another essential issue regarding meanings of words in language is that words generally have more than one meaning. When learners look up

a word in a dictionary, they may encounter many different meanings for the word. Thus, learners need to know the various meanings that may correspond to written and spoken forms of a single word (Nation, 2001).

Collocation constitutes another aspect of vocabulary knowledge. Collocation refers to typical co-occurrence of particular words more often than that would be expected by chance. Accordingly, collocational knowledge involves sequencing words in a way that is frequently observed in native speaker use of words in phrases and sentences (Nation, 2001). Collocational knowledge is believed to affect fluency and the appropriate use of language (Pawley & Syder, 1983 cited in Nation, 2001 p. 323). Thus, learners need to know what words typically occur together.

Word parts are other important aspect of vocabulary knowledge. Word parts knowledge involves knowing how to form different words by using a root word with the help of derivational suffixes and prefixes. Knowing how to form new words by using derivational suffixes and prefixes in English becomes particularly important because of widespread and frequent use of derivational prefixes and affixes (Carstairs-MacCarthy, 2002). In addition, according to studies on word parts (morphological properties of words) word parts knowledge is represented in our mental dictionary and has a role in how words are organized and stored in our mental dictionary (Nation, 2001). Word parts knowledge also plays an important role in using words in phrases and sentences as learners sometimes need to consult their word parts knowledge when they are placing the words in sentence and phrase patterns (Carstairs-MacCarthy, 2002). Words are also closely related to grammatical

patterns. It is necessary for learners to know what part of speech a word is in order to place it in a grammatical pattern accurately (Schmitt 2002).

The last aspect of vocabulary knowledge deals with having information about contexts in which a given word can be used appropriately (Miller, 1999 cited in Nation, 2001). The context refers to a particular situation in which the communication is taking place. Particular words and phrases can be more appropriate for a given communication context. Thus, learners need to have knowledge about the appropriateness of a word in particular contexts in order to communicate successfully (Nation, 2001).

In this section of the literature review, aspects of vocabulary knowledge were discussed. The literature review on the aspects of vocabulary knowledge indicates that learning a word involves learning a particular word's pronunciation, spelling, word parts, meaning, grammatical properties, collocations, and contextual factors effecting its appropriate use (Nation, 2001). Learners need to attend to all these aspects in order to use the target language effectively and appropriately. In the next section of the literature review, the importance of vocabulary knowledge in second language acquisition is presented.

Importance of Vocabulary in Second Language Acquisition

Teachers observe that students experience problems relating to a shortage of lexical knowledge while reading, speaking, listening and writing in the target language. Often, students cannot understand an English text well or a person who is talking to them in English because of insufficient vocabulary knowledge. Sometimes

students cannot express themselves effectively simply because they do not possess the needed vocabulary for successful communication.

Although not research-based, Krashen (1989) emphasizes the role of vocabulary in a language when he states that most of the meaning in a language is carried by words. This is why people visiting a foreign country prefer to take their dictionaries with them rather than grammar books (Krashen, 1989). This view is also held by Read (2000). He states that words in a given language are the most basic units of meaning, and users of the language form phrases, sentences and larger units of meaning by using words.

Vocabulary is also the foundation for reading comprehension. The relationship between reading and vocabulary size is a complex and dynamic one. This relationship can be viewed from two different points of view: the effect of vocabulary size on reading comprehension, and the effect of reading on vocabulary size.

Regarding the effects of English vocabulary size on reading comprehension, the most frequent 2000 words comprise 80 % of all words in a given English text, and a vocabulary size of the 2000 most frequent words enables learners to have “a good degree of comprehension of a text” (Nation & Waring, 2001). Regarding the effect of reading on vocabulary, in order for learners to enlarge their vocabulary size, some scholars argue that learners need to read extensively in the second language (Krashen, 1989; Nation, 2001). By reading extensively, learners encounter the most frequent words repeatedly in meaningful contexts.

A large vocabulary size can also have a positive impact on understanding the grammar of the target language. According to Ellis (1995), knowing the words in a

text can have a facilitative effect on learning grammatical rules as learners understand the discourse functions better. Vocabulary knowledge may make the meaning of grammatical functions more transparent to learners.

In this section of the literature review, the role of the vocabulary knowledge in second language acquisition was presented. In the next section, the nature of the vocabulary acquisition process is presented.

The Nature of Vocabulary Acquisition

An advanced language learner knows approximately ten thousand words (Schmitt, 2002). Although there is not a consensus on how learners learn such a large amount of vocabulary, there is a general picture of vocabulary acquisition in the literature (Schmitt, 2002). Some important features of vocabulary acquisition have been revealed through research on vocabulary acquisition.

One of those features is the incremental nature of vocabulary knowledge. Incremental nature of vocabulary acquisition refers to the gradual learning of different knowledge types that belong to a single word (Schmitt 2002). Schmitt (2002) stresses that these different types of knowledge cannot be learned entirely at one time. Moreover, some knowledge types are mastered before others. For example, in a study by Schmitt (2002), learners first learned a words' spelling, then the meaning of the words. He also found that within a single type of word knowledge, there was also a continuum. In this continuum, the learners first learned a word's basic meaning and then learned other meanings of the word. One conclusion that can be drawn from Schmitt's study is that complete mastery of a word takes time because of the incremental nature of vocabulary acquisition.

Another aspect of vocabulary acquisition is the distinction between receptive and productive vocabulary. The term receptive vocabulary refers to the type of vocabulary knowledge that lets learners recognize and understand a word when encountered in a written or audio piece of language, whereas productive vocabulary refers to the type of vocabulary knowledge that enables learners to produce a word (Melka, 2001). According to Melka (2001), although there are certain levels of knowledge about a particular word, such knowledge should not be considered as two separate systems. They should be considered as differing degrees of familiarity dependent on each other (Melka, 2001). In other words, “knowing a word is not an all-or-nothing proposition; some aspects may have become productive, while others remain at the receptive level.” (Melka, 2001)

Another important feature of vocabulary acquisition is its retention fragility. When there is learning, there is also forgetting what has been learned. Forgetting is a natural part of learning. When it comes to second language vocabulary, according to several research studies, lexical knowledge is more likely to be forgotten than grammatical knowledge (Cohen as cited in Craik; Craik, 2002). According to Schmitt (2002, pp. 130), the fragility of vocabulary knowledge is due to the fact that “vocabulary is made up individual units rather than a series of rules.” Forgetting the learned vocabulary can mean losing all the effort put into learning them. Thus, once the vocabulary items are partly or completely learned, they should be recycled systematically to foster successful retention.

To summarize, traditionally, words such as *go*, *fast*, *orange* were considered to be acquired when the corresponding concepts were matched successfully with the

sounds and written forms (Schmitt 2002; Melka, 2001). However, recent studies on vocabulary acquisition have revealed that the knowledge of a word involves more than knowing its meaning (Nation, 2001; Read, 2000). Knowing a word means mastery of its pronunciation, spelling, relation to other words, and the other meanings it has. Once these knowledge types are learned, further effort should be put into activation of this knowledge. In addition, due to the existence of different types of knowledge about a word, the mastery of all these features cannot be developed at once (Schmitt 2002). Furthermore, vocabulary knowledge is subject to forgetting. Words should be systematically revised in order not to be forgotten (Craig, 2002). Considering all these insights, learners need to allocate a considerably long time to extend, consolidate, and retain their vocabulary knowledge (Schmitt 2002; Wesche&Paribakht, 2000).

In this section of the literature review, the nature of the vocabulary acquisition process was explored through existing studies on second language vocabulary acquisition. In the next section, spaced-repetition as way to enhance the vocabulary retention is discussed. Additionally, the principles of spaced repetition and the effects of spaced repetition on vocabulary retention are presented.

Vocabulary Retention

Most language learners seem to think that once they have studied particular words, they have completed learning those words. They do not do any further systematic study to remember and use them in other contexts. However, overtime, they may forget some of the learned words either partially or completely. Mnemonic

strategies and spaced repetition are seen effective techniques to ensure retention of newly-learned vocabulary items for a longer period of time (Ellis, 1995; Schmitt 2002).

In general, mnemonics are described as devices to aid the memory; a pattern of letters, ideas, or associations which assist in remembering information or facts (Oxford English Dictionary, 2005). One of the main characteristics of mnemonics is that new learning materials are learned by linking them with the existing ones (Ellis, 1995). In foreign language vocabulary acquisition, mnemonic strategies mainly include using keywords and using imagery (Ellis, 1995; Hulstijn, 1998).

Using key words involves the establishment of an acoustic link between an L2 word to be learned and a word in L1 that sounds similar (Ellis, 1995). For instance, the Russian word *linkor* (battleship) can be learned by establishing an acoustic link with the English word *Lincoln* (Atkinson and Raugh, 1975 cited in Ellis, 1995, pp. 115). Using imagery involves the establishment of an image link between an L2 word to be learned and a word in L2 that sounds similar. For instance, the English word *revenue* can be learned by first establishing an acoustic link with the Turkish word *revani* (a traditional Turkish dessert) and then visualizing a man who sells *revani* to earn money (Duyar, 2005).

Spaced-repetition is also regarded as an effective technique to ensure retention of newly-learned vocabulary items for a longer period of time (Schmitt, 2002). Spaced-repetition is a learning technique in which subsequent repetitions of learning material are separated by increasing intervals of time (Baddeley, 1982). Spaced repetition was developed on the basis of how human memory works. According to

studies on memory (Baddeley, 1982; Bahrick et al, 1993), dividing learning practice time equally over a period, leads to better learning and remembering. The studies suggest extending the space between successive repetitions gradually since practicing items massively at one time does not result in better learning and retention. Baddeley (1982, pp. 29) describes the spaced repetition sequence by stating “if the learner fails an item in the learning material it should be presented after a shorter delay; whenever the student is correct the delay should be increased.”

Although the studies on memory and spaced-repetition have resulted in positive findings, and although the findings have been widely known by language educators, spaced repetition has not been widely integrated into language learning programs (Ellis, 1995; Schmitt, 2002). When it is implemented, spaced repetition may be able to optimize the vocabulary acquisition process for second language learners as they may remember words better if the words are repeated in a spaced manner rather than in a condensed or unsystematic manner.

In this section of the literature review, mnemonic techniques and the spaced-repetition procedures was presented along with studies on the effects of spaced-repetition on vocabulary learning. The next section is allocated to a discussion on the benefits and challenges of intentional and incidental vocabulary acquisition approaches.

Intentional and Incidental Vocabulary Learning

Lexical skills are one of the most fundamental components of second language reading, listening, speaking and writing. Lexical skills extend over a broad area with

many dimensions as Nation (2001) and Schmitt (2002) point out. As a result, vocabulary learning is a demanding task for language learners.

One goal of research on vocabulary acquisition is to find the most effective ways for language learners to learn and use the target vocabulary. Two central positions exist in the field on second language vocabulary learning: incidental vocabulary learning and intentional vocabulary learning. Incidental vocabulary learning refers to reading-based vocabulary enlargement while intentional vocabulary learning refers to provision of support to learners by teachers, dictionaries, and some exercise types that allow students to manipulate vocabulary items. Besides these two central positions on vocabulary learning, some scholars (Hulstijn, Hollander, Greidanus 1996; Coady 1998; Wesche, Paribakht 2000) argue that intentional and incidental vocabulary learning should be used at the same time as they both have an important place in language learners' vocabulary development.

Krashen (1989) argues that vocabulary acquisition occurs when learners read extensively for meaning in the target language. He opposes explicit presentation of vocabulary items because "linguistic competence developed this way is highly limited" (Krashen 1989, p. 440) in terms of quantity, usability and quality of learned vocabulary. According to incidental vocabulary learning, the most salient incidental vocabulary learning strategy is inferring meaning of words by using contextual clues during reading for meaning. The active derivation of meaning from context makes the vocabulary more memorable and therefore results in better vocabulary retention (Hulstijn, 1993).

However, two questions in the literature remain unresolved about incidental vocabulary learning through reading. One question concerns how many encounters to a word are needed to acquire it. Lack of conclusive results regarding this question is due to the incremental nature of the vocabulary acquisition process (Zahar, Cobb, Spada 2001). Since aspects of a word such as its pronunciation, spelling, meaning, collocations, grammatical category, and appropriate use can not be learned by language learners at one time, learners need to encounter a particular word several times in different contexts to acquire it completely (Schmitt, 2002). The review of the literature by Zahar, Cobb, Spada (2001) seem to suggest that at least six encounters of a particular word in reading texts may result in its acquisition. However, they also suggest that this number of encounters to a particular word may not be adequate for full acquisition.

The second question concerns the kinds of contexts that facilitate acquisition of a new word. Natural texts may contain contexts with insupportive or misleading clues for incidental word learning purposes (Zahar, Cobb, Spada 2001, Hulstijn, Hollander, Greidanus 1996; Coady 1998; Wesche, Paribakht 2000). For some words in insupportive and misleading contexts, learners might need to wait for other contexts that are clear for them; otherwise they may learn the words incorrectly ((Zahar, Cobb, Spada 2001).

Intentional vocabulary instruction holds that learners' acquisition of new vocabulary can be facilitated by the provision of support to learners by teachers, dictionaries, and some exercise types that promote consolidation and retention of the vocabulary items (Nation,2001; Schmitt, Schmitt,1995; Wesche, Paribackht, 2000;

Zahar, Cobb, Spada, 2001). In an intentional vocabulary instruction environment, learners are encouraged to notice the words that are unfamiliar; they consult dictionaries, their teachers and friends in order to learn the unknown words in a text. Learners involve in these intentional vocabulary teaching activities in addition to inferring meaning of unknown words from context. Furthermore, learners consolidate the newly learned words by repetition and vocabulary learning exercises. According to this view, learners are active processors of vocabulary knowledge since the process of vocabulary learning is a complex task and requires varied mental processing (Wesche & Paribackht, 2000). To provide that kind of processing, Wesche and Paribackht (2000) argue that besides inferring meaning from context, learners should be engaged in vocabulary exercises such as definition matching, multiple choice cloze, open cloze, semantic mapping, negotiating meaning with peers. These exercises help learners process vocabulary knowledge in depth and can lead to successful retention (Wesche, Paribakht 2000).

According to the intentional vocabulary instruction view, an overemphasis on incidental vocabulary learning by teachers may prevent learners from checking the correctness of inferred meaning of words. Learners may not look up words in the dictionary to check if their inferred meaning is correct or not (Hulstijn, 1993). As a result, students may learn and remember some word meanings incorrectly. Moreover, unless eighty percent of words in a reading text are known, it is difficult to infer the meaning of the unknown words from context (Nation, 2001; Sökmen 2001), and students may then make incorrect inferences because they may think all unknown words can be inferred by using contextual clues (Hulsjtin, 1993). Additionally, an

overemphasis on incidental vocabulary instruction may encourage students to ignore some unknown words in a text; thus students may not learn very many words from a reading text (Hulstijn, Hollander, Greidanus 1996).

Based on these findings, some researchers (Lyman-Hager & Davis 1996; Schmitt 2002; Maera 2001; Sökmen 2001) argue that incidental vocabulary learning alone does not answer the needs of the students in an EFL context where learners do not have the chance to meet the target vocabulary as frequently as needed to reach optimal vocabulary size and quality. Another problem in an EFL context is the limited time available for learning large and quality vocabulary (Cobb, 1999). Thus, according to Cobb (1999) the vocabulary learning process should be accelerated to meet the EFL learners' needs. Because of time limitations and the low rate of incidental vocabulary learning, there seems to be a consensus on providing learners both with incidental and intentional vocabulary learning opportunities.

In this section of the literature review, incidental and intentional vocabulary learning procedures were discussed. The strengths and weaknesses of both learning types were also presented. As each vocabulary learning type has both benefits and challenges for language learners vocabulary, it was concluded that both instruction types should be used at the same time. The next section of the literature review is allocated for a discussion of the effects of multimedia on learning.

Multimedia and Learning

Media, multimedia, hypertext, and hypermedia are important concepts in computer assisted language learning. They all have distinct features although they are

closely related. These terms will be defined below before an explanation of the effects of multimedia on learning.

Media refers to the tools used to present, store and access information (Kommers, et al., 1996). More traditional media consist of printed text, photos, and drawings while more recently, media include audio, video, and animations (Pusack & Otto, 1997). The primary characteristic of multimedia is presentation and access of these media in a single environment, the computer (Pusack & Otto, 1997). Hypertext is a computer-based system that allows design and access of nonlinear texts. By combining hypertext and multimedia, hypermedia uses multimedia resources including texts.

All of these tools enable presentation of information in different ways. The type of information presentation that facilitates learning the best is an important issue in the educational use of computers. Several questions emerge when considering this issue, including whether or not hypermedia is better for providing learning opportunities than other more traditional media like textbooks and classrooms

There are two opposing views about the effects of media on learning. According to some researchers, media are tools to deliver information, and they do not provide more effective learning experiences than the more traditional experiences (Clark, 1983). In other words, this view claims that teaching methods are more important than teaching tools; how tools are used based on pedagogical principles facilitate learning more than the use of the tools themselves (Clark, 1983).

A second view emphasizes the different impact of various types of media on learning. According to this view, types of media are different from technological tools used to present them. Thus, books, computers, and television are used to deliver media whereas words, pictures, audio, video and animations are presentation modes of information (Mayer, 1997).

Dual coding theory and generative theory about information processing of humans support the second view (Mayer, 1997). According to dual coding theory, learning is better when the information is received in both verbal and visual modes at the same time (Pavio, 1986 cited in Mayer, 1997; cited in Plass et al., 1998). According to Wittrock's generative theory (Wittrock, 1974, cited in Mayer, 1997), humans construct meaning by selecting relevant information. The learner in a multimedia environment then takes an active role in selecting and combining different modes of information to construct meaning, and, as a result of this active role, learning becomes better (Mayer, 1997).

In this section, two opposing views about the effects of media on learning were discussed: the view that technology is merely a tool to deliver information (Clark, 1983), and the view that is technological tools enrich the presentation of input through the use of different modes. The second view points out the differential impact of media on information processing (Mayer, 1997). In the next section, studies on the effectiveness of CAVI and the CAVI design principles are presented.

Computer Assisted Vocabulary Instruction

Today, computer and Internet technologies are valuable tools to assist in learning a second language, including its vocabulary. Today, computers and Internet

creates a new language learning environment. The effects of computers and multimedia in language learning have been discussed for some time by practicing educators, parents and related people who want to know whether technology in language learning is more effective for teaching and learning a second language than the traditional environment and methods (Goodfellow, 1994). As the purpose of this study is to explore the effectiveness of computer assisted vocabulary instruction (CAVI), in this section of the literature review, only the use of computers in vocabulary teaching will be discussed.

Recent CAVI research has aimed to examine various factors of computer-assisted vocabulary instruction and to suggest ways in which the computer environment can improve students' vocabulary. Several researchers have shown great interest in CAVI software design principles (Van de Poel, Swanepoel 2003; Goodfellow, 1994; Ellis, 1995) while others have aimed to test the effectiveness of CAVI (Groot, 2000; Cobb, 1999; Goodfellow, Laurillard, 1994; Hulstijn et al., 1996; Chun, Plass, 1996; Lomicka, 1998; Roby, 1999).

With respect to studies on CAVI software design principles, with surveys of vocabulary acquisition theories and empirical vocabulary studies, researchers have suggested guidelines for the design of CAVI programs. For instance, Goodfellow (1994) proposes that CAVI software need to do several things for effective computer assisted vocabulary instruction. Vocabulary acquisition software should help learners acquire a large vocabulary by promoting the deep processing of words and allow learners both to study and use the target vocabulary. Furthermore, vocabulary

acquisition software should maximize the interaction between learners and the CAVI program. The interaction between learner and the program as well as the learners' development in vocabulary acquisition, should be recorded by a learner-behavior-tracking device built into the software. This is because learner-behavior data may provide valuable insights in students' development and effectiveness of the software. Finally, a CAVI software should train learners how to use the software effectively as learners may fail to use some features of the CAVI program.

In another similar study on CAVI design principles, Van de Poel and Swanepoel (2003) stress several guidelines while designing CAVI software. According to them, a program should make targeted words noticeable; provide learners with some explicit instruction on words in order to ensure that they learn them correctly; provide learners with a variety of exercise types for the deep processing of target words; allow learners to produce the learned items so that they can see their errors and then correct them; and allow learners to repeat newly learned vocabulary.

Ellis (1995), in an article on CAVI design principles, provides guidelines from a psycholinguistic point of view. He suggests that CAVI programs should provide language learners with both intentional and incidental vocabulary learning opportunities. Ellis argues that several features of a given word involve implicit learning while other features involve explicit learning. For example, pronunciation, spelling, and production of a word can be learned implicitly while learning and retaining a word's meaning can be achieved through explicit learning. He also argues that as learning the meaning of words involves explicit learning and is a conscious

process, it is strongly affected by the quality of the mental processing and repetition. The implicit learning of pronunciation, spelling and production of a word can be promoted by computerized reading texts. Learners can thus, pay brief initial attention to the words, and producing the word forms should be left to encounters in meaning focused use. Explicit vocabulary learning, on the other hand, can be promoted through online dictionaries, annotations containing explanations and sample uses of target words. Repetition of words' meaning can be achieved by computerized drills and exercises which have been effectively implemented in computer-assisted vocabulary instruction programs.

As mentioned above, guiding CAVI software design principles have been emerging. However, the question as to whether or not the software programs for computer assisted vocabulary instruction are effective remains unanswered. In the following parts of this section empirical studies exploring the effectiveness of CAVI are presented. Those studies mainly involve comparisons of the effectiveness of more traditional vocabulary acquisition strategies with computer-assisted vocabulary learning. The students' preferences and behaviors while studying the target words in a computer environment are also under close scrutiny in recent CAVI studies.

In a study by Groot (2000), traditional list learning and computerized vocabulary learning were compared. Results indicated that learners who used lists of words and their definitions in L1 scored higher marks than the computer group on the vocabulary recognition tests where the test task involved matching the target words with their L1 definitions. But when the target vocabulary was tested through cloze

tests, the computer group outperformed the list learning group. Moreover, the results from the delayed posttest showed that the decrease in scores on immediate and delayed posttests was larger in the list learning group. Based on the results, Groot concluded that list learning does not lead to deep processing and successful retention.

In a one-year study investigating computer assisted vocabulary instruction, Tom Cobb (1999) examined the effectiveness of student use of concordance software on vocabulary knowledge. In his research design, the experimental group used concordance to learn the vocabulary from the course readings and the control group used dictionary and word lists to learn the required vocabulary items. He compared the vocabulary gain of the two groups. Overall findings indicated that concordance software could help students expand their vocabulary gains faster and increase their functional reading within a discipline. Thus, concordance appears to be a viable way of presenting vocabulary without depending on teachers. Using concordance software to learn vocabulary involves reading sentences all of which contain a given target word. Furthermore, the sentences containing the word are presented along with the texts they appear. Access to the whole text is a click of a mouse away. Since studying vocabulary through concordancers involves exploratory vocabulary learning, it is believed to promote a deep level of lexical processing, and therefore results in successful vocabulary retention (Cobb, 1999; Nation, 2001).

In a case study, Goodfellow and Laurillard (1994) observed the vocabulary learning of an L2 Spanish learner at the elementary level who had learned Spanish in a natural setting in Spain for 12 months. The learner received instruction for two

weeks on some words that he reported he did not know. The CAVI program was designed according to current vocabulary learning theories. A concordancer, dictionary, and note-saving device were attached to the CAVI program. The computer recorded the learner's behaviors during the learning sessions. According to the learner-behavior record, the learner failed to use some of the features of the CAVI program; therefore, the intended learning outcome could not be obtained. Goodfellow and Laurillard (1994) concluded that learners in a CAVI environment should receive training in how to use a CAVI program and should be informed about the aims of the different types of exercises present in a program. Without that kind of training, learners may fail to use a given CAVI program to its full potential. The researchers also stressed the need for research on learner types in this new learning environment as well as on the types of CAVI programs.

Although some studies reported above have contradictory findings, previous research has generally supported the idea that computer assisted vocabulary instruction programs facilitate L2 vocabulary acquisition (Ellis, 1995; Goodfellow 1994; Cobb, 1999; Van de Poel & Swanepoel 2003, Groot, 2000; Chun & Plass, 1996). In addition, empirical studies both qualitative and quantitative have provided us with some practical and theoretical insights to understand CAVI, but more research should be conducted to provide learners with rich and effective vocabulary learning experiences in a computer environment.

In the next section of the literature review, use of multimedia annotation for vocabulary instruction, one of the most studied sub-areas in CAVI, will be presented.

The studies on multimedia annotations are handled in more detail and in a separate section as they have a focal place in this present study.

Multimedia Annotations and Vocabulary Learning

The studies on incidental vocabulary learning through reading, without consulting dictionary or annotations suggest that students can not learn very many unknown words from a single reading text (Chun, Plass 1996; Hulstijn et al. 1996). According to Chun and Plass (1996), who reviewed the previous studies on incidental vocabulary learning, the amount of incidentally learned vocabulary ranges from 5% to 20% of the unknown words in a reading text. According to some scholars (Chun, Plass 1996; Hulstijn et al. 1996), by learning incidentally between 5% and 20% out of 100 % of the unknown words in a single text, some students may not be able to develop minimal vocabulary knowledge to comprehend an English text effectively. For students learning English for general purposes, the minimal vocabulary size for effective reading comprehension is the most frequent English 2000 words, for students learning English for academic purposes, the minimal vocabulary size is and additional 1000 words that occur frequently in academic texts (Nation, 2001). Generally, language learners, especially in foreign language contexts, do not have enough time to read and learn incidentally that amount of vocabulary (Cobb, 1999).

This low rate of incidental vocabulary learning (5% to 20 % of the unknown words from a text) during reading is attributed to several reasons (Hulstijn, Hollander, Greidanus 1996). One reason is that learners may not recognize the words that they do not know. Sometimes, learners recognize unknown words but consciously

overlook them. Another factor contributing to the low rate of vocabulary learning via reading is that learners may infer the meaning of words incorrectly due to inadequate contextual clues for the meaning of a word (Hulstijn et al.1996; Sökmen, 2001).

Furthermore, the incremental nature of the vocabulary learning process may contribute to the low rate of incidental vocabulary learning. Studies on vocabulary acquisition process show that learners can not learn all properties of a word at once in a single encounter with that word in context (Schmitt, 2002; Zahar, Cobb, Spada, 2001).

When the low rate of incidental vocabulary learning through reading is taken into consideration, provision of support for learners becomes a basic concern for language teachers. To help learners overcome problems during vocabulary learning while reading, researchers emphasize the use of glosses or annotations (Hulstijn et al., 1996; Chun and Plass , 1996; Lomicka, 1998; Roby, 1999). A gloss or annotation is an additional note giving explanations about a word (Oxford Advanced Learner's Dictionary of Current English, 2000). Annotations are generally placed in the side or bottom margins of a reading text, and they have been used historically by both L1 and L2 readers (Lomicka1998; Roby 1999). In the most basic sense, annotations are offered to readers to facilitate reading comprehension by providing definitions or translations of difficult words in a text.

With respect to the use of annotations by L2 learners for vocabulary learning, Hulstijn et al. (1996) investigated the effects of dictionary use, the provision of marginal annotations and provision of no aid during reading on L2 learners' vocabulary retention. According to the study, the students who were able to use

annotations during reading recalled more words than those who used the dictionary and than those who were provided with no aid. Hulstijn et al. (1996) attributed the better performance of the annotation group to the learners' easy access to the meaning of words without an interruption in the flow of the reading process. They also stated that looking up a words in the dictionary takes "considerable time and mental effort" and thus learners may ignore some words during reading.

The issue of annotation use to promote vocabulary learning was taken to a higher level with the advent of hypertext technology. Hypertext and multimedia technology allow the design of annotations containing images, sounds or videos, along with the traditional annotation content, such as definitions and translations. Furthermore, hypertext and multimedia technology allow for the presentation and access of these various forms of information in a single environment, on the computer (Pusack & Otto, 1997).

The computerized format appears to be more effective than the paper format and may result in better vocabulary retention due to the variety of information-presentation modalities such as picture, sound, and text (Hulstijn et al.,1996; Chun and Plass ,1996; Lomicka, 1998; Roby, 1999). Different modalities of information in multimedia annotations appear to enhance vocabulary learning, as words are presented to learners through both verbal and visual modes. According to "dual coding effect", when learning material is delivered through both verbal and visual modes, it will be remembered or learned better than when it is delivered through only a verbal mode (Pavio, 1986 cited in Mayer,1997; cited in Plass et al., 1998).

The variety of presentation modes used in multimedia annotations have elicited several studies (Chun, Plass 1996; Lyman-Hager et al. 1993 cited in Lyman-Hager, Davis, 1996; Lomicka 1998) to test the differential impact of different types of annotation content on vocabulary learning (Roby, 1999). For example, Chun and Plass (1996) compared the effectiveness of three types of annotation content. One annotation type involved only textual information, another type involved both text and still picture, and an additional type consisted of text and video. According to the results of the study, the words annotated with the text and pictures were remembered better than the words annotated only with text or the words annotated with text and video.

In the light of research on multimedia annotation, annotations appear to enhance vocabulary learning and retention. One reason is that annotations provide learners with visual, audio and verbal sources to learn the meaning of words. Furthermore, annotations can focus learners' attention on important words (Stewart & Cross cited in Roby, 1999, pp.97) and as a result of this focussing and multi modes of delivering word meaning to learners, they are more likely to learn and retain a higher number of words from a text.

In this section of the literature review, paper and multimedia forms of annotations were presented along with research studies exploring their effects on vocabulary learning and retention. The next section of the literature review is allocated to a discussion of the benefits and challenges of multimedia annotations in terms of second language vocabulary acquisition.

Challenges and benefits of multimedia annotations

Computer-assisted vocabulary instruction has caught people's attention with its promise of individualized and multisensory language education. However we need to maintain a critical stance toward the use of multimedia for vocabulary instruction. Although the advantages of multimedia seem attractive to many people, using multimedia alone is not a substitute for informed pedagogical design and content. In this part of the literature review, the use of multimedia annotations for vocabulary learning purposes will be discussed in relation to teacher-led vocabulary instruction in terms of communicative vocabulary use, learner control, learner styles and provision of feedback and help.

To begin with, written and oral language is experienced in the real world communicatively. Important goals for language learners go beyond the acquisition of knowledge about the grammatical aspects of the language. Students should be prepared to handle the complex reality of the foreign language. One of the ways to prepare students to cope with the complexities of language is by using authentic materials. These conclusions are also claimed valid for second language vocabulary acquisition (Nation, 2001). In this respect, multimedia annotations may have the potential for presenting students with vocabulary explained by using authentic documents, sounds, and images from the target culture. Additionally, computers can help students learn the meaning of words and improve their pronunciation. However, when it comes to using the target language words productively in speaking and writing, the role of technology may be minimal because it is clear that multimedia

platforms can not respond as interlocutors with language learners. In this respect, computers can not replace traditional classrooms and instruction and can only assist or build a base for later productive use of words.

If computer programs can teach passive aspects of vocabulary knowledge, they can make learning and teaching more efficient. If computers can teach these passive aspects of vocabulary, teachers then may be able to allocate more time for teaching the communicative aspects of target language. Language programs may make effective use of vocabulary software as support for the vocabulary classroom instruction.

Another important issue relating to multimedia annotations deals with the students' control over the learning material. Research indicates that students' attitudes and motivation tend to be better if they have control over their learning, and that some students learn more if given the opportunity to control their learning (Skehan, 1998). Multimedia environment can provide a level of control that reduces anxiety and provides flexibility in the pacing of activities for vocabulary (Chun and Plass, 1996). For instance, students can spend as much time as they want on a multimedia annotation, and they can consult it as many times as they want to overcome lexical difficulties. Moreover, they can choose the type of help they need as they try to comprehend the reading material and learn the meanings of words. These advantages cannot be achieved in teacher-led classroom instruction as students need to adapt their speed according to the other students and the teacher. For every individual

student, classroom environment does not offer choices as to what, and how long to study a particular vocabulary item or a reading text.

Regarding the disadvantages of student control in a multimedia environment, the students' ability or inability to make the best choices for their own learning emerges as a problem. For instance, a student using a multimedia software may get lost in a program and fail to use program's features effectively (Goodfellow and Laurillard, 1994). The studies also suggest that when students with low language ability meet complex tasks they learn less than when they study with more control (Hannafin & Sullivan 1995 cited in Pusack & Otto, 1997).

Another benefit of multimedia annotations considers learner styles. Language learners favour different presentational modalities such as audio, text, and video. Multimedia annotations use a variety of modalities that complement each other meaningfully, thereby providing a learning experience that can accommodate different learner styles (Plass, Chun, Mayer, Leutner, 1998). If the right modalities or combination of modalities are used for effective vocabulary learning, multimedia annotations have the potential to help students comprehend reading texts and learn vocabulary effectively by providing alternative presentation modalities to match specific student styles (Plass et al. 1998). Additionally, due to the rich graphics and animation, multimedia annotations are attractive to the students and seem to foster student motivation.

Feedback and help provision are also important issues in language and vocabulary learning. Teachers provide feedback on students' performance in order to help students improve their skills and knowledge about the target language and

vocabulary. Lyster, Lightbown, and Spada (1999 as cited in Tsutsui, 2004) state that classroom research supports the practice of corrective feedback as potentially effective and necessary for improvement. In a classroom environment, teachers can provide students with feedback and help according to a particular situation, and they can provide extra material if necessary. On the other hand, in a multimedia environment, students are not provided with individualized feedback and help due to a lack of the technology that can respond to a particular student's performance in a tailored way. All students using a software program typically get the same help and feedback when they encounter a difficulty or make a mistake. Furthermore, research on how much help is necessary for students to have an effective vocabulary learning experience does not provide a conclusive answer. Too little or too much help in a computer environment might have a negative impact on students' vocabulary learning. For example, Davey, Jones, and Fox (1995) who observed a group of students' feedback and help usage behaviors in language learning software, report that too much help affected the students' learning negatively. Providing the students too much help just because they are studying without a teacher does not necessarily result in effective learning in a computer environment. Students might adopt a low effort strategy and use help and feedback menus without thinking first. On the other hand, the availability of instant help for vocabulary items in a multimedia environment can enhance vocabulary learning. Chun and Plass (1996) suggest that the existence of multiple types of annotations for words and the ease of clicking for meaning of words may encourage students learn more vocabulary.

In this section of the literature review, some challenges and strengths of multimedia annotations were discussed in comparison to teacher-led vocabulary instruction in terms of communicative vocabulary use, learner control, learner styles and provision of feedback and help. Although multimedia annotations promise new ways of vocabulary learning, it also has challenging limitations. Thus, a mixture of classroom instruction and computer-assisted instruction seems a wise approach to enhance the vocabulary acquisition process.

Conclusion

This chapter discussed the theoretical issues and research findings relevant to the study. The review of current theories of L2 vocabulary acquisition showed that both intentional and incidental vocabulary acquisition approaches should be used in foreign language programs because both approaches can contribute to language learners' vocabulary acquisition. The literature review also showed that the vocabulary acquisition process is incremental and that students should be provided with opportunities to review the target words both through encountering them in reading texts and intentional vocabulary review procedures. Intentional review of vocabulary items can be distributed based on the spaced repetition. Spacing the successive vocabulary reviews systematically results in better vocabulary retention than reviewing the vocabulary massively at one time.

As to the effects of computer-assisted vocabulary instruction, although some studies (Goodfellow, Laurillard, 1994; Groot, 2000) resulted contradictory findings, previous research (Cobb, 1999; Chun, Plass, 1996; Lyman-Hager, Davis, 1996; Roby, 1999) has generally supported the idea that CAVI programs facilitate L2 vocabulary

acquisition because they provide a flexible, interactive environment, and present vocabulary through multiple forms of media like verbal, aural, or visual. However, the literature review also points out the need for CAVI software incorporating sound theoretical principles of the vocabulary acquisition process (Goodfellow 1994; Ellis, 1995; Van de Poel & Swanepoel, 2003). In addition, the question as to whether hypermedia environments can be as equally effective as classroom environments for vocabulary instruction needs further investigation. It is these issues which form the basis of this study.

METHODOLOGY

Introduction

This study compares the effectiveness of computer-assisted vocabulary instruction with teacher-led vocabulary instruction and the effectiveness of spaced repetition both in teacher-led vocabulary instruction and computer-assisted vocabulary instruction. Additionally, the study explores how the computer group students perceived the computer assisted vocabulary instruction classes, what the students' feelings were about the effectiveness of these classes, and strengths and weaknesses of the classes.

This study aims to answer the following research questions:

- 4- Is computer assisted vocabulary instruction more effective in subjects vocabulary gain than classroom instruction?
- 5- Does spaced repetition through computerized exercises and spaced repetition in the classroom have different impacts on students' vocabulary gains?
- 6- What are the weaknesses and strengths of computer-assisted vocabulary instruction?

This chapter covers information about the participants, instruments, data collection procedures, and data analysis procedures.

Participants

This study was conducted with the participation of 76 freshman students who were learning English at Selcuk University School of Foreign Languages in Konya, Turkey. Because my intention was to discover the viability of using computers as vocabulary learning tools in the preparatory English program at Selcuk University School Of Foreign Languages, all student participants were from Selcuk University School Of Foreign Languages.

The 76 students were attending six different classes, and the assignment of the subjects to the treatment conditions were random, based on their usual classes. Two classes were assigned to the teacher-led instruction condition; 2 classes were assigned to the computer-instruction condition; and 2 classes were assigned to the control condition. The teacher-led group learned and practiced the target words using spaced repetition via teacher instruction, the computer group learned and practiced the target words using spaced repetition via computers, and the control group learned the target words via teacher instruction while they practiced vocabulary massively at one time. The control group did not use spaced repetition. All groups studied the vocabulary instruction material under their regular teachers' supervision.

The treatment material involved thirty-one words taken from an article in *National Geographic Journal*, the article itself, pictures, sample sentences, and English definitions related to the selected words. The treatment material also included matching, crossword and cloze exercises for the revision of the target words. All these materials were used for all three treatment types. But either the presentation

environment or the distribution of the material over time was different for groups. The initial presentation of the material to the computer group took place in the computer environment in the form of hypermedia. Two classroom sessions (of 45 minutes each) were allocated for the computer group. However, the students in the computer group spent only one classroom session (45 minutes) to complete the vocabulary learning task. The subsequent revisions of the target words were distributed according to spaced repetition principles in the computer group's vocabulary instruction. On the other hand, the initial presentation of the material for the teacher and the control group took place in the classroom environment. Two classroom sessions (of 45 minutes each) were allocated for both groups and the both groups completed the vocabulary learning task as expected in two classroom sessions (90 minutes). However, the treatment of the control group and the teacher group differed only in the distribution of subsequent revisions of the target words. While the teacher group's target vocabulary revisions were distributed based on the spaced repetition principles, the control group's treatment did not include the spaced-repetition procedures. They completed the target vocabulary revision materials in a condensed manner.

In order to ensure parallelism between classroom and computer environment instructions, the same materials were used in the teacher computer and control instructions. For 16 words in the treatment material, teachers (teachers of both control and teacher-led groups) gave the grammatical category of the words and three sample sentences per word. Those exact sentences were also used in the material for the

computer group. For another 15 words in the treatment material, teachers gave the grammatical category of the words and one sample sentence. Besides that, teachers showed several pictures explaining the meaning of the words. Those pictures and sample sentences were also used in the material for computer group. Regarding the clues and feedback for vocabulary revision exercises, teachers were able to give feedback and clues similar to the ones given by the computer to the computer group students. For example, when a student made a mistake while doing vocabulary exercises, the computer only indicated the existence of an error and the students were able give another answer for a given exercise item. Additionally, students were able to access the correct answer by clicking a button on the screen. Accordingly, the teachers of the teacher and the control groups indicated the existence of an error and wait for students to give another answer and then after a while provide the correct answer for the students.

As to the data collection instruments conducted with three groups, a vocabulary retention test was conducted with all groups to determine their vocabulary retention scores. There were also two questionnaires in the study. The teacher group and the control group completed the Classroom-Based Vocabulary Instruction Questionnaire. The computer group, on the other hand, completed the Computer-Assisted Vocabulary Instruction Questionnaire. The following table demonstrates three groups' corresponding treatments and data collection instruments.

Table 1

Treatments and the data collection instruments of the groups

Groups	N	Environment	Vocabulary Presentation Material	Distribution of revision Material	Data Collection Instruments
Teacher-led vocabulary instruction group (teacher group)	24	Classroom	Same material but paper based	Spaced repetition	• Vocabulary retention test • Classroom-based vocabulary instruction questionnaire
Computer-assisted vocabulary instruction group (computer group)	33	Computer	Same material but computer based	Spaced repetition	• Vocabulary retention test • Computer-assisted vocabulary instruction questionnaire
Control group	19	Classroom	Same material but paper based	No spaced repetition	• Vocabulary retention test • Classroom-based vocabulary instruction questionnaire

Instruments

Vocabulary retention test as pretest and post-test

Since this was a quasi-experimental research study with three groups (computer group, teacher group, control group) and with has three treatment or instruction types for each group, a vocabulary test was designed in order to assess the effect of treatment types. The participants took the vocabulary test before and after the treatment sessions as this study had both a within-subject and a between- subject design.

The vocabulary retention test was based on Nation's vocabulary level test in terms of its format (2001). The vocabulary retention test consisted of thirty-one English words from a text taken from *National Geographic Journal*. These thirty-one

words were divided into ten sets and each set consisted of six English words, three of which were the target words from the reading text and three of which were distracters. The three distracters were included in each set to reduce the guessing factor. The participants were expected to match the three definitions with the three words from the text. (See Appendix E for a copy of the Vocabulary Retention Test.)

Regarding the criteria for selecting the 31 target words to be included in the vocabulary retention test, first an article from *National Geographic Journal* was given to 20 intermediate students who did not participate in the actual study. They were asked to underline the unknown words that they wanted to learn. Additionally, the text was given to the participant teachers to underline the words that they thought their students would not know. Second, the underlined words were counted and the most frequent 31 unknown words were determined. Finally, those most frequent unknown words were analyzed by using an online vocabulary analysis tool titled “Web Vocab Profiler” developed by Tom Cobb (Heatley, A. and Nation, P.1994). Tom Cobb developed this program based on Paul Nation and Batia Laufer’s vocabulary frequency measure called “Lexical Frequency Profiler”. This program indicates “how many word types the text contains from the following four frequency levels: (1) the list of the first 1000 word families, (2) the list of the second 1000 word families, (3) the Academic Word List, and (4) the words that do not appear in any of the preceding lists” (Tom Cobb, 2005). Table 2 displays the results of the vocabulary frequency analysis.

Table 2

Frequency profile of the target words in vocabulary retention test

Vocabulary frequency List Types	The Most Frequent 1000 Words (1 to 1000)	The Second 1000 Word Families (1001 to 2000)	The Academic Word List	Off-List Words	
Words Belonging to a Particular List	Remain Beyond Spirit Spiritual Concerned Valuables	Treatment	Infrastructure Priority Obviously Issue	Eyewitness account Emergency Supply Relief Agency Swamp Makeshift camp Looter Debris Transcription Daunting Logistics Laceration	Massive Emotion Flee Ordeal Traumatized Spook Tow Trafficking
Number of the Words	6	1	4	19	

Note: Total number of words in the vocabulary retention test for the study was 31.

As can be seen in table 2, the selected 31 words to be included in the vocabulary test were comprised of 6 words belonging to the most frequent 1000 words list, 1 word belonging to the most frequent 2000 words list, 4 words belonging to the academic word list and 19 words belonging to off-list words. it is essential to note here that lexical units such as “relief agency” are included in the off-list category as the online vocabulary frequency analysis tool does not recognize the lexical units as a single word referring to a single concept. For example, although the program indicates that the word “agency” belongs to the most frequent 1000 words list and the word “relief” belongs to the most frequent 2000 words list, the program does not tell

which vocabulary list the word “relief agency” belongs to. Therefore such lexical units were placed under the off-list category.

The selected words included in the vocabulary test were also analyzed in terms of their grammatical category. Five words were verbs; 19 words were nouns; 5 words were adjectives; and 2 words were adverbs.

To conclude, the vocabulary recognition test was designed based on Nation vocabulary level test (2001) and given to all the students as pre and post-tests. Although the 31 words included in the vocabulary recognition test was analyzed in terms of their frequency and grammatical category, they were not selected based on their frequency levels and frequency counts. They were selected based on whether they were known or unknown by the participants prior to the treatment sessions. The vocabulary retention test was administered as the pretest to reveal the vocabulary items that had been known by the participants prior to the treatment sessions. The vocabulary recognition test was administered as the post-test to reveal how many target vocabulary items were learned and retained by the all participants immediately after the treatment sessions.

A Reading Text

An authentic reading text was used to present the target vocabulary items in context. The authentic reading text was selected from *The National Geographic Journal* web site. Since the original text would take longer to read than the amount of time allocated for this research, only parts of it were used. Since the text had an interview format and contained some questions and answers, the adaptation was done by

excluding several questions and answers. The parts used were about the tsunami disaster happened in Thailand on December 26, 2004. The selected parts were not simplified semantically or lexically. After the adjustments made the text's readability ease was calculated by using Flesch-Kincaid Reading Ease formula which grades passages on a scale of 0-100. "Higher scores indicate material that is easier to read; lower scores indicate material that is harder to read" (Wikipedia online encyclopedia, 2005). According to Flesch-Kincaid readability ease formula, the text's difficulty was determined as 68,3 by using Microsoft Word. With a score of 68.3, the adapted text's difficulty can be interpreted as suitable for a native speaker of English attending 6th grade. Accordingly, the difficulty of the text is suitable for intermediate level language learners. (See Appendix C for a copy of the reading text.)

As this study compares the effectiveness of computer instruction with teacher instruction, for the computer instruction group, paper version of the reading text was converted into hypermedia reading text using a multimedia authoring software designed by Macromedia (2004). The software enabled the researcher to put the reading text into a hypermedia environment and design the multimedia annotations. The text was annotated by using multiple forms of media such as text, sound and graphics, which were obtained from various Internet sites including the website of *The National Geographic Journal*.

As mentioned earlier, thirty-one words from the reading text were selected as target words to be taught. For the electronic version of the reading text, fifteen of the selected words were annotated with both forms of media (text, audio and graphic)

while 16 target words were annotated with only textual and audio media, as some of the words had abstract meanings and it was impossible to annotate them by using pictures.

The textual annotations involved the definition of the target words and their grammatical forms. The textual annotations also consisted of three sample sentences containing the target words. For example; words such as “issue” and “spiritual” were annotated by using textual media. (See Appendix G for a sample of the textual annotations.) On the other hand, for picture annotations involving the definitions of the target words and their grammatical forms, only one sample sentence and several pictures explaining the meaning of the target words were used. For example, words such as "to swamp" or "looter" were annotated by using both textual and picture media. (See Appendix F for a sample of visual annotations.)

Reading Comprehension Test

A reading comprehension test was developed to provide students with a task while they were reading the text. However, the students’ responses to the reading comprehension questions were not used in the study, as there was not a tracking device built into the program to record the students’ responses to the comprehension questions. It was hoped that giving the students a reading task would encourage them to attain aspects of words involving contextual information.

In order to develop the questions, the researcher determined the main and important points, and designed the questions based on these points. There were 10 multiple-choice questions in the reading comprehension test. The test was available

on the computer to the computer group along with the text. (See Appendix D for a paper-based copy of the Reading Comprehension Questions.)

Computer assisted Vocabulary instruction software:

The interactive multimedia computer program used in this study was designed by the researcher to enhance L2 vocabulary acquisition based on the generally accepted theories about the vocabulary acquisition from the literature. The aim of the vocabulary program was for language learners to learn and retain the meanings of the target words in their memory. Because of the time restraints allocated for this study, the program was not designed to take the learners through each stages of the vocabulary acquisition process. Furthermore, with present computer technology, learners do not have opportunities in a computer environment for interactive, truly communicative language use. Thus, the software designed for the study addresses preliminary stages in the development of a truly interactive and communicative vocabulary knowledge. In this section of the methodology chapter, features of the CAVI program used in the study and the theoretical principles behind those features of the CAVI program will be presented and discussed.

Before explaining the theoretical principles behind the design of the CAVI program, for clarity, the stages of the second language vocabulary acquisition process will be briefly presented. First learners notice various properties of a new word, including its spelling, pronunciation, meaning, collocations, and grammatical features. Second, learners store some features of the word in their memory and they may use the word for comprehension and production while reading writing, listening and speaking in the target language. Finally, learners consolidate their vocabulary

memory storage through further exposure to the word in other contexts, providing the learner with additional properties of that word (Nation, 200; Read, 200). Although the stages are presented here in a linear fashion for clarity, the literature indicates that they actually develop gradually and cannot be distinguished from each other (Schmitt, 2002).

Some stages of the vocabulary acquisition process and some properties of vocabulary knowledge described above are integrated into various sections of the CAVI program. The program takes the learners through a sequence of vocabulary learning activities to enhance their vocabulary knowledge. Specifics relating to which of the vocabulary acquisition processes and the vocabulary properties are being activated are described below. Generally, however, on the surface, the program provides students with the meanings of the target words via hypermedia links embedded into a reading text. While reading the annotated reading text, the students are asked to answer computerized multiple choice comprehension questions. Then, the students are provided with vocabulary practice and recycling opportunities by doing matching, close test and crosswords exercises. The learning purpose for each of these activities in terms of vocabulary acquisition is described below.

The words to be learned are presented in a reading text to provide learners an opportunity to see the words in context thereby enabling them to notice properties of the words. The target words are annotated with textual, visual and audio media. All annotations are provided outside the body of the text and are indicated in blue in the reading text. When the students click on a highlighted word or a phrase, they can see what information is available on the link (i.e. text, pictures). All of the media (text,

picture, sound) in multimedia annotations are intended to aid the students in understanding, learning and retaining of unknown words as according to dual coding theory, learning is better when the information is received both verbal and visual modes at the same time (Pavio, 1986 as cited in Mayer, 1997). Furthermore, the information in the form of textual, visual and audio modes provides students with memorable vocabulary learning experience and an opportunity to consolidate their vocabulary knowledge since the textual media provides the definition of a word or phrase and its grammatical form such as noun, adjective, verb. Oxford Advanced Learner's Dictionary of Current English (2000) was used for dictionary definitions of words. In the annotations, all target words are also presented in sentences to help learners understand the meaning of target vocabulary items. Visual media provides photos or drawings to illustrate a word, a notion, or an idea.

The program also provides the students with matching, cloze test and crosswords exercises. Those exercises are intended to help the students to consolidate and review their knowledge about the words to be learned as these exercises help learners process vocabulary knowledge in depth and can lead to successful vocabulary retention (Wesche, Paribakht 2000). The sequence of the revision exercises is based on the sequence of vocabulary acquisition processing. That is, from recognition to production. For example, the first activity is a matching exercise; the last is a fill in the blank cloze type exercise.

The computerized definition matching exercise is presented first as it involves recognition skills. The task in the exercise is to match the given definitions with the

words. While doing the matching exercises, the students are able to do the exercises as many times as they want. When a student matches a word with an incorrect definition the computer indicates the mistake and the students can match the words and definitions again that have been incorrectly matched.

The computerized crossword exercise is presented second as it involves remembering the words after reading their definitions. In the crosswords exercises, the task is to read the definition of a target word and type the word into crossword grids. When a student has difficulty finding the correct word, the computer provides the student with the first letter of the word by clicking on the clue button on the screen. If the student still has problem he/she can get the other letters of the word from the computer. When students complete the crossword they can check their answers by clicking on the check button on the screen. If the students have some incorrect answers the computer indicates the incorrect words in the crossword grids. Then the students can answer the incorrect words again.

The computerized fill-in-the-blank cloze test is presented last as it involves using contextual clues and remembering the correct words to complete the omitted parts in a text. The students' task in the cloze test involves writing the missing words in given sentences or reading passages. The students are presented sentences with omitted words and asked to type in the missing words. When the students have difficulty finding the required word, they are provided with the definition of the word by clicking on the help button. In addition, the computer can provide the students with the first letter of the word when they click on the clue button on the screen.

Regarding the authoring software used to design the CAVI software, the program was written in an HTML editor *Dreamweaver MX* (2004), and then published on CD-ROM. HTML was chosen as the programming language because it provides easy integration of hypermedia. The audio component was processed using *SpeechPlugin* (1996), and the pictures with Adobe Photoshop 7.0 (Adobe, 2002).

Questionnaires

Two different questionnaires were prepared and conducted in the study. One of the questionnaires was administered with the subjects in the computer group and the other questionnaire was administered with the subjects in the control group and the teacher group. In both questionnaires, the subjects were asked their ideas about their corresponding instructional conditions. Thus, the subjects in both conditions completed their corresponding questionnaires after they had experienced the instruction condition they were assigned. Through questionnaires, the study explored how the students perceived the corresponding learning conditions, what the students felt about the effectiveness of these conditions, and their perceptions of problems with the conditions.

Computer-Assisted Vocabulary Instruction Questionnaires were administered to the thirty-three students who learned the target vocabulary in the computer environment. The purpose of the questionnaire was to discover three types of information about the subjects in the computer group. The first section of the questionnaire focused on personal information about the subjects. The second section focused on the subjects' background information regarding the Internet and computer

use. The third section of the questionnaire was used to determine participants' thoughts, attitudes and feelings about the learning experience they had while in the computer environment. Additionally, the third section served to reveal the weaknesses and the strengths of the computer-assisted vocabulary instruction. (See Appendix A for a copy of the questionnaire)

The Classroom-Based Vocabulary Instruction Questionnaire was conducted with the forty-three students who learned the target vocabulary in the classroom environment (teacher-led vocabulary instruction group and control group). The aim of the questionnaire was to discover if the vocabulary instruction the teacher and control group students received was perceived as natural by the students in the teacher and control groups. It was essential to explore the teacher- instructed students' perceptions about the vocabulary instruction, as their teachers were asked to follow certain instructional formats while teaching the target vocabulary to ensure equivalent instruction between classroom and computer environment conditions. It was predicted that several irrelevant variables might cloud the variables that are the focus of the study. For example, the irrelevant variables might include unequal provision of additional material or feedback and dissimilar periods of time devoted for a vocabulary item. Excluding the irrelevant variables mentioned above as much as possible by asking the teachers to follow certain instructional formats would highlight the variables that were essential for the study. The targeted variables in the study were the effect of teacher instruction and the computer assisted vocabulary instruction on subjects' vocabulary retention rate while using the same vocabulary instruction

material and same amount of instructional material. In other words, the study did not explore the effects of different types of material, different vocabulary instruction activities or the different amount of vocabulary instruction.

Regarding the preset limitations for the teachers of the control and teacher group, teachers were asked to give a definition, only three specific sample sentences for the 16 target words. Those exact sentences were also used for computer group in order to teach those same 16 target words. For other 15 target words, teachers were asked to give a definition, one sample sentence and show several pictures explaining the meanings of those words. Those pictures and sample sentences were also used in the material for the computer group. Regarding the clues and feedback for vocabulary revision exercises, teachers were able to give feedback and clues similar to the ones given by the computer to the computer group students. For example, when a student made a mistake while doing vocabulary exercises, the computer only indicated the existence of an error, and the students were able to give another answer for a given exercise item. Additionally, students were able to access the correct answer by clicking a button on the screen. Accordingly, the teachers in the teacher-led vocabulary instruction condition and in the control condition were asked to indicate only the existence of an error and to wait for students to give another answer, and then after a while, they could provide the correct answer for the students.

In spite of these preset instructional constraints, the researcher attempted to design as natural a classroom vocabulary instruction environment as possible. The students who were exposed to the target words in the classroom environment were

given the teacher-led vocabulary instruction questionnaire in order to check if the students perceived the teacher instruction as natural. (See Appendix B for a copy of the questionnaire)

Data Collection Procedures

The study was conducted at Selcuk University School of Foreign Languages as a first step in exploring the viability of integrating computers into second language vocabulary teaching and the recycling of the vocabulary through spaced repetition procedures. This section provides a detailed description about how the data was collected during the pilot and actual study.

A reading text from the *National Geographic Journal* web site was selected and adjusted in terms of its length. No semantic or lexical simplification was done in the text. The paper version of the text was piloted with 16 students from the intermediate level at the school, who did not take part in the actual study. The goal of the pilot study was to trial a pen-and-paper version of the text in order to investigate its difficulty level and to determine the target vocabulary.

In order to determine the target vocabulary, the students were asked to read the text for comprehension and underline all the unknown words. Additionally, the students were given a multiple-choice reading comprehension test to check the appropriateness of the comprehension questions. Target words were then determined based on the data from the pilot study. Words that were marked as "unknown" by the participants in the pilot study were selected in addition to those that the researcher and the teachers of the participants of the actual study considered crucial. Once the

target words were specified, the researcher searched for available resources. Pictures or drawings, and text files from many web sites were collected to be used for the content of the multimedia annotations and for the teacher instruction.

After designing the computer group's instructional software, the software was tested by four other students who did not take part in the actual study. They were asked to go through the program and click on as many annotated words as they could. They were also asked to report those annotations which did not work properly.

The actual data collection procedure consisted of three main phases, each occurring on different days. The first phase of the study lasted one class period for each of the three groups. All participants were given the vocabulary retention test to determine their vocabulary knowledge prior to the treatment.

The second phase lasted two class periods and involved learning how the software worked. Only the computer group took part in the second phase while other groups did not receive any kind of training on how to use the learning material.

The third phase was the actual study and was conducted on five different days over a two-week period. In this phase of the study, all three groups received different types of instruction. On the first day, computer-assisted vocabulary instruction group, teacher-led vocabulary instruction group and control group were presented with the target vocabulary under their corresponding instruction conditions. The computer-assisted group read an electronic form of the reading text with annotated words. The teacher-led group and control group read the same text as the computer group but they received teacher-fronted instruction. This instruction consisted of the same

definitions, sample sentences and pictures as those designed for the computer group. On the following day, all groups participated in completing the revision material containing the target words. The revision material was composed of cloze, crosswords and matching exercises. The computer group studied the computerized versions of the exercises while teacher and control group studied the paper version of the exercises. However, the teacher and the computer groups' revision exercises were distributed on four different days based on the spaced repetition procedures while the control group studied all revision exercises massively in one day. In other words, the control group completed whole revision exercises in a condensed manner on the day following the presentation session while other groups completed the same revision exercises based on the spaced repetition procedures. The control group also completed the teacher-led vocabulary instruction questionnaire after the revision exercises were completed on the day following the presentation session.

As mentioned above, for the teacher-led and computer group students, the revision exercises were distributed over a two-week period based on spaced repetition procedures. That is, subjects were given the first revision exercises one day after the presentation of the target words. The second revision exercise was delivered two days after the first revision session. The third revision session took place four days after the second revision session. The last revision session took place eight days after the third revision session. On the last revision session day, all three groups took the vocabulary retention test as a post-test. On the same day, the computer group and teacher-led vocabulary instruction group also answered their corresponding questionnaires about the learning experience they had. The following table presents a

summary of the events involved in the actual data collection procedures. The numbered events took place on different days.

Table 3

Summary of the events involved in the actual data collection procedures

Sequence of the Events	Computer Group	Teacher Group	Control Group
1	Implementation of the pretest	Implementation of the pretest	Implementation of the pretest
2	Demonstration about how the software worked for computer group		
3	Day1: Presentation of the target words in the reading text with annotations.	Day1: Presentation of the target words by teachers.	Day1: Presentation of the target words by teachers.
4	Day2: fist repetition session.	Day2: fist repetition session.	• Massive repetition by using the same exercises used with teacher and computer group • Implementation of post-test • Filling out the Classroom-based Vocabulary Instruction Questionnaire
	Day 4: second repetition session	Day 4: second repetition session	
5	Day 8: Third repetition session	Day 8: Third repetition session	
6	• Day 16: fourth repetition session • Implementation of the post-test. • Filling out the Computer-assisted Vocabulary Instruction Questionnaire	• Day 16: fourth repetition session • Implementation of the post-test. • Filling out the Classroom-based Vocabulary Instruction	

Data Analysis

To explore the research questions of the study, quantitative and qualitative data collection instruments were used in the study. The quantitative data was gathered through vocabulary retention test. The vocabulary retention test was conducted as a pretest before the treatment sessions began and it was conducted a second time as the post-test immediately after the treatment sessions were completed by the participants. The pre and post-test scores of the groups were compared by running two one-way ANOVA tests and one two-way ANOVA tests. The test scores served as the values of the between and within-subjects variables of the study.

Regarding the qualitative data, two different questionnaires were prepared and both of them were administered once. One of the questionnaires was administered with the subjects in the computer group and the other questionnaire was administered with the subjects in the control group and the teacher group. Through the questionnaires, the study explored how the students perceived the corresponding learning conditions. The subjects in both conditions completed their corresponding questionnaires only once after they had experienced the instruction condition they were assigned. Thus, the data analyses procedures involved only within-subject variables. Accordingly, data analysis techniques such as calculation of means, frequencies and one-way chi-square tests were used to analyze the gathered data from the both questionnaires (Brown, 2001).

Conclusion

This chapter introduced the methodology of the study organized to find answers to the research questions. It also provided information about the participants, the CAVI program, the instruments, the data collection procedures and data analysis. The next chapter will provide information on the results of the data analysis using the above-mentioned statistical methods.

CHAPTER 4: DATA ANALYSIS

Overview of the Study

This study compared the effectiveness of computer-assisted vocabulary instruction with teacher-led vocabulary instruction and investigates the effectiveness of spaced repetition both in teacher-led instruction and computer-assisted vocabulary instruction. Additionally, the study explored how the computer group students perceived the computer assisted vocabulary instruction classes, what the students felt about the effectiveness of these classes, and the strengths and weaknesses of the classes.

This study aims to answer the following research questions:

- 7- Is computer-assisted vocabulary instruction more effective in students' vocabulary gains than classroom instruction?
- 8- Does spaced repetition through computerized exercises and spaced repetition in the classroom have different impacts on students' vocabulary gains?
- 9- What are the strengths and weaknesses of computer-assisted vocabulary instruction?

This study was conducted with the participation of 76 freshman students studying English at Selcuk University School of Foreign Languages. The 76 students

were attending 6 different classes and the assignment of the students to the treatment conditions was random in that it was based on the students' usual classes. Three treatment conditions were determined. Two classes were assigned to the teacher-instruction condition; two classes were assigned to the computer-instruction condition; and 2 classes were assigned to the control-condition. The teacher group learned and revised the target words using spaced repetition via teacher instruction, the computer group learned and revised the target words using spaced repetition via computers, and the control group learned the target words via teacher instruction while revising vocabulary massively at one time. This group did not use spaced repetition.

This chapter covers the type of research design and the quantitative and qualitative data analyses involved in the study. Before presenting the results of qualitative and quantitative analyses of the data, the type of the research design of the study will be presented, as the research design determines the statistical tests and analyses (Hatch, Lazaraton, 1991). The design of the study consists of a single within subject variable (vocabulary test), with two levels (pre and post), and a single between subjects variable (vocabulary instruction), with three levels (teacher-led vocabulary instruction with spaced repetition, computer-assisted vocabulary instruction with spaced repetition and teacher-led instruction without spaced repetition). Table 4 displays the research design of the study.

Table 4

Research Design of the Study

Between Group Factor (Instruction Type)	Within Group Factor (Vocabulary Gain)	
	Pretest	Post-test
Teacher Group: Teacher instruction with spaced repetition.	Teacher Group	Teacher Group
Computer Group: Computer instruction with spaced repetition	Computer Group	Computer Group
Control Group: Teacher instruction without spaced repetition	Control Group	Control Group

As shown in the table above, this was a pre and post test experimental design with three groups; the analysis of data collected through the vocabulary test was computed by running one two-way ANOVA test, and two one-way ANOVA tests.

Regarding the qualitative data collection design, two different questionnaires were prepared and both were administered only once. One of the questionnaires was administered with the subjects in the computer group and the other questionnaire was administered with the subjects in the control group and the teacher group as both were teacher-fronted classroom environments. In both questionnaires, the subjects were asked their ideas about their corresponding instruction conditions. Through the questionnaires, the study explored how the students perceived the corresponding learning conditions, what the students felt about the effectiveness of these conditions, and the perceived problems of the conditions. Forty-three Classroom-Based Vocabulary Instruction Questionnaires were administered to the students who studied

the target vocabulary in the classroom environment and thirty-three Computer-Assisted Vocabulary Instruction Questionnaires were administered to the students who studied the target vocabulary in the computer environment. (See appendix A for a copy of the questionnaire)

The subjects in both conditions completed their corresponding questionnaires after they had experienced the instruction condition to which they were assigned. Thus, the data analyses procedures for the questionnaires involved only within-subject factors. Accordingly, data analysis techniques such as calculation of means, frequencies and a one-way chi square test were used to analyze the gathered data from both questionnaires (Brown, 2001).

In this part of the data analysis chapter, both quantitative and qualitative data analysis techniques used in the study are presented. In the remaining sections of the chapter, tables and results will be presented to display the analyses of quantitative and qualitative data.

The quantitative data analysis is given in two sub-sections: (1) separate comparison of pre and post-test results, (2) A comparison of groups in terms of their mean differences in pre and post-test scores

The qualitative data analysis is given four sub-sections: (1) analysis of Computer-Assisted Vocabulary Instruction Questionnaire, (2) analysis of the Classroom-Based Vocabulary Instruction Questionnaire, (3) comparison of CAVI

and classroom-based vocabulary instruction in terms of effectiveness of teaching material and feedback, (4) analysis of the open-ended questions.

Analysis of the Quantitative Data

In this study, the quantitative data was collected through the Vocabulary Retention Test. The analysis of data from the test was computed by running two one-way ANOVA and one two-way ANOVA tests. Two one-way ANOVA tests were run separately for pre and post tests. A two-way ANOVA test was run to compare the mean differences in pre and post test scores of the groups generated by the grouping factor.

Separate Comparisons of the Pre and Post Test Scores in terms of Grouping Factor

In order to reveal if there is a significant difference in pretest results between groups, one-way ANOVA was run. The table below shows the means, standard deviation and the one-way ANOVA results for the pretest.

Table 5

Comparison of the groups in terms of the number of the words they knew prior to the treatment sessions. (One-Way ANOVA Test Results for the Pretest)

	N	M	S D	F	Sig.
Teacher Group	24	6.13	4.16	0.29	0.747
Computer Group	33	5.45	3.64		
Control Group	19	6.26	5.00		
Total	76	5.87	4.14		

Note. N = number; M = mean; SD = standard deviation; F = variance *p < .05

The results in the table show that there is not a significant difference in means of pretest between groups at the level of $P > .05$. Thus, the one-way ANOVA analysis showed that all groups performed similarly on the pretest.

In order to reveal if there is a significant difference in post-test results between groups, another one-way ANOVA was run. The table below shows the means, standard deviation and the one way ANOVA results for the post-test.

Table 6

Comparison of the groups in terms of the number of the words they knew after the treatment sessions. (One-Way ANOVA Test Results for the Post-test)

	N	M	S D	F	Sig.
Teacher Group	24	18.17	8.51	1.53	0.224
Computer Group	33	15.70	6.95		
Control Group	19	14.11	8.08		
Total	76	16.08	7.81		

Note. N = number; M = mean; SD = standard deviation; F = variance * $p < .05$

The results in the table show that there is not a significant difference in means between groups at the level of $P > .05$. Thus, the one-way ANOVA analysis showed that all groups performed similarly on the post-test.

A comparison of groups in terms of their mean differences in pre and post test scores

In this part of the vocabulary test analyses, two types of information were sought. One type of information involved the overall vocabulary gain of the subjects regardless of grouping or instruction conditions. The second type of information, which was the main aim of the study, involved a comparison between the mean differences in pre and post test scores with a reference to the grouping factor.

In order to discover the overall significance in all subjects' vocabulary gains, pre and post-test scores were compared regardless of the grouping factor. The table below displays the results of one-way ANOVA test results related to within subject comparison regardless of grouping factor.

Table 7

The overall vocabulary gain of all subjects regardless of grouping factor.

	N	M	F	Sig.
Pretest	76	5.87	184.27*	.000
Post- test	76	16.08		

Note. N = number; M = mean; F = variance *p < .05

As seen in the table, the mean score for all subjects on the pretest was 5.9 and the mean score for all subjects on the post test was 15.9. This showed that there is a statistically significant vocabulary gain for all subjects in the study. In other words, the overall effect of the treatment, regardless of its treatment type was statistically significant at the level of $P < .05$.

As explained in the introductory section of the vocabulary test results analyses, since the study had a factorial design, in order to compare the possible differences between the groups due to instruction type, a two-way ANOVA test was run. The procedure began by calculating the difference in the subjects' marks on the pre- and post tests and then the means of the differences of the three groups were compared, with a reference to instruction type, by running a two-way ANOVA test. The table below shows the results of the ANOVA test illustrating the effect of

grouping factor on the vocabulary gains of the subjects. The table also displays the means of groups on the pretest, the means of groups on the post-test and the mean differences between each group's pre and post test scores.

Table 8

Effects of the grouping factor on the vocabulary gains of students (two-way ANOVA between-subject and within-subject comparison)

Group	N	Pretest Mean	Post test Mean	Difference Mean	F	Sig.
Teacher	24	6.13	18.17	12.04	2.367	.101
Computer	33	5.45	15.70	10.25		
Control	19	6.26	14.11	7.85		
Total	76	5.87	16.08	10.21		

Note. N = number; F = variance *p < .05

As shown in the table, the teacher-led group had a mean score of 6.13 on the pretest, increasing to 18.17 on the pretest. The computer-group had a mean score of 5.45 on the post test, increasing to 15.70 on the post-test. On the other hand, The control group had a mean score of 6.26 on the pretest, increasing to 14.11 on the post-test. The mean difference between the pretest and the post-test for the teacher-led group was 12.04, for the computer group 10.25, and for the control group 7.85. When the mean differences of three groups are compared, the teacher-led group learned more target words than the computer and the control groups. Additionally, the computer group learned more target words than the control group. The control group learned the least number of target words. However, the results of between groups contrast showed that there was not a statistically significant difference in vocabulary gain between the three groups, as the F score is lower than $P > .05$.

In this part of the data analysis, results of the within subjects' contrasts and between groups' contrasts were presented. Although all subjects' showed significant vocabulary gains (see table 8), there is not a statistically significant difference between the treatment groups. The types of treatment condition, that is teacher-led vocabulary instruction with spaced repetition, computer-assisted instruction with spaced repetition, and control-condition without spaced repetition, did not generate significantly more vocabulary learning when compared one to the other. In the next section, the qualitative data analyses results for the questionnaires for teacher-led group, computer group, and control group are presented.

Analyses of the Qualitative Data

In this study, the qualitative data was collected through two questionnaires: the Computer-Assisted Vocabulary Instruction Questionnaire and the Classroom-Based Vocabulary Instruction Questionnaire. The Computer-Assisted Vocabulary Instruction Questionnaire was conducted with the computer-group students. The Classroom-Based Vocabulary Instruction Questionnaire was conducted with the teacher and control-group students.

The qualitative data analysis is given four sub-sections: (1) analysis of Computer-Assisted Vocabulary Instruction Questionnaire, (2) analysis of the Classroom-Based Vocabulary Instruction Questionnaire, (3) comparison of CAVI and classroom-based vocabulary instruction in terms of effectiveness of teaching material and feedback, (4) open-ended questions.

The Analysis of the Computer-Assisted Vocabulary Instruction Questionnaire

There were 25 items, and two sections in the questionnaire for the computer group. The first section consisted of 8 items on information relating to the subjects' computer and language learning experiences prior to the current study. For these 8 items, one-way chi square test was not computed as the information sought through them had a descriptive nature. The First 3 items in the first section of the questionnaire addressed the subjects' general computer experience and familiarity with the concept of hypertext; the last 5 items were aimed to reveal the subjects' experiences and familiarity with the use of computers for learning, including English language and vocabulary learning.

The second section of the computer group questionnaire consisted of 17 Likert scale statements. The aim of the section was to reveal if students had positive feelings about the computer assisted vocabulary instruction. Another aim of the second section was to discover the specific weaknesses and strengths of the current vocabulary program and the computer instruction sessions in terms of feedback and help provision, timing, students' self confidence, and effective use of the annotations.

The data analysis procedures for the second section of the questionnaire started with a calculation of the frequencies for each item. Then, a one-way Chi-square analysis was computed to discover the significance of distribution of the responses on the Likert-scale since Chi-square (χ^2) is a statistical analysis that is used to compare frequencies for one variable at a time and determine "the probability that frequencies depart from the expected frequency distribution" (Brown, 2001, p. 158). Based on the principles of Chi-square test, the expected frequency for each item in the

questionnaire was 6.6 as thirty-three students answered the computer group questionnaire and each item had a 5-point scale ($33/5=6.6$). Additionally, each question was treated as a single variable in the chi-square analysis. The items that revealed significant results were those with most of the responses in one single option.

Analysis of the background questions

In the background section of the computer group questionnaire, item 1 was a Yes/ No question asking students if they had used a computer before the study or not. The students' responses to the question are displayed in table 9.

Table 9

Students' Experience with Computers

1. Was this class your first experience with computers?	Frequency	Percentage
YES	12	36.4%
NO	21	63.6%
Total	33	100%

Note: Number of the respondents: 33

As table 9 shows, 12 students stated that they used the computer for the first time during the study, while 21 students reported some experience with computers. Since question 1 only asked about whether or not the students had had any prior computer experience, two additional items (items 2 and 3) explored how frequently students use computers and the Internet. These questions also explored the degree of students' familiarity with the concept of a hypertext environment because the CAVI program involved the use of hypertext technology to present and annotate the target

words. Table 10 and 11 display the students' responses to questions 2 and 3 on the questionnaire.

Table 10

Internet Experience

2. Do you use internet?	Never	Barely	Sometimes	Very often	All the time	Total
Frequency	1	5	12	6	9	33
Percentage	3	15.2	36.4	18.2	27.3	100%

Note: Number of the respondents:33

Question 2 was a Likert scale type question. It aimed to reveal how often the students use the Internet. Only one student reported that she/he never used the Internet while 15 % of the students reported that they barely use the Internet. Thirty-six percent of the students reported that they sometimes use it, 18% of the students reported that they use the Internet very often, while the remaining 27% of the students reported that they use the internet all the time. The responses indicate that 81% of the students use the Internet fairly often and that they are familiar with the concept of hypertext. Question 3 was designed to explore how well students browse web pages (hypertexts). Question three was a Likert type question asking students to rate how well they can browse web pages. The students' responses to question 3 are displayed in table 11.

Table 11

Students' Internet browsing skills

3. Please rate how well you can browse web pages.	I do not know how to do it.	I can do it with difficulty	I can do it with a little difficulty	I can do it easily	I can do it very easily.	Total
Frequency	4	4	6	10	9	33
Percentage	12.1	12.1	18.2	30.3	27.3	100%

Note: Number of the respondents: 33

Four students (12%) stated that they do not know how to browse web pages, while another four students (12%) reported that they can browse web pages but with difficulty. Eighteen percent of the students stated that they can browse web pages with a little difficulty while 30 % stated they can browse web pages easily and 27% of the students stated that they can browse web pages very easily. The students' responses to question three seem to indicate that 75 % of the students did not have great difficulty in using and browsing through the web pages on the Internet. Additionally, the responses may also indicate that 75 % of the students were previously familiar with the concept of hypertext which was used for vocabulary annotations in the CAVI program in the study.

To discover information as to whether students had any previous experience in using computers for learning an educational subject or learning English language and English vocabulary, questions 4,5,6,7 and 8 were included. These items are presented in separate tables because the question formats were different. The responses to questions 4 and 6 are reported below in one table because the Likert scales were the same, while 5, 7 and 8 are reported in a separate table because the Likert scale descriptors were different. Questions 4 and 6 were yes/no questions asking if students

ever used computers for learning an educational subject and if they ever used computers for learning English and vocabulary. Table 12 displays the students' responses to questions 4 and 6.

Table 12

Previous Computer-Assisted Learning Experience

Questions		Yes	No	Total
4. Have you ever used computers for learning an educational subject?	Frequency	19	14	33
	Percentage	57.6	42.4	100%
6. Have you ever used computers for learning English and its vocabulary?	Frequency	11	22	33
	Percentage	33.3	66.7	100%

Note: Number of the respondents: 33

For question four, 58% of the students said they had used computers for learning an educational subject, while 42% of the students said they had not used computers for learning an educational subject. For question six, 33% of the students said they had used computers for learning English vocabulary while 67% percent of the students said they had never used computers for learning English and its vocabulary. Based on the results from both items (4 and 6), approximately 40% of the students had never used computers for learning an educational subject while approximately 70% of the students had no previous experience using computers for learning English and vocabulary.

The results gathered from students' responses to questions 4 and 6 did not give much in-depth information about how familiar the students were in using computers for learning educational subject, English language and English vocabulary learning. Therefore, questions 5,7 and 8 were asked to explore students' degree of familiarity

with using computers for the particular purposes mentioned above. Table 13 displays the students' responses to questions 5,7 and 8.

Table 13

Students' familiarity with using computers for learning

Questions	Frequency & Percentage	VF	F	BF	UF	VUF	Total
5. Familiarity with using computers in educational subject learning.	Frequency	1	12	16	3	1	33
	Percentage	3	36.4	48.5	9.1	3	100%
7. Familiarity with using computers for learning English?	Frequency	0	11	9	7	6	33
	Percentage	0	33.3	27.3	21.2	18.2	100%
8. Familiarity with using computers for English vocabulary learning?	Frequency	2	8	16	2	5	33
	Percentage	6.1	24.2	48.5	6.1	15.2	100%

Note. VF = Very Familiar, F =Familiar, BF = Barely Familiar, UF = Unfamiliar, VUF = Very Unfamiliar. Number of the respondents: 33

As can be seen in table 13, question 5 asked the students how familiar they were with using computers for educational subject learning. Forty percent of the students reported that they were familiar with using computers for educational subject learning while 49% of the students reported that they were barely familiar. Additionally, 10% of the student stated that they were unfamiliar with using computers in educational subject learning. Regarding question 6, in this item the students were asked about their degree of familiarity in using computers in English language learning. Thirty-three percent of the students stated that they were familiar with using computers for English language learning. On the other hand, 27 % stated that they were barely familiar and 40 % of the students said they were unfamiliar in using the computers in English language learning.

Question 8 was designed to reveal the students' familiarity in using computers for English vocabulary learning. Responses to question 8 show that 30% of the students were familiar with using computers for English vocabulary learning while 49% were barely familiar. Twenty- one percent of the students said that they were totally unfamiliar in using the computers for English vocabulary learning purpose.

When we consider the results from questions 5,7,8 and from questions 4,5 simultaneously, it can be concluded that approximately 75% of the students in the study had used computers for learning English and its vocabulary but their familiarity varied a great deal. Therefore, some students may have had some problems during the treatment sessions while they were using the CAVI program due to their lack of familiarity or little familiarity with using computers for language and vocabulary learning.

Students' attitudes toward CAVI

In order to explore the students' attitudes toward computer assisted language and vocabulary instruction, questions 9 and 10 were designed. Question 9 investigated students' feelings about use of computers for English language learning with a Likert scale format. Question 10 asked for the students' feelings about the use of computers for English vocabulary learning and also with a Likert scale format. The responses to the both questions are displayed in table 14 below.

Table 14

Students attitudes toward CAVI

Attitude Questions	Means	VP/P	N	NG/VN	Chi ²
9. Feelings about using computers for English language learning.	2.82	25	6	2	37.15*
10. Feelings about using computers for English vocabulary learning.	2.82	25	6	2	27.24*

Note. VP = Very Positive, P =Positive, N = Neutral, NG = Negative, VN = Very Negative. Chi² = Chi-square * p < .05. Number of the respondents: 33

As can be seen in table 14, in question 9 , the students were asked to rate their positive or negative feelings about use of computers for English language learning. Twenty-five students stated that they had positive feelings, while 2 students stated that they had negative feelings. However, 6 students stated that they neither had positive nor negative feelings about the use of computers for English language learning. To explore specifically the subjects' feelings about the use of computers for English vocabulary learning, question 10 was posed. The responses to this item indicate that 25 students had positive feelings while 2 had negative feelings. On the other hand, 10 subjects did not indicate either positive or negative feelings. The overall interpretation of the responses for questions 9 and 10 seem to indicate that most of the students had positive feelings about the use of computers both for learning English language and vocabulary.

Perceived strengths of CAVI

The 10 positively-phrased items were designed to reveal the strengths of the CAVI program used in the present study. The positive items also were written to reveal whether or not the students could use the features of CAVI usefully and

effectively. Students were asked to grade their agreements on ten statements on a five scale ranging from strongly agree to strongly disagree. Students were also given the option “undecided”. In the following paragraphs, discussion of the data from the positively phrased items revealing the perceived strengths of CAVI will be presented along with tables displaying means, frequencies and critical chi square p values.

Table 15

Perceived strengths of CAVI

Positively phrased items	Means	SA/A	U	D/SD	Chi²
11. I liked the immediate feedback that I received from the computer program.	3.06	28	3	2	22.15*
13. I liked the computer program because it let me work at my own speed independently.	3.03	28	3	2	24.82*
14. I liked the computer program because I was able to practice as many times as I wanted.	2.64	23	4	6	21.70*
15. I liked the computer program because I was able to study vocabulary links as long as I wanted .	2.76	24	2	7	16.85*
16. I was confident in using the computer program because it was similar to web pages that I use on the internet.	2.06	11	11	11	11.70*
17. I used all the vocabulary links usefully.	2.06	11	11	11	.08
18. While learning the words in the reading text, the sample sentences, pictures and definitions were enough and I did not need further help.	2.45	19	8	6	14.64*
19. When I had difficulty while doing the practice exercises, the help and the clues from the computer program were enough.	2.70	21	6	6	3.97
20. I liked the computer program because I was learning without a teacher.	2.39	20	6	7	26.55*
22. I learned the vocabulary quickly and felt then I had nothing to do.	1.67	5	13	15	14.40*

Note. SD = Strongly Disagree, D =Disagree, U = Uncertain, A = Agree, SA = Strongly Agree, Chi² = Chi-square * p < .05.

As the table shows, in item 11, the students were asked if they liked the immediate feedback they received from the program. The mean score for the item was 3.06 and the distribution of the answers was statistically significant at the level of

$p < .01$. The results indicate that the students participated in the study appreciated the availability of instant feedback from the CAVI program to a great extent.

The item 13 asked the students for their ideas about studying and learning the words independently at their own speed. The mean score for the item was 3.03 and the distribution of the responses on the scale was significant at the level of $p < .05$. As the mean score for the item indicates, most of the students stated that they liked studying the words independently and at their own speed.

Items 14 and 15 also asked the students for their ideas about their self pacing the activities. The results for these two items accordingly support the results from item 18. For item 14, the mean score was 2.64 and the distribution of the responses were significant at the level of $p < .05$. For item 15, the mean score was 2.76 and the distribution of the responses were significant at the level of $p < .05$. The results from both items support the idea that students appreciated their being able to self-pace the learning and practice the target words presented by the CAVI program.

Item 16 asked the students if they were confident in using the computer program because it was similar to the web pages that they used on the Internet. The distribution of the responses for item 16 is statistically significant and the mean score of 2.06 for the item seems to indicate that the students were slightly confident while using the program as a result of their familiarity with the web pages that some of them had used on the internet prior to the study. However, the students' responses were divergent to a great extent as they were equally distributed among negative, positive and undecided options. This might be due to the most of students'

unfamiliarity with the use of computers for English vocabulary learning purposes as indicated in the analyses of items 6 and 8 that revealed the unfamiliarity of the students with the use of computers in language learning.

Item 17 asked if the students used all the vocabulary links (multimedia annotations) usefully. Although the mean score of 2.06 for the item indicates an overall positive response, the distribution of the responses for item 17 is not statistically significant, that is the most of the responses did not fall into a single option. By looking at the divergent responses, it can be concluded that not all the students were able to use the vocabulary links (multimedia annotations) effectively, probably because of their individual differences in terms of their learning styles, language proficiency levels and familiarity with such a learning environment.

As can be seen in table 15, the distributions of the students responses for item 17 and item 16 appear identical and yet produced different significance values at the level of $p < .05$. However, the distribution of the responses for these two items were not identical although this data is not apparent in Table 15. This difference between two items can not be seen in the table as the frequencies of the students' responses for strongly disagree and disagree options were combined into one category for practical reasons and the same procedure was followed for the strongly agree and disagree options. Because of the above mentioned procedures followed in reporting the data, item 16 and 17 yielded different significance values at the level of $P < .05$ although they look identical in table 15. In item 16, the responses were distributed across five options while in item 17, the responses were distributed across four options.

Accordingly, the expected N for item 17 was higher (8.25) compared to the expected N for item 16 (6.6) and the significance values of the distribution of the responses were different for these two items although results appear identical in Table 15.

Item 18 asked the students if the sample sentences, pictures and definitions in the vocabulary links were sufficient for them to learn the vocabulary items presented in a reading text or they needed further help to learn the words. As can be seen in table 15, the mean score of 2,45 indicates that most of the students agreed that they did not need further help and that the sample sentences, pictures and definitions in the vocabulary links were sufficient for them to learn the vocabulary items. The distribution of the responses for this item was also significant at the level of $p < .05$. Thus it can be concluded that majority of the students perceived that the material used to present and teach the vocabulary items was sufficient.

Item 19 aimed to reveal the adequacy of the help and clues the students received from the computer while they were doing vocabulary practice exercises. Although the mean score for the item was 2.70 the distribution of the responses was not significant at the level of $p < .05$. By looking at the chi square results, it can be concluded that the help and the clues that the students received from the computer were perceived neither sufficient nor insufficient by majority of the students. This result may be due to the lack of individualized feedback and clues appropriate for a specific situation and student. All students using the CAVI program received the identical feedback and clues from the computers. The feedback and the clues were pre-prepared based on the predicted difficulties students might encounter.

Item 20 asked the students if they liked the computer program because they were learning the target words without a teacher. The mean score for this item was 2.39 and the distribution of the answers was significant at the level of $p < .05$. The results seem to indicate that the students liked learning the target words independently without a teacher. Results from item 18 (adequacy of the information in annotations) also support the results from item 20 since the majority of the students stated that they did not need additional information about the target words than they received from the computer while they were learning the words in a reading text with multimedia annotations. Also, most of the students believed that they could learn the words in a computer environment. In addition, the results from item 20 supports the results from the two-way ANOVA analysis computed to explore the effects of the different vocabulary instruction type on students' vocabulary gains. According to the ANOVA results, there was no significant difference in vocabulary gains of computer-instructed and teacher-led students. The results from ANOVA test and item 20 showed that the students in the computer-assisted vocabulary instruction group were not disadvantaged compared to the students in teacher-led vocabulary instruction group and the control group.

In item 22, the students were asked to rate their agreement on the following statement: "I learned the vocabulary quickly and felt then I had nothing to do." This question was included in the computer group questionnaire because the researcher observed that some students finished studying the material faster than the others during the sessions in the computer lab. Thus the aim of the question was to reveal

the number of the students who finished studying the material relatively quickly compared to the rest of the class members as well as the number of those who were slower in finishing the vocabulary learning tasks. Five students stated that they learned the vocabulary quickly and felt they had nothing to do, while 15 students stated that they did not learn the vocabulary quickly. Additionally, 13 students stated that they were undecided. The mean score for the item was 1.67 and the distribution of the responses was statistically significant at the level of $p < .05$. The mean score and the chi square value seem to indicate that the majority of the students used all the time allocated for them to study the target words in the computer lab.

Perceived weaknesses of CAVI

There were 5 negatively phrased items in the second section of the computer group questionnaire. The negative items were reverse scored while responses for them was being entered the SPSS program. Accordingly, high means scores and answers falling into disagree and strongly disagree levels indicate positive results for the CAVI program. The negative items in the questionnaire involved similar issues asked in the positive items discussed above. The aim in asking the students their ideas about the same issues was to triangulate and support the findings gathered from negative and positive items in the questionnaire. Thus the results from negative items will be presented with reference to the findings from the positive items discussed earlier in the section. Table 16 displays the mean score, chi-square test results and the distribution of the responses for each negative item.

Table 16

Perceived weakness of CAVI

Negatively-phrased items	Mean	SA/A	U	D/SD	Chi ²
12. While I was using the vocabulary program, I was not certain what to do and feel I wasted a lot of time.	2.48	8	6	19	5.91
21. I was bored by the time I spent at the lab using the vocabulary program.	2.24	7	11	15	12.30*
23. The sample sentences, definitions of words and pictures were useful but it was unnecessary to present them via a computer program.	2.42	6	9	18	14.42
24. While learning the words at the computer lab, enough time was not provided for me to learn the words effectively.	1.67	15	6	12	8.67
25. I did not like the computer program because teacher help was unavailable.	2.48	6	7	20	15.03*

Note. SD = Strongly Disagree, D = Disagree, U = Uncertain, A = Agree, SA = Strongly Agree, Chi² = Chi-square * $p < .05$.

As can be seen in table 16, item 12 asked the students if they were uncertain what to do and felt they wasted a lot of time while using the vocabulary program. The mean score was 2.48 and majority of the students (19 out of 33) stated that they were certain and did not feel they wasted a lot of time. However, the distribution of the responses was not statistically significant at the level of $p < .05$. In the earlier discussion of the strengths of CAVI, item 11 asked the students if they were confident while using the program (see table 15). Although the majority of responses for item 11 fell into a single positive choice and the distribution was found to be statistically significant, it was noted that the responses fall into the choices divergently. Thus, to some extent, both negative and positive items asking about students' confidence in using the CAVI program support each other. It seems that some of the students were certain about what to do while some of them were

uncertain, which may be attributed to their differing previous internet and computer experiences as well as their previous learning experiences in a computer environment.

In item 21, the students were asked to state their agreement about the following statement: “I was bored by the time I spent at the lab using the vocabulary program.” The mean score for the responses was 2.24 and the distribution of the responses was significant at the level of $p < .05$. Thus, it can be concluded that majority of the students were not bored by the time they spent at the lab using the CAVI program.

In item 23, the students were given the statement, “ The sample sentences, definitions of words and pictures were useful but it was unnecessary to present them via a computer program.” The mean score for the item was 2.42, but the distribution of the responses was not statistically significant. However, 18 students disagreed with the statement and 6 students agreed, while 9 students neither disagreed nor agreed. The responses appear to indicate that majority of the students considered the presentation of the vocabulary instruction material in a computer environment essential while some students (6 students) considered as not essential.

In item 24, the students were asked to grade their agreement on the following statement: “While learning the words at the computer lab, enough time was not provided for me to learn the words effectively”. 12 students disagreed on the statement while 6 students were undecided and 15 students agreed. As this was a negative statement, the students who disagreed on the statement found the allocated time sufficient. On the other hand, the students who agreed on the statement found the allocated time insufficient. At this point of the analysis, it is essential to note that two class sessions (90 minutes total) was allocated for the computer group to study

the text with vocabulary links and the vocabulary exercises. However, the students stopped studying the material approximately after 45 minutes. Additionally, the researcher observed that approximately 10 students stopped studying the material after 15 minutes. The observations and the students' responses to item 24 may be due to different factors, such as different levels of competence in the language, or different pace in task-completion or a combination of various other factors.

Item 25 asked the students if they disliked the computer program because teacher help was unavailable. A majority of the students disagreed with this statement and the distribution of the responses was significant at the level of $p < .05$. The results seem to indicate that most of the students did not consider the lack of teacher help as a disadvantage.

Analysis of the Classroom-Based Vocabulary Instruction Questionnaire

This second section of the questionnaire analysis presents the results of the Classroom-Based Vocabulary Instruction Questionnaire analyses. The classroom-based instruction questionnaire was administered to both the teacher group and the control group. The aim of the questionnaire was to reveal the students' feelings about the vocabulary instruction and the materials used in the treatment sessions. Both the teacher-led vocabulary instruction group and the control group responded to the same questionnaire as their treatment only differed in the distribution of the revision sessions after studying the words with teachers. That is, the teacher-led vocabulary instruction group studied the vocabulary revision material according to the principles of spaced repetition while the control group studied the vocabulary revision material in a condensed manner without spaced repetition.

Questionnaires were administered to the teacher-led and control group students in order to sought information as to whether or not the teachers' instruction was perceived natural by the subjects in both groups. Exploring the perceptions of all the teacher-instructed students about the naturalness of the teacher-led vocabulary instruction was essential in the sense that the teachers who taught the target vocabulary to the students had to follow certain limitations in order to approximate the treatment of the computer group. (See page 55 for the limitations set for the teachers). The limitations for the teachers were set to exclude irrelevant factors from the study as much as possible. As Cohen and Manion (1996) point out, in experimental designs in educational research studies, it is essential to insist on common teaching patterns for experimental groups in order to obtain valid results. Creating common teaching patterns in educational experiments involves excluding irrelevant variables and focusing on specific variables (Cohen & Manion 1996).

To analyze the responses of the students in the control and the teacher-led group statistically, frequencies were calculated and the distribution of the responses was analyzed by running a one-way chi-square test. A one-way chi square test was run because the questionnaire was administered only once. The questions in the questionnaire included 6 statements with a 5-point Likert scale. The scoring for the positive statements was as follows: Strongly agree = 4, Agree = 3, undecided = 2, Disagree = 1, Strongly Disagree = 0. The results of the data analysis from teacher and control questionnaire will be presented by using tables displaying means, frequencies and chi-square test values.

Students' perceptions about the classroom-based vocabulary instruction

To explore the students' perceptions about the vocabulary instruction they received, students were given five positive statements and asked to indicate their agreement and disagreement on the given statements. Table 17 and 18 displays the frequency of the students' responses and the chi square test values for the items in the questionnaire.

Item 6 was a 5-point Likert scale item. The students were asked how familiar they were with the technique that the teachers used to teach the target words. The scoring for the item was as follows: Very Familiar = 4, Familiar = 3, Barely Familiar = 2, Unfamiliar = 1, Very Unfamiliar = 0. Table 17 displays students' responses to the item and also the chi square results.

Table 17

Students familiarity with the teacher-led vocabulary instruction.

Item	Means	VF/F	BF	UF/VUF	Chi ²
6. How familiar are you with the technique that your teacher used to teach the target words?	2.3	22	14	7	22.23*

Note. VF = Very Familiar, F = Familiar, BF = Barely Familiar, UF = Unfamiliar, VUF = Very Unfamiliar, Chi² = Chi-square * $p < .05$.

As can be seen in table 17, for item 6, twenty-two students stated that they were familiar with the technique that their teacher used to teach the target words and 7 students stated that they were unfamiliar. On the other hand, 14 students stated that they were barely familiar with the technique the teachers used. The distribution of the responses was significant at the level of $p < .05$ as most of the responses fell into the one single choice: familiar. By looking at the results, it can be concluded that most of

the students were previously exposed to vocabulary instruction techniques that were similar to the ones used in the treatment sessions of the study. This result implies that the vocabulary instruction led by teachers was natural, and that the students did not notice the limitations followed by their teachers.

To explore the strengths and weaknesses of the vocabulary instruction given to the teacher and control group students, students were given five positive statements and asked to grade their agreement and disagreement on the given statements. Table 18 displays the frequency of the students' responses and the chi square test values for items 1, 2, 3, 4 and 5.

Table 18

Strengths and weaknesses of the teacher-led vocabulary instruction

Items	Mean	SA/A	U	D/SD	Chi ²
1. I was able to learn the words in the text easily with teacher help.	2.4	25	10	8	15.95*
2. I found the definitions, pictures and sample sentences given by the teacher helpful.	3.3	37	5	1	23.51*
3. When I was learning the target words, the definitions of the target words, the pictures and the sample sentences were enough. I did not need extra information.	2.2	20	10	13	12.47*
4. I was bored by the time I spent learning the target words as the teacher spent too much time for presenting them.	2.4	23	11	9	16.42*
5. While we were repeating and practicing the target words, the feedback and the clues my teacher provided were enough.	2.8	32	5	6	19.42*

Note. SD = Strongly Disagree, D =Disagree, U = Uncertain, A = Agree, SA = Strongly Agree, Chi² = Chi-square * p < .05.

As seen in the table above, the responses of the students generated statistically significant results at the level of p<0.5 for all the items in the questionnaire.

Regarding the students perceptions about the vocabulary instruction they received, when all items are considered together, it seems that the only problematic area for the students was the time spent by the participant teachers to present the target words. The teachers spent two class sessions (90 minutes) to present the 31 target words and the majority of the students stated they were bored by the amount of time they spent learning the target words as it took the teacher too much time to present them. Regarding the other issues such as adequacy of given material, feedback and clues, the majority of the students considered them as normal and sufficient. In other words the students did not need extra material, help, feedback and clues in order to learn and practice the target words. In that respect, the treatment procedures for teacher-led and control groups were natural and effective for the students despite the limitations the teachers followed. The imposed study limitations on the teachers to create a common instructional pattern between treatment conditions were achieved without effecting the naturalness of the instruction. The only problem was the longer period of time spent by the teachers to present the vocabulary items by using the treatment materials.

Comparison of the computer and classroom environment

in terms of the effectiveness of the vocabulary teaching material and feedback

As mentioned earlier, both the control group and the teacher-led vocabulary instruction group studied the vocabulary in a classroom environment while the computer assisted vocabulary instruction group studied the vocabulary in a computer environment. Accordingly, the teacher and the control group completed the

Classroom-Based Vocabulary Instruction Questionnaire, while the computer group completed the Computer-Assisted Vocabulary Instruction Questionnaire.

Two questions about the effectiveness of the material, the feedback and the clues were included in both the Classroom-Based Vocabulary Instruction Questionnaire and the Computer-Assisted Vocabulary Instruction Questionnaire. In this section, a comparison of the classroom-based vocabulary instruction and the computer-assisted vocabulary instruction in terms of the perceived effectiveness of the material, the feedback and the clues is presented

In order to explore the effectiveness of the sample sentences, pictures and definitions used in the vocabulary instruction for all groups, the students were given the following statement: “When I was learning the target words, the definitions of the target words, the pictures and the sample sentences were enough. I did not need extra information.” The students were asked to grade their agreement with the statement. The table below displays the students’ responses, the frequencies, and the chi square results.

Table 19

Adequacy of the sample sentences, pictures and definitions

	N	Mean	SA/A	U	D/SD	Chi ²
Classroom-based Instruction	43	2.2	20	10	13	12.47*
Computer-assisted Instruction	33	2.45	19	8	6	14.64*

Note. SD = Strongly Disagree, D =Disagree, U = Uncertain, A = Agree, SA = Strongly Agree, Chi² = Chi-square * p < .05.

As can be seen in table 19, in both environments, the students perceived the material they received as being adequate.

In order to explore the effectiveness of clues and the feedback that all groups received, the students were given the following statement: “While we were repeating and practicing the target words, the feedback and the clues I received were enough.” The students were asked to indicate their agreement with the statement. The table below displays the students’ responses, the frequencies, and the chi square results.

Table 20

Adequacy of the feedback and clues in computer and classroom environment.

	N	Mean	SA/A	U	D/SD	Chi ²
Classroom Environment	43	2.8	32	5	6	19.42*
Computer Environment	33	2.7	21	6	6	3.97

Note. SD = Strongly Disagree, D =Disagree, U = Uncertain, A = Agree, SA = Strongly Agree, Chi² = Chi-square * p < .05.

As shown in table 20, most students who received the same feedback and the help in the classroom environment perceived feedback and clues as being adequate and the distribution of the answers was significant at the level of p<.05. As to the computer environment, although the majority of the students perceived the feedback and clues as adequate, the distribution of the responses was not statistically significant.

In terms of feedback and clues they received, two environments differ. The students receiving the feedback from the teachers found the feedback and clues mostly satisfactory. The students receiving the same type of feedback from the computer found the feedback and clues not very satisfactory.

Analysis of the Open-ended Questions

In the study, there were three groups: teacher-led vocabulary instruction group, computer-assisted vocabulary instruction group, and control group. The groups differed either in terms of the environment (classroom or computer) or in terms of the distribution of the vocabulary revision material (spaced repetition and not spaced repetition). The following table displays the corresponding vocabulary instruction types of the three groups and the corresponding questionnaire the groups completed in the study.

Table 21

Group treatment type and their corresponding questionnaires

Groups	N	Environment	Distribution of Revision Material	Type of Questionnaire
Computer-assisted vocabulary instruction group (computer group)	33	Computer	Spaced repetition	Computer-assisted vocabulary instruction questionnaire
Teacher-led vocabulary instruction group (teacher group)	24	Classroom	Spaced repetition	Classroom-based vocabulary instruction questionnaire
Control group	19	Classroom	No spaced repetition	Classroom-based vocabulary instruction questionnaire

Note. N: 76

Participants studied and revised the vocabulary in three different groups. Computer-assisted vocabulary instruction group studied the vocabulary in a computer environment, and the distribution of their vocabulary revision material was conducted according to the principles of spaced repetition. The teacher-led vocabulary instruction group studied the vocabulary in the classroom, and their vocabulary revision material was also distributed according to spaced repetition principles. The

control group studied the vocabulary in classroom environment, but the vocabulary revision material was not distributed according the principles of spaced repetition. They completed the revision material on the day following the vocabulary presentation session. Regarding the questionnaires the groups completed, the computer group responded to the Computer-Assisted Vocabulary Instruction Questionnaire, while the teacher and control groups responded to the Classroom-Based Vocabulary Instruction Questionnaire. The Classroom-Based Vocabulary Instruction Questionnaire was conducted with both the teacher group and the control group as both groups studied the target vocabulary in a classroom environment.

Two open-ended questions were asked to the respondents of the both questionnaires in order to explore the most effective and the least effective features of their corresponding vocabulary instruction environment (computer and classroom).

The students' responses to these two open-ended questions are presented in two sub-sections below. The first section presents the most frequently reported effective feature by all groups. The second section evaluates other features.

The most frequently reported strengths of the vocabulary instruction types

The first open-ended question asked the students about the strongest feature of the vocabulary instruction they received. Most students in all three groups reported the following three features as strengths in their vocabulary instruction: the pictures, sample sentences, and definitions. Furthermore, some of those students also reported that pictures in combination with sample sentences, or in combination with definitions, or all three combined together were effective features of their

corresponding vocabulary instruction type. The table below shows the most effective features reported by students by groups.

Table 22

Pictures, definitions and sample sentences as the strongest feature of respective groups.

Features	Teacher group:	Computer group	Control group
Pictures	12	11	6
Pictures and definitions	3	5	1
Definitions	2	-	-
Pictures and sample sentences	2	3	3
Pictures, sample sentences and definitions	1	-	4

Note. N: 76

As can be seen in the table, the provision of the pictures alone was reported most frequently as the strongest feature of the all vocabulary instruction conditions. Furthermore, pictures along with other types of information about words, were reported frequently as the strongest feature of the lessons. For example, five students from the computer assisted vocabulary instruction group reported that the pictures and the definitions together were most effective for them to learn the meanings of the words in the treatment material. For several students from the control group, provision of pictures, sample sentences and definitions together was most effective in learning the target words.

The over all interpretation of the responses indicates that all students in the three groups perceived the pictures as being the most helpful and most effective in learning vocabulary. Given that the students across groups indicated that pictures were the most effective way for them to learn vocabulary, an investigation was

conducted to determine whether or not the words taught with visual material were learned better than the words not taught with visual material.

In order to reveal if the students in all groups learned the target words with visually-supported material better, the number of the words learned through visually supported material and the number of the words learned with only textual materials were identified. It was found that, in all three groups, 15 target words were taught with visually-supported material while 16 words were taught with only textual material. Accordingly, the students' vocabulary gains for visually-taught words and the textually-taught words were calculated separately based on the data gathered from the Vocabulary Retention Test. A comparison of the textual- only words and visually-supported words was computed by running a series of paired samples t-tests. This comparison only involved within-subjects comparison. In other words, the vocabulary gains of groups were compared within themselves, not across groups. The table below shows all groups' vocabulary gains for the visually-supported words and the words with only textual information. The table also displays the results of four paired sample t-test results for within-subjects comparison.

Table 23

Vocabulary gains of groups for the visual words and the textual words

Group	N	Picture vocabulary gain	Textual vocabulary gain	Mean difference	T	Sig. (2-tailed)
Teacher	24	6.41	5.62	0.79	1.01	.323
Computer	33	5.34	4.91	0.43	1.30	.202
Control	19	4.96	2.89	2.07	2.91	.009
All subjects	76	5.58	4.63	0.95	2.77	.008

Note. N:76, T= t-test

As illustrated in the table above, for visually-taught words, the mean score of all subjects regardless of grouping factor is 5.58, for textually-taught words the mean score is 4.63 and the difference between two scores is significant at the level of $p < .05$. The results support the students' responses in terms of picture effectiveness. The words with visually-supported material were learned better by all subjects.

Regarding the teacher group who studied the same material as the other groups in the classroom and whose revision material was distributed based on the spaced repetition procedures, the mean score for the visual words was 6.41 and the mean score for the textual words was 5.62. The difference between these means was not significant at the level of $p < .05$. This result indicate that the target words with visual materials were not learned significantly better than the words with textual material by the teacher group.

Regarding the computer group who studied the same material in the computer environment, and whose vocabulary revision material was distributed according to the spaced repetition procedures, the mean score for the words taught with visual

material was 5.34, and the mean score for the words taught with only textual material was 4.91. the difference between these scores are not statistically significant at the level of $p < .05$. Based on these results, the computer group did not learn visually supported words significantly better than the words taught with only textual material.

Regarding the control group, who studied the vocabulary in the classroom similar to the teacher group, and whose vocabulary revision material was not distributed according to the spaced repetition procedures, the mean score for the words taught with visual material was 4.96 and the mean score for the words taught with textual material was 2.89. The difference between these two means was statistically significant at the level of $p < .05$. Based on the t-test result, the control group learned visually-supported words better than the words taught with textual material.

The results indicate that the impact of pictures on the vocabulary gains of the subjects in the computer group and the teacher group was not effective at a statistically significant level. However, the impact of pictures on the control group students was effective at a significant level. Significantly less vocabulary gain for the words with only textual material in the control group might be attributed to the fact that they studied the vocabulary revision material in a condensed manner without following the spaced repetition procedures.

In order to investigate the impact of the grouping factor on subjects' vocabulary gains for textually-taught and visually-taught words separately, two two-way ANOVA tests were run. This comparison involved between-groups comparison. One

two-way ANOVA was run to compare the groups' vocabulary scores for the words with visually supported words, and another two-way ANOVA was run to compare the groups' vocabulary scores for the words with only textual material. The results of the ANOVA tests are displayed in table 24 and 25.

In order to investigate the impact of the grouping factor on subjects vocabulary gains for visually-taught words, a two-way ANOVA test was run. The table below shows the ANOVA results and mean scores for all groups.

Table 24

Comparison of the groups' visually-supported vocabulary gains.

Group	N	Picture vocabulary gain	F	Sig.
Teacher	24	6.41	1.322	.273
Computer	33	5.34		
Control	19	4.96		
All subjects	76	5.58		

Note. N = number; F = variance *p < .05.

Although there is a difference in vocabulary gains of all groups, the difference is not significant at the level of $p < .05$ as the F score of 1.32 is not lower than .05. based on ANOVA results, all groups learned and retained similar number of words taught with visual material. This implies that grouping factor did not have a significant level of impact on the retention of the words taught with visual material.

In order to investigate the impact of the grouping factor on subjects vocabulary gains of the words taught with textual material, a two-way ANOVA test was run. The table below shows the ANOVA results and mean scores for all groups.

Table 25

Comparison of the groups' textually-supported vocabulary gains.

Group	N	Textual vocabulary gain	F	Sig.
Teacher	24	5.62	3.098	.051
Computer	33	4.91		
Control	19	2.89		
All subjects	76	4.63		

Note. N = number; F = variance *p < .05.

As can be seen in table 25, the teacher groups' mean for the words taught with textual material was 5.62. The computer groups' mean score was 4.91 and the control group's mean score was 2.89 for the words taught with textual material. The difference between the groups' means are not significant at the level of $p < .05$. The p value of .051 computed for the F score (3.098) of this comparison indicates a tendency toward a somewhat significant difference between groups. Although not a statistically significant difference between the groups might be generated by the control group scores as they learned the least number of words that were taught only with textual material.

An overall interpretation of the paired sample t-test and the ANOVA test seem to indicate that the students in the control condition remembered words with visual material as successfully as the other groups while they could not retain textual words as successfully as other groups. Since the control group received a treatment that was different in terms of the distribution of the revision material from other groups, the researcher concluded that these results imply that pictures can foster vocabulary retention as successfully as spaced repetition.

Other strong and weak features of the respective treatments in the study

Other strongest features stated by the students are reported separately for experimental groups as the responses varied to a great extent. Computer-assisted vocabulary instruction students' responses regarding the strongest features of their vocabulary instruction environment are displayed in table 26 below.

Table 26

Other strongest features of CAVI

Students responses	Frequency
Easy access to explanations of the words	8
I learned quickly	3
Repeating the words again and again	2
Individual study	1

Note. N: 33

As can be seen in table 26, the most frequently mentioned strongest feature of the CAVI was the easy access to explanations for the unknown target words in the reading text. Easy access to information about the target words as an inherent characteristic of the CAVI, was appreciated by many of the students in the computer-assisted vocabulary instruction condition.

As for the teacher-led vocabulary instruction group, the students did not report many other strong features of their vocabulary learning condition apart from pictures, definitions and sample sentences. Only two students stated that the vocabulary instruction sessions were enjoyable. As for the control group students, similar to the teacher-led vocabulary instruction group, they did not report different features of their instruction condition as the strongest feature. One student reported that the vocabulary instruction sessions were enjoyable. Another student reported that the

repeating the words many times was the strongest feature of the vocabulary instruction he/she received.

The second open-ended question explored perception of weakest features of the three vocabulary instruction conditions. The students were asked to write the weakest feature of their corresponding vocabulary instruction condition. The computer group students' responses are displayed in table 27 below.

Table 27

Weaknesses of CAVI

Students responses	frequency
Students did not take the class seriously	7
I could not use my time effectively	5
I could not learn the spelling	2
Time was too much	2
Unknown words in definitions	2
Definitions should be in Turkish too	2
Too much help	2
You were not able to ask questions to the computer	1

Note. N: 33

As shown in the table 27, the most frequently reported weakest feature of the computer-assisted vocabulary instruction was the students' inadequate attention to the vocabulary instruction in the computer environment. Seven students from the computer group stated that the students did not take the instruction seriously. The researcher also observed that some students were not studying the vocabulary instruction material. This might be due to the fact that the treatment instruction was not a component of the school curriculum. The second most frequently reported weakness of CAVI was students' ineffective use of time during CAVI sessions. This

might be due to some students' lack of familiarity with studying second language vocabulary in a computer environment.

As for the teacher-led vocabulary instruction, the students' responses to the item asking about the weakest features of the instruction they received are displayed in table 28.

Table 28

Weaknesses of classroom-based vocabulary instruction for teacher group

Students' responses	frequency
Too much time	3
Definitions were in English	2
Nobody took the lesson seriously	2
Too many repetitions	2
No picture some words	1

Note. N: 24

As shown in table 28, students in the teacher-led vocabulary instruction reported 5 types of weaknesses. However the frequencies for the weakest points are low. This result is supported by the teacher-led vocabulary instruction questionnaire. As mentioned in the discussion of the questionnaire, the students' responses to the items indicated that the whole instruction was considered as effective by a majority of the students.

As for the control group, the students in the control group also did not report very many weak features for their instruction condition. The weakest features of the vocabulary instruction for the control group students are displayed in table 29 below.

Table 29

Weaknesses of classroom-based vocabulary instruction for control group

Students' responses	Frequency
Too many words	2
Definitions were in English	2
too few sample sentences	1
Too little time	1

Note. N: 24

In this section, the strongest and the weakest features of the three vocabulary instruction conditions were presented. To summarize, among the features reported by the students, visual elements used in the treatment material were considered the most effective by a majority of the students regardless of their groups. Additionally, easy access to the information on the target words was the most effective feature of the computer assisted vocabulary instruction. Regarding the weakest features reported by groups, the students who learned the vocabulary in a classroom environment (teacher-led and the control group), did not report very many weak features for their corresponding conditions while the students who studied the vocabulary items in the computer environment reported various weaknesses. Among those weaknesses, the most frequently reported one include the lack of students' interest in the vocabulary instruction they received from computers and the students' inefficient use of time in CAVI sessions.

Conclusion

This study compared the effectiveness of computer-assisted vocabulary instruction with teacher-led vocabulary instruction and the effectiveness of spaced

repetition both in teacher-led instruction and computer-assisted vocabulary instruction. Additionally, the study explored the computer group students' attitudes toward the computer assisted vocabulary instruction classes, what the students felt about the effectiveness of these classes, and the strengths and weaknesses of the classes.

In order to investigate possible different effects of the teacher-led vocabulary instruction and computer-assisted vocabulary instruction in their vocabulary gains, the subjects took a vocabulary retention test as a pre- and a post-treatment test. None of the treatment types generated significantly different vocabulary gain in subjects' vocabulary.

In order to investigate the possible strengths and the weaknesses of the computer- assisted vocabulary instruction, a questionnaire was given. In spite of the limited available qualitative data, there is evidence that problematic areas include the feedback provision, time allocated for the vocabulary study in computer environment and students' varied learning experiences of using computers for vocabulary learning.

CHAPTER 5: CONCLUSION

Introduction

This study compared the effectiveness of computer-assisted vocabulary instruction with teacher-led vocabulary instruction and, the effectiveness of spaced repetition in both teacher-led vocabulary instruction and computer-assisted vocabulary instruction. Additionally, the study explored how the computer group students perceived the computer-assisted vocabulary instruction classes, what the students felt about the effectiveness of these classes, and the strengths and weaknesses of the classes.

Results

The main question of the study, whether students learn vocabulary better if they receive computer-assisted vocabulary instruction was not completely answered. In the classroom, the Teachers' presentation of the 31 target words took longer than the time spent by the computer-assisted vocabulary instruction subjects studying the same 31 target words. If time-on task is taken into account, the computer group studied the vocabulary presentation material in half the time of the teacher-led vocabulary instruction group, and yet the computer-assisted vocabulary instruction group gained a similar number of words as the teacher group. On the other hand, if time-on task is disregarded, the computer assisted vocabulary instruction did not yield significantly better results in vocabulary acquisition. The researcher considered taking the time-on

task factor into consideration while interpreting the results because the teacher-fronted instruction requires inherently more execution time than the computer-assisted instruction because of its self-pacing characteristic. In teacher-fronted instruction, students do not have the opportunity to skip known vocabulary items, to self-pace and to study the material at their own speed and within their own comprehension levels. Thus time on each vocabulary learning task is relatively short compared to time-on task in teacher-fronted instruction.

Another reason for a lack of significance could be the short length of time of the study. The fact that the vocabulary study was performed only for one reading text might have contributed to this similarity between the groups' vocabulary retention test scores.

Another question that prompted the study was whether the revision of vocabulary through spaced repetition procedures in CAVI would result in more vocabulary gain than vocabulary revision through spaced repetition in teacher-led vocabulary instruction. Again, based on the ANOVA results, the teacher group and the computer group gained almost the same number of words. Thus, differential impact of the computer environment and classroom environment on the spaced repetition procedures could not be determined.

Another point of comparison was whether the teacher and the computer group would perform better than the control group which did not follow spaced repetition procedures. The control group which did not follow the spaced repetition procedures did not perform any worse compared to the other two groups (teacher and computer) which studied the vocabulary revision material based spaced repetition procedures.

This inconclusive result might be due to the limited time allocated for this study as the studies on spaced repetition indicate that the effects of spaced repetition is greater as the time extends (Bahrick et al., 1993) If subjects could have been given the vocabulary retention test after a time interval, at least a two-week period, instead of immediately after their treatments, the effects of the spaced repetition could have been investigated more clearly.

Although not a research question of the study, the study seem to indicate that visual elements and spaced repetition procedures may have a similar positive impact on vocabulary retention. Two analysis results support this preliminary conclusion. One result comes from a within-group comparison of the vocabulary gains for the words taught with visual material, and the vocabulary gains for the words taught with only textual material. Based on the results of the paired sample t-test, the words taught with visual material and the words taught with only textual material were not learned any better by the teacher group or by the computer group, both of which followed the spaced repetition procedures. However, the control group which studied the vocabulary revision material in a condensed manner gained significantly fewer words taught with textual material than words taught with visual material.

Other evidence comes form two separate between-groups comparisons of the vocabulary gains for the words taught with visual material and the vocabulary gains for the words taught with only textual material. According to the ANOVA test computed to compare three groups in terms of their vocabulary gains for the words taught with visual material, all three groups performed similarly.

According to another ANOVA test computed to compare three groups' in terms of their vocabulary gains for the words taught with only textual material, three groups showed no statistically significant difference in terms of their vocabulary gains. However the F (variance) for the difference was .051, close to the significance p value of .05. The ANOVA results computed to compare three groups in terms of their vocabulary gains for the words taught with only textual material imply that the teacher group and the computer group which followed the spaced repetition procedures learned these words (textual) better when compared to the control group which did not follow the spaced repetition procedures. This conclusion should be approached cautiously as the ANOVA test did not provide a significant level difference between groups. The question as to whether or not pictures are as effective as spaced repetition procedures might be investigated by a future study that is especially designed to investigate this particular preliminary and tentative conclusion.

Another research question of the study concerns the strengths and the weaknesses of CAVI. The answer to this question was explored through the computer assisted-vocabulary instruction questionnaire conducted with the computer group students. An examination of the questionnaire revealed that inclusion of visual elements in multimedia annotations was perceived as the most effective feature of CAVI. The examination of the questionnaire also indicated that there were two important weakness of the CAVI designed for this study. These weaknesses included the inefficacy of computer-provided feedback and the students' ineffective use of time. The inefficacy of the computer-provided feedback can be attributed to the lack of personalized feedback provided by the computers for each individual student.

Regarding the students' inefficient use of time in a computerized vocabulary learning task, the data from the questionnaire indicate that the majority of the students studying language in a computer environment did not have the skills or strategies to use the time allocated for a learning task effectively and usefully. This result might be due to the novelty of such a learning experience. Assuming that CAVI is a component of the school curriculum and students are exposed to such a learning approach repeatedly, they can be better able to develop skills and strategies to learn in a computer environment effectively.

Implications

The results of this study showed that language learners can gain a basic recognition knowledge of words through multimedia annotations. Integrating CAVI in language programs is therefore worthwhile as it enables classroom time to be sent on other activities. Basic recognition knowledge can be further developed into a larger and more active vocabulary knowledge through communicative activities in the classroom.

CAVI can only be effective if students are equipped with skills to study individually and use their time effectively and usefully. Without increased experience, students can not develop suitable skills to study individually and use their time effectively in a computer environment where there is less teacher control compared to classroom environment. Language programs need to adopt a step- by- step approach toward the use of CAVI tools so that students can develop the needed skills gradually without anxiety.

Deliberate training of language learners on how to use CAVI materials and programs also seems to be essential. Without initial training, learners may get lost in the CAVI material and may lose their motivation and positive attitudes toward CAVI tools and facilities.

Training language teachers is as important as training language learners. CAVI facilities can only be effective and helpful in the hands of skillful teachers. To gain skills of using CAVI tools, teachers may need training from professionals. Training sessions that will include both the use of particular CAVI programs and pedagogical issues could be helpful. Teachers need to be aware of the potential of CAVI as a learning tool so that CAVI can be used advantageously to promote efficient language learning.

The use of visual elements in second vocabulary instruction both in the classroom and computer environment provides more effective vocabulary retention as visual elements foster vocabulary retention and seem to motivate students. Additionally, spaced repetition is as effective as the visual elements for vocabulary retention. If visual elements are not available, textual information on words can be studied by language learners using spaced repetition procedures instead of reviewing newly-learned vocabulary by massive repetition at one time.

Limitations of the study

The study compared the effectiveness of CAVI with spaced repetition with teacher-led vocabulary instruction by including two experimental groups. The study also included a control group to explore the effects of spaced repetition. However, none of the conditions generated significantly more vocabulary gains in students'

vocabulary knowledge growth. This might be due to the limited time allocated for the study.

The study period was five-lesson hours on five different days within 20 days. This period was too short to be definitive in predicting the effect of computer-assisted vocabulary instruction and spaced repetition. A longer time could have been allocated to explore the impact of the CAVI and the spaced repetition procedures on vocabulary acquisition. Furthermore, a delayed post-test would have provided more data on the retention level of the three groups. The researcher intended to give a retention test to all groups thirty days after administration of the post-test in order to find out the retention rate of groups over time. But the arrangements could not be fulfilled by the teachers of all groups due to program restrictions and exams at the school.

As for the qualitative data, a learner-behavior tracking device would have provided valuable information on students' effective use of the multimedia annotations. However, a learner-behavior tracking device was not embedded in the CAVI material as the study material was written in a HTML editor Dreamweaver MX (2004), which does not possess the facilities to integrate such a device.

Implications for further research

The question as to whether or not pictures are as effective as spaced repetition procedures might be investigated by a future study with a four-group research design: (1) vocabulary instruction with visual material and without spaced repetition, (2) vocabulary instruction with textual material and without spaced repetition, (3)

vocabulary instruction with visual material and with spaced repetition, (4) vocabulary instruction with textual material and with spaced repetition.

This study indicated that visual materials are effective in vocabulary learning. Based on this result, another aspect to be investigated by a future study might be the methods by which non-concrete items can be visualized or represented by non-textual material both for classroom-based and computer-based vocabulary acquisition.

In order to investigate the effectiveness of CAVI through qualitative research procedures, a future study with two treatments and only one experimental group can provide valuable insights. A within-subject research design in which the same students are exposed to both CAVI and classroom-based vocabulary instruction can ensure a true comparison of two treatment conditions. In such a study, interviews with participants along with a vocabulary test could provide valuable information regarding the classroom-based and computer-assisted vocabulary instruction.

Conclusion

This study compared the effectiveness of computer-assisted vocabulary instruction with teacher-led vocabulary instruction and the effectiveness of spaced repetition in both teacher-led vocabulary instruction and computer-assisted vocabulary instruction. Additionally, the study explored how the computer group students perceived the computer-assisted vocabulary instruction classes, what the students felt about the effectiveness of these classes, and the strengths and weaknesses of the classes.

Neither computer group nor the teacher group showed significantly more vocabulary gains. Thus, computer assisted vocabulary instruction was found to be as effective as teacher-led vocabulary instruction. However, the uncontrolled time-on task in this study remains a controversial point. If time-on task is taken into account, the computer group studied the vocabulary presentation material in half the time of the teacher-led vocabulary instruction group, and yet the computer-assisted vocabulary instruction group gained a similar number of words as the teacher group. On the other hand, if time-on task is disregarded, the computer assisted vocabulary instruction did not yield significantly better results in vocabulary acquisition.

The impact of the spaced repetition procedures on the vocabulary gains of both the teacher group and the computer group was also not at a significant level. However, when the teacher group and the computer group were compared with the control group in terms of their vocabulary gains for the words taught with textual words, textual words appeared to be learned better by teacher and computer groups.

Regarding the strengths and the weaknesses of CAVI, inclusion of visual elements in multimedia annotations was perceived as the most effective feature of CAVI. Weaknesses of CAVI included the inefficacy of computer-provided feedback and the students' ineffective use of time.

REFERENCE LIST

- Adobe Photoshop 7.0 [Computer Software]. (2002). Mountain View, CA: Adobe Systems.
- Chun, D. M. & Plass, J. L. (1996). Effects of multimedia annotations on vocabulary. *Modern Language Journal*, 80, 183-198.
- Baddeley, A. D. (1982). *Memory: A user's guide*. London: Penguin
- Bahrack, H. P. & Bahrack, L. E. & Bahrack, A. S. & Bahrack, P. E. (1993). Maintenance of foreign language vocabulary and the spacing effect. *Psychological Science*, 4, 316-321.
- Brown, J. D. (2001). *Using surveys in language programs*. Cambridge: Cambridge University Press.
- Carstairs-MacCarthy, A. (2002). *An introduction to English Morphology*. Edinburg: Edinburg University Press.
- Clark, R. E. (1983). Reconsidering research on learning from media. *Review of Educational Research*, 53, 455-459.
- Craik, F. I. M. (2002). Levels of processing: Past, present.....and future? *Memory*, 10, 305-318.
- Coady, J. (1998). L2 vocabulary acquisition through extensive reading. In J. Coady and T. Huckin (Eds.), *Second Language Vocabulary Acquisition*. (pp. 225-237). Cambridge: Cambridge University Press.
- Cobb, T. (1999). Breadth and depth of lexical acquisition with hands-on concordancing. *Computer Assisted Language Learning*, 12, 345-360.
- Cohen, L. & Manion, L. (1996). *Research methods in education*. London. Routledge.
- Davey, D. & Jones, K. G. & Fox, J. (1995). Multimedia for language learning: Some course design issues. *Computer Assisted Language Learning*, 8, 31-41.
- Davis, J. N. (1989). Facilitating effects of marginal glosses in foreign language reading. *The Modern Language Journal*, 73, 41-48.

- Dreamweaver MX [Computer Software]. (2004). San Francisco, CA: Macromedia, Inc.
- Duyar, M. S. (2005, July). Mega hafiza. Available ftp: www.megahafiza.com.tr/urunler/test-eng.htm.
- Ellis, N. (1995). The psychology of foreign language vocabulary acquisition: Implications for CALL. *Computer Assisted Language Learning*, 8, 103-128.
- Ellis, N. (2001). Vocabulary acquisition: Word structure, collocation, word class, and meaning. In N. Schmitt and M. McCarthy (Eds.), *Vocabulary: Description, acquisition, and pedagogy* (pp.122-139) Cambridge: Cambridge University Press.
- Gé Stoks (1993). Integrating new technologies into the modern languages curriculum. *CALICO Journal*, 11, 76-93. Retrieved from: <http://calico.org/>
- Goodfellow, R. (1994). Design principles for computer aided vocabulary learning. *Computers and Education*, 23, 53-62.
- Goodfellow, R. & Laurillard, D. (1994). Modeling learning processes in lexical CALL, *CALICO Journal*, 11, 19-46. Retrieved from: <http://calico.org/>
- Groot, P.J. M. (2000). Computer assisted second language vocabulary acquisition. *Language Learning and Technology*, 4, 60-81.
- Hatch, E. & Lazaraton, A. (1991). *Research manual: Design and statistics for applied linguistics*. New York: Newbury House.
- Heatley, A. and Nation, P. (1994). Range. Victoria University of Wellington, NZ. [Computer program, available at <http://www.vuw.ac.nz/lals/>.] Adapted for WWW by T. Cobb as Vocabprofile [<http://www.lex tutor.ca/vp/>].
- Hulstijn, J. H. (1993). When do foreign language readers look up the meaning of unfamiliar words? The influence of task and learner variables. *The Modern Language Journal*, 7, 139-147.
- Hulstijn, J. H (1998). Mnemonic methods in foreign language vocabulary learning. In J. Coady and T. Huckin (Eds.), *Second Language Vocabulary Acquisition* (pp.203-223). Cambridge: Cambridge University Pres.

- Hulstijn, J. H., Hollander, M., Greidanus T. (1996). Incidental vocabulary learning by advanced foreign language students: The influence of marginal glosses, dictionary use, and re-occurrence of unknown words. *The Modern Language Journal*, 80, 327-339.
- Krashen, S. (1989). We acquire vocabulary and spelling by reading: Additional evidence for the input hypothesis. *The Modern Language Journal*, 73, 440-464.
- Kommers, P. A. M., Grabinger, S., Dunlap, J. C. (1996). *Hypermedia learning environments: Instructional design and integration*. New Jersey: Lawrence Erlbaum.
- Kozma, R. B. (1991). Learning with media. *Review of Educational Research*. 61, (2), 179-211.
- Lomicka, L. L. (1998). "To gloss or not to gloss": An investigation of reading comprehension on line. *Language Learning and Technology*, 1, 41-50.
- Lyman-Hager M. A. & Davis J. F. (1996). The case for computer-mediated reading: Une vie de boy. *The French Review*, 69, 775-792.
- Maera, P. (2001). Towards a new approach to modeling vocabulary acquisition. In N. Schmitt and M. McCarthy (Eds.), *Vocabulary: Description, acquisition, and pedagogy* (pp.109-121). Cambridge: Cambridge University Press.
- Mayer, R. E. (1997). Multimedia learning: Are we asking the right questions? *Educational Psychologist*, 32, 1-19.
- Melka, F. (2001) Receptive vs. productive aspects of vocabulary. In N. Schmitt and M. McCarthy (Eds.), *Vocabulary: Description, acquisition, and pedagogy* (pp.84-102).Cambridge: Cambridge University Press.
- Nation, I.S.P. (2001). *Learning vocabulary in another language*. Cambridge: Cambridge University Press.
- Nation, I. S. P. & Waring, R. (2001). Vocabulary size, text, text coverage and word lists. In N. Schmitt and M. McCarthy (Eds.), *Vocabulary: Description, acquisition, and pedagogy* (pp.6-19). Cambridge: Cambridge University Press.

- National Geographic Journal website. (2005, January). Retrieved from:
http://news.nationalgeographic.com/news/2005/01/0111_050111_tsunami_sumatra.html
- Oxford Advanced Learner's Dictionary of Current English*, (6th edition). (2000).
 Oxford: Oxford University Press.
- Oxford English Dictionary* (2005). Oxford: Oxford University Press.
- Plass, J. L., Chun, D. M., Mayer, R. E., Leutner, D. (1998). Supporting visual and verbal learning preferences in a second-language multimedia learning environment. *Journal of Educational Psychology*, 90, 25-36.
- Pussack, J. P. & Otto, S. K. (1997). Taking control of Media. In M. D. Bush. (Eds.), *Technology-enhanced language learning* (pp.1-46). Chicago: National Textbook Company
- Read, J. (2000). *Assessing vocabulary*. Cambridge: Cambridge University Press.
- Roby, W. B. (1999). What's in a gloss. *Language Learning and Technology*, 2, 94-1001.
- Schmitt, N. & Schmitt, D. (1995). Vocabulary notebooks: Theoretical underpinnings and practical suggestions. *ELT Journal*, 49, 133-143.
- Schmitt, N. (2002). *Vocabulary in language teaching*. Cambridge: Cambridge University Press.
- Skehan, P. (1998). *A cognitive approach to language learning*. Oxford: Oxford University Press.
- Sökmen, A. J. (2001). Current trends in teaching second language vocabulary. In N. Schmitt and M. McCarthy (Eds.), *Vocabulary: description, acquisition, and pedagogy*. (pp.237-257). Cambridge: Cambridge University Press.
- SpeechPlugin [Computer Software]. (1996) Menlo Park, CA: DirectXtras Inc.
- Svenconis, D. j. , Kers, S. (1995). Investigating the teaching of second language vocabulary through semantic mapping in a hypertext environment. *CALICO Journal*. 12, 33-57. Retrieved from: <http://calico.org/>
- Tsutsui, M. (2004). Multimedia as a means to enhance feedback. *Computer Assisted Language Learning*, 17, 377-402.

- Van de poel, K & Swanepoel, P (2003). The theoretical and methodical pluralism in designing effective lexical support for CALL. *Computer Assisted Language Learning*, 16, 173-211.
- Wesche, M. B. & Paribakht, T. S. (2000). Reading based exercises in second language vocabulary learning: An introspective study. *The Modern Language Learning Journal*, 84, 196-213.
- Wikipedia online encyclopedia (2005, July). Retrived from:
http://en.wikipedia.org/wiki/Flesch-Kincaid_Readability_Test).
- Zahar, R., Cobb, T., Spada, N. (2001). Acquiring reading through reading: Effects of frequency and contextual richness. *The Canadian Modern Language Review*, 57, 541-572.

APPENDICES

Appendix A

Name:

Class:

Date:

COMPUTER-ASSISTED VOCABULARY INSTRUCTION QUESTIONNAIRE

SECTION 1: BACKGROUND INFORMATION

This section of the questionnaire aims to investigate your background information related to computer and internet experiences. Please **circle** the option that best describes your experience.

1. Was this class your first experience with computers?

A-YES

B-NO

2. Do you use internet?

A- Never B- Barely C- Sometimes D-Very often E- All the time

3. Please rate how well you can browse web pages

I do not know how to do it.	I can do it with difficulty	I can do it with a little difficulty	I can do it easily	I can do it very easily.

4. Have you ever used computers for learning an educational subject?

A-YES

B-NO

5. How familiar are you with using computers in educational subject learning.

A-Very Unfamiliar B-Unfamiliar C- Barely Familiar D- Familiar E- Very Familiar

- 6- Have you ever used computers for learning English and its vocabulary?

A-YES

B-NO

6. How familiar are you with using computers for learning English?

A-Very Unfamiliar B-Unfamiliar C- Barely Familiar D- Familiar E- Very Familiar

8. How familiar are you with using computers for English vocabulary learning?
A-Very Unfamiliar B-Unfamiliar C- Barely Familiar D- Familiar E- Very Familiar

SECTION 2: STUDENTS' PERCEPTIONS ABOUT COMPUTER-ASSISTED VOCABULARY INSTRUCTION

This section of the questionnaire is to learn your opinions about computer-assisted vocabulary instruction. Please *circle* the answer which best shows your opinion.

9. How are your feelings about using computers for English language learning.
A-Very Negative B- Negative C-Neutral D- Positive E- Very Positive
10. How are your feelings about using computers for English vocabulary learning.
A-Very Negative B- Negative C-Neutral D- Positive E- Very Positive
11. I liked the immediate feedback that I received from the computer program.
A- Strongly Disagree B- Disagree C-Uncertain D- Agree E- Strongly Agree
12. While I was using the vocabulary program, I was not certain what to do and feel I wasted a lot of time.
A- Strongly Disagree B- Disagree C-Uncertain D- Agree E- Strongly Agree,
13. I liked the computer program because it let me work at my own speed independently.
A- Strongly Disagree B- Disagree C-Uncertain D- Agree E- Strongly Agree,
14. I liked the computer program because I was able to practice as many times as I wanted.
A- Strongly Disagree B- Disagree C-Uncertain D- Agree E- Strongly Agree,
15. I liked the computer program because I was able to study vocabulary links as long as I wanted .
A- Strongly Disagree B- Disagree C-Uncertain D- Agree E- Strongly Agree
16. I was confident in using the computer program because it was similar to web pages that I use on the internet.
A- Strongly Disagree B- Disagree C-Uncertain D- Agree E- Strongly Agree
17. I used all the vocabulary links usefully.
A- Strongly Disagree B- Disagree C-Uncertain D- Agree E- Strongly Agree,

18. While learning the words in the reading text, the sample sentences, pictures and definitions were enough and I did not need further help.

A- Strongly Disagree B- Disagree C-Uncertain D- Agree E- Strongly Agree

19. When I had difficulty while doing the practice exercises, the help and the clues from the computer program were enough.

A- Strongly Disagree B- Disagree C-Uncertain D- Agree E- Strongly Agree

20. I liked the computer program because I was learning without a teacher.

A- Strongly Disagree B- Disagree C-Uncertain D- Agree E- Strongly Agree

21. I was bored by the time I spent at the lab using the vocabulary program.

A- Strongly Disagree B- Disagree C-Uncertain D- Agree E- Strongly Agree

22. I learned the vocabulary quickly and felt then I had nothing to do.

A- Strongly Disagree B- Disagree C-Uncertain D- Agree E- Strongly Agree

23. The sample sentences, definitions of words and pictures were useful but it was unnecessary to present them via a computer program.

A- Strongly Disagree B- Disagree C-Uncertain D- Agree E- Strongly Agree

24. While learning the words at the computer lab, enough time was not provided for me to learn the words effectively.

A- Strongly Disagree B- Disagree C-Uncertain D- Agree E- Strongly Agree

25. I did not like the computer program because teacher help was unavailable.

A- Strongly Disagree B- Disagree C-Uncertain D- Agree E- Strongly Agree

SECTION 3: OPEN ENDED QUESTIONS:

26. What was the strongest feature of the vocabulary instruction you received?

27. What was the weakest feature of the vocabulary instruction you received?

Appendix B

Name:

Class:

Date:

CLASRROOM-BASED VOCABULARY INSTRUCTION QUESTIONNAIRE

SECTION 1: STUDENTS' PERCEPTIONS ABOUT THE TEACHER-LED VOCABULARY INSTRUCTION.

This section of the questionnaire is to learn your opinions about computer-assisted vocabulary instruction. Please *circle* the answer which best shows your opinion.

1. I was able to learn the words in the text easily with teacher help.
A- Strongly Disagree B- Disagree C-Uncertain D- Agree E- Strongly Agree
2. I found the definitions, pictures and sample sentences given by the teacher helpful.
A- Strongly Disagree B- Disagree C-Uncertain D- Agree E- Strongly Agree
2. When I was learning the target words, the definitions of the target words, the pictures and the sample sentences were enough. I did not need extra information.
A- Strongly Disagree B- Disagree C-Uncertain D- Agree E- Strongly Agree
4. I was bored by the time I spent learning the target words as the teacher spent too much time for presenting them.
A- Strongly Disagree B- Disagree C-Uncertain D- Agree E- Strongly Agree
5. While we were repeating and practicing the target words, the feedback and the clues my teacher provided were enough.
A- Strongly Disagree B- Disagree C-Uncertain D- Agree E- Strongly Agree
6. How familiar are you with the technique that your teacher used to teach the target words?
A-Very Unfamiliar B-Unfamiliar C- Barely Familiar D- Familiar E- Very Familiar

SECTION 2: OPEN ENDED QUESTIONS:

7. What was the strongest feature of the vocabulary instruction you received?

8. What was the weakest feature of the vocabulary instruction you received?

Appendix C

The Reading Text

***Tsunami Eyewitness Account by National Geographic Photographer
Chris Rainier in Banda Aceh, Indonesia
for National Geographic News
January 11, 2005***

Two weeks after the Southeast Asian tsunami swamped the Indonesian city of Banda Aceh, thousands of bodies still cover the area. Looters are picking through the debris, and survivors, still in shock, wait for medical help, according to National Geographic photographer Chris Rainier. Rainier phoned in his first-person account from Banda Aceh yesterday.

Transcription of Rainier's Report, Filed by Telephone Yesterday:

It's day 15 [January 10, 2005] since the disaster, and still there are vast areas where dead bodies can be seen lying around. Just cleaning up, picking up the bodies, remains the biggest challenge.

The medical situation is just as daunting. Hundreds of thousands of survivors are refugees, living in makeshift camps wherever you go. A lot of relief agencies are trying to get in here to set things up. But the logistics remain a nightmare.

Are the emergency supplies of food and medicine getting through to the people?

Food and medical aid is arriving, and it is getting to the survivors. An infrastructure is being setting up here in Banda Aceh, but the needs are huge. We still see a lot of people with broken bones that have not received treatment. We see people with deep lacerations that have been covered with a dirty cloth.

It's going to be interesting to see how the massive amount of money raised in the countries all around the world. So many people are here and so much assistance is coming in. Getting it out to all the places and all the people who need it is a problem.

Then the medical assistance needs to move beyond treating the most urgent cases to treating broken bones and deep wounds. People are dying because they are unable to get this basic medical attention.

How are the survivors holding up?

The survivors show no emotion in their eyes. They're still in shock. Thousands of people who fled into the hills for safety are streaming back every day. Because they have heard that there is food and medical help here.

But it remains an ordeal for them to come near the ocean. People are still traumatized. Many will not go down to the beach. One driver I hired absolutely refused to go down to the beach. They're terrified of the ocean. Picking up the bodies is a priority. People are spooked by all the bodies and the dead. They believe a lot of spirits are flying around. The dead bodies must be buried, not only for health reasons but also for spiritual reasons and to be able to start to get beyond the trauma.

A lot of looting is going on. The military is not very concerned about it. People are picking through the debris and we see many people carrying off household goods. Trucks have been coming in and towing off cars. Motorcycles are loaded up with stereos and other valuables.

There are many children here, many without adults to care for them. The government is obviously concerned that the children could be carried off for the sex trade in Thailand, but I have not seen any roadblocks so I don't know if this is happening and whether anyone is stopping it. Child trafficking is a big issue in this part of the world. There are thousands and thousands of children here without parents.

Not everything is hopeless. Each day I come across scenes of hope. People are helping one another and there is a great spirit of generosity. Many local people have remarked that the tragedy has brought the people together. It is amazing and touching to see.

Appendix D

Reading comprehension questions

COMPREHENSION QUESTIONS:

1. **What kind of text is it?**
 - A. **A transcription of a telephone call.**
 - B. A transcription of a survivor's speech in Banda Aceh
 - C. A transcription of a television report.
 - D. A transcription of a government speaker's speech.
2. **The text primarily deals with.....**
 - A. **All the issues below.**
 - B. The medical situation in Banda Aceh.
 - C. Problems that parentless children have in Banda Aceh
 - D. The physiological state of survivors in Banda Aceh.
3. **The text does not mention about.....**
 - A. Where survivors live.
 - B. **Which countries have send assistance.**
 - C. Dangers for parentless children
 - D. The looters who are picking up valuable goods in debris.
4. **Which of the following best describe the health conditions in Banda Aceh?**
 - A. All survivors have not had any medical treatment yet. They all wait for medical treatment.
 - B. Survivors have been receiving physiological treatment.
 - C. **Some survivors started to get medical treatment but all survivors have not received treatment.**
 - D. All survivors have received basic medical treatment.
5. **Survivors.....**
 - A. are not effected by dead bodies around.
 - B. are full of emotions
 - C. are afraid of relief workers.
 - D. **are still afraid of going near the sea.**
6. **Why is the government concerned about the children without parents?**
 - A. The government is worried because there aren't any houses for them to live.
 - B. The government is worried because children can die because of hunger.
 - C. The government is worried because parentless children may involve in crime in the future.
 - D. **The government is worried because children can be used in sex trade in Thailand.**

7. Which of the following is true according to the text?
- A. The army took precautions against looting and child trafficking.
 - B. Dead bodies should be picked immediately for both medical and psychological reasons.**
 - C. People are not afraid of sea. They easily go near the ocean.
 - D. All survivors received emergency supplies and medical treatment.
8. Which of the following is incorrect according to the text?
- A. Survivors live in makeshift camps.
 - B. a new infrastructure has been completely rebuilt by relief agencies.**
 - C. Thousands of dead bodies are still around and survivors are afraid of them.
 - D. A lot of assistance is coming in from countries from all over the world.
9. Dead bodies should be picked up immediately because.....
- A. Children are afraid of dead bodies.
 - B. Dead bodies may cause illnesses among the people there and survivors think that spirits of the dead are in the air.**
 - C. Dead bodies may cause illnesses and more people may die.
 - D. People can not go down to beach where there are still a lot of dead bodies.
10. We can infer from the passage that.....
- A. Food and medical supplies are received by all survivors.
 - B. Relief agencies are not welcomed by survivors.
 - C. There is no more need for food and medical supplies.
 - D. People still die because they do not receive basic medical help.**

Appendix E

Name:

Class:

Date:

VOCABULARY RETENTION TEST

Explanations

In this test, you are expected to match the given three definitions with the correct words. You have 6 words but only three of them match with the given definitions. When you think one of the definitions matches with a word, you need to write the word in the middle column next to the corresponding definition. Before you start answering the test, please look at the examples below.

Before you answer , the question will look like the following:

Set 1:

Words	Answer	Definitions
happy		easy
school		To say something very loudly
shout		test
exam		
simple		
sorry		

You will write your answers here.

After you write your answers , the question will look like the following:

Set 1:

Words	answers	Definitions
happy	simple	easy
school	shout	To say something very loudly
shout	exam	test
exam		
simple		
sorry		

Correct answers are written here

Set 1:

Words	Answers	Definitions
Debris		Rubbish or garbage that is left somewhere after a disaster.
Theft		The secret buying and selling of illegal goods.
Trafficking		A written or spoken description of an event.
Figure		
Account		
Debt		

Set 2:

Words	Answers	Definitions
Dormitory		Building that is low quality and used temporarily by survivors because the permanent houses are not available.
Stationary		Things such as food, medicines, fuel, etc. that are needed immediately for living by a group of people.
Emergency Supplies		The basic systems and services that a country or organization needs in order to work properly, for example roads, railways, banks etc.
Plaster		
Makeshift camp		
Infrastructure		

Set 3:

Words	Answers	Definitions
Flee		To fill or cover with a lot of water.
Consider		To leave somewhere very quickly, in order to escape from danger.
Remain		To still need to be done, or to be dealt with.
Claim		
Infect		
Swamp		

Set 4:

Words	Answers	Definitions
Anticipation		A subject or problem which people are thinking and talking about.
Medication		a cut
Logistics		The careful organization that is needed to make a complex plan successful when a lot of people and equipment is involved
Laceration		
Issue		
Hassle		

Next Page

Set 5:

Words	Answers	Definitions
Eyewitness		Someone who has seen something such as a crime happen, and is able to describe it afterwards.
Resolution		A difficult or unpleasant experience.
Ordeal		Something that you think is more important than other things and should be done first.
Priority		
Independence		
Prospect		

Set 6:

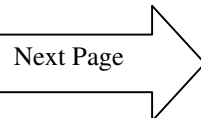
Words	Answers	Definitions
Fairy		A person who steals things from shops, buildings after a disaster.
Public property		An organization that provides help, food, money, medicine and shelter for survivors of a disaster.
Border		Ghost
Spirit		
Relief agency		
looter		

Set 7:

Words	Answers	Definitions
Spook		To frighten a person or an animal.
Mention		To pull a car or boat behind another vehicle, using a rope or chain.
Adopt		More or greater than a particular amount, level, or limit.
Beyond		
Tow		
Clash		

Set 8:

Words	Answers	Definitions
Destruction		An exact written copy of a speech or a telephone call.
Schema		Small objects that are worth a lot of money, especially small personal things such as jewelry, cameras, etc.
Transcription		Human feelings such as fear, love, anger or jealousy.
Valuables		
Emotions		
Terms		



Set 9:

Words	Your Answers	Definitions
Unlikely		Worried
Concerned		Very large, heavy and solid.
Confused		Used to say that a particular situation or fact is easy to see or understand.
Massive		
Thorough		
Obviously		

Set 10:

Words	Answers	Definitions
Spiritual		Relating to deep feelings and beliefs especially religious beliefs.
Weary		Making you feel worried because it is difficult and it needs hard work.
Distinctly		Being unable to think and work normally because you are in shock.
Traumatized		A medical method of curing someone who is ill or injured.
Daunting		
Treatment		
Existence		
Enhancing		

The test is over

Appendix F

A sample of the visual annotations

Tow: *Verb*

Definition: to pull a car or boat behind another vehicle, using a rope or chain.

Sample sentence:

* The police had towed his car away because it was blocking the road.



In this Picture, a yellow truck is towing off a car.

Appendix G

A sample of the textual annotations

Account: *Noun*

Definition: A written or spoken description of an event.

Sample sentences:

- * A man gave the police a full account of the car accident. (He described how the accident happened.)
- * The diaries had detailed accounts of the writer's experiences during World War 1.
- * There were several different accounts of the story in the newspapers.