Effects of the Presentation Mode of Multimedia Annotations on L2 Reading Comprehension and Incidental Vocabulary Learning

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ABSTRACT

Emine TÜRK, Effects of the Presentation Mode of Multimedia Annotations on L2 Reading Comprehension and Incidental Vocabulary Learning

This study aims at exploring the effects of presentation mode of multimedia annotations on reading comprehension and incidental vocabulary learning of intermediate level learners of English.

There were two types of presentation mode: simultaneous and successive. In the simultaneous mode, learners received verbal (definitions) and visual (pictures) annotations at the same time by just one click while in the successive mode, annotations were presented one after another. 82 intermediate level learners of English at a state high school were required to read an annotated expository text with a view to comprehending it. Learners were administered a prior knowledge test one day before the treatment to ensure that they did not differ in terms of topical knowledge. Participants were randomly assigned to groups and treatment conditions. They were given reading comprehension and vocabulary tests immediately after reading. Data were collected using a tracking tool and analyzed using a multivariate analysis of variance (MANOVA).

Results indicated that the group that received both types of annotations simultaneously performed better on multiple choice reading comprehension test while no significant difference was found between the groups in recall. Vocabulary tests revealed similar results. Simultaneous group scored higher on tests of form recognition, meaning production and active meaning recognition but passive

meaning recognition. No significant differences were observed between the performances of the groups on bilingual passive meaning recognition test.

Results were in line with the contiguity principle of Generative Theory of Multimedia Learning according to which presenting verbal and visual information at the same time results in better learning. The rationale behind that assertion is that simultaneous presentation makes it easier for learners to build connections between verbal and visual mental representations as they are held in the working memory at the same time, which reduces cognitive load. Therefore it is suggested that learners could benefit from simultaneous presentation of information in dual mode as it facilitates reading comprehension and incidental vocabulary learning.

ÖZET

Emine TÜRK, Multimedya Açıklayıcı Notlarının Sunu Modunun İkinci Dilde Okuduğunu Anlama ve Rastlantısal Kelime Öğrenme Üzerine Etkileri

Bu tez multimedya açıklayıcı notlarının sunu modunun ikinci dilde okuduğunu anlama ve rastlantısal kelime öğrenme üzerine etkilerini araştırmayı amaçlamaktadır.

Sunu modu iki çeşittir: eş zamanlı ve ard arda. Eş zamanlı sunu modunda, öğrenciler hem sözel (kelime tanımları) hem de görsel (resimler) açıklayıcı notları tek bir tıkla aynı anda alırken ard arda sunu modunda açıklayıcı notlar birbiri ardına seçilebilecek şekilde sunulmuştur. Bir devlet lisesinde okuyan 82 orta seviyede ingilizce bilen öğrencilerin anlama amacıyla bir okuma parçasını okuması istenmiştir. Uygulamadan bir gün önce öğrencilere konuyla ilgili bilgileri açısından aralarında fark olmadığından emin olmak için ön bilgi testi uygulanmıştır. Katılımcılar gruplara ve uygulama durumlarına rastgele atanmıştır. Okumanın hemen ardından okuduğunu anlama ve kelime testleri verilmiştir. Veriler bir izleme aracı yardımıyla toplanmış ve çoklu varyans analizi kullanılarak incelenmiştir.

Her iki açıklayıcı notu aynı anda alan grup çoktan seçmeli okuma anlama testinde daha iyi performans gösterirken, iki grup arasında okuduğunu hatırlama testinde bir fark bulunmamıştır. Kelime testleri benzer sonuçlar vermiştir. Eş zamanlı grup, pasif anlam tanıma testi hariç, biçim tanıma, anlam üretme ve aktif anlam tanıma testlerinde daha yüksek skorlar elde etmiştir. İki dilli pasif anlam tanıma testinde grupların performansları arasında önemli bir fark gözlemlenmemiştir.

Sonuçlar Mayer'in Multimedya Öğrenme Teorisinin sözel ve görsel bilgiyi aynı anda sunmanın daha iyi öğrenmeyi sağlayacağını ileri süren *eş zaman prensibine* uygundur. Bu iddianın temeli eş zamanlı sunumun sözel ve görsel bilginin aynı anda kısa süreli bellekte bulunmasını sağlaması ve böylece öğrencilerin iki bilginin zihinsel temsilleri arasında bağlantı kurmasını kolaylaştırması ve bunun da bilişsel yükü azaltmasıdır. Bu nedenle, okuduğunu anlamayı ve rastlantısal kelime öğrenmeyi kolaylaştırdığı için, öğrencilerin iki farklı modda sunulan bilgiyi eş zamanlı almalarının öğrenmelerine katkıda bulunacağı ileri sürülmüştür.

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CHAPTER I

INTRODUCTION

It has been one of researchers' main concerns to study the characteristics and requirements of supportive learning environments learners can benefit from. Influence of media is one such area researchers are interested in. Traditionally, the quest was for the medium that would result in better learning. Studies were conducted using different mediums to teach the same thing. Although methodologies were not without their flaws (Kozma, 1991), results usually indicated no significant differences between the mediums employed (Clark, 1983; Clark & Craig, 1992). In his meta-analysis, Clark (1983) argued that (multi)media does not make a difference in learning. He asserted that if there were any differences in the learning gains, they were due to teaching methods employed or the novelty effect the medium created. On the other hand, researchers like Kozma (1991) and Mayer (1997) pointed out that it is futile to investigate if one medium is better than the other. Kozma (1991) suggests that what needs to be done is to study the effect of mediums and methods together as they should be integrated. Mayer (1997) suggests that it is the circumstances under which media could make a difference that need to be investigated. He proposed many multimedia design principles to account for the conditions under which potentials of media could be effectively utilized. Mayer's studies in L1 have been extended to foreign/second language learning contexts as it is considered that multimedia has a lot to offer to L2 teaching and learning especially because it helps to contextualize the process of language acquisition (Kramsch & Andersen, 1999).

In SLA, the potential of multimedia have usually been investigated in terms of reading comprehension and vocabulary learning and glosses have been used to incorporate the features of multimedia (Akbulut, 2005; Al-Seghayer, 2001; Ariew & Erçetin, 2004; Chun & Plass, 1996a, 1996b; Erçetin, 2003; Hulstijn et al.,1996; Knight, 1994; Lomicka, 1998; Şakar & Erçetin, 2005).

Although Mayer (1997) proposed several principles for designing multimedia environments, most of the cited studies in the L2 have focused on the *multimedia principle* which suggests that presenting the same information in more than one modality (verbal and visual mode) leads to better learning. In L2 studies that were conducted on reading and vocabulary, students were provided with annotations that were in the form of word definitions, visuals (pictures, videos) or both. Learners who received both verbal and visual annotations performed better than the ones who received either alone on subsequent reading comprehension and vocabulary tests (Akbulut, 2005; Al-Seghayer, 2001; Chun & Plass, 1996a, 1996b). These studies confirmed the multimedia principle for vocabulary learning. However, results were not as conclusive for reading as they were for vocabulary (Chun, 2006). Some of the studies found no effect of annotations on reading comprehension (Akbulut, 2005; Ariew & Erçetin, 2004), some found negative relationship (Sakar & Erçetin, 2005) while some other found positive relationship implying that annotations when presented both verbally and visually facilitated reading comprehension (Chun & Plass, 1996b; Lomicka, 1998; Plass et al., 1998). These contradictory results might be explained by differences in verbal ability, proficiency and prior knowledge.

The other principle of interest was the *individual differences* principle according to which design effects are greater for low-knowledge and high-spatial ability learners than high- knowledge and low-spatial ability learners. Studies

conducted on vocabulary, reading comprehension, working memory capacity and preference for annotation type to test this principle indicated parallel results with the theory (Chun & Payne, 2004; Knight, 1994; Plass et al., 1998, 2003; Yeung, 1999).

This study investigates yet another principle- the *contiguity principle*. It suggests that when presented simultaneously, mixed mode information leads to better learning than when presented successively. Therefore the effects of presentation mode of annotations on L2 reading comprehension and incidental vocabulary learning as well as total time spent on reading are investigated. The study draws upon theories of L2 reading, vocabulary learning and learning in multimedia learning environments.

Theoretical Background of the Study

Reading

The process models have been proposed to account for the process of L1 reading process and extended to L2 reading. Models were suggested on the basis of the influential science movement of their time and hence reflected the most salient characteristics of those movements. The first model is bottom-up model of reading which draws upon behaviourism. Since the emphasis was on the observable in behaviourism, what researchers considered most important in the reading process was the visible part of it- the text. Readers were assumed to decode letters, phonemes, words and sentences serially. The meaning was in the text. On the other hand, the second model-top-down model of reading- was based on cognitive psychology and emphasized the importance of the individual reader and his/her background knowledge, schemata. With his/her previously formed knowledge

structures, the readers set expectations and form hypotheses as to what is crucial in the text and what is to come next. On the basis of those hypotheses, readers may skip some parts of the texts as they may be deemed irrelevant and form new hypotheses when the expectations are not met. This cyclical process goes on until reading task is over (Goodman, 1988).

The third model, interactive model, of reading suggests that both the text and the reader are important for the reading process as opposed to emphasizing either alone. Bottom-up processes such as decoding and top-down processes like using background knowledge to make sense of the text act simultaneously (Samuels & Kamil, 1988). Weakness in one area can be compensated by the strength in another (Urquhart & Weir, 1998).

Incidental Vocabulary Learning

There are varying levels of vocabulary knowledge and the act of reading may result in vocabulary gains in some levels of that knowledge. Acquiring vocabulary through reading is seen as incidental since the learners' intention is not to learn new words but to comprehend the text. There is not a total consensus on what is meant by "incidental". There are two major definitions usually adopted in the literature. In the first sense, incidental vocabulary learning is defined as learning as by-product of a main activity-reading. That is to mean, learners' focal attention is directed at comprehending the text at hand while only peripheral attention is paid to words; most probably to be able to comprehend the text (Gass, 1999; Huckin & Coady, 1999; Paribakht & Wesche, 1999; Wesche & Paribakht, 1999). Methodologically,

incidental learning is measured through unannounced vocabulary tests following a reading task (Hustijn, 2001; Laufer & Hulstijn, 2001; Swanborn & Glopper, 1999).

Although incidental vocabulary learning is possible from context through reading, it has its limitations such as incorrect guesses. Therefore using dictionaries or glosses to check the meaning of unknown words while reading is suggested to lead to larger and more accurate vocabulary gains (Davis, 1989; Hulstijn, 1993; Hulstijn et al., 1996; Knight, 1994; Watanabe, 1997)

Multimedia Learning

Hasebrook (1997) defines multimedia as the integration of different types of media in an interactive computer application while hypermedia is defined as the applications that present information in a non-linear way using a variety of media. Accordingly, in multimedia learning verbally presented information can easily be supported with visuals.

Multimedia is argued to have positive influence on learning in general and on L2 learning in particular since it is considered to have the potentials to support meaningful learning (Shea, 1996) and to provide opportunities for contextualized language learning (Kramsch & Andersen, 1999)

The latest theory of multimedia learning is that of Mayer's (1997). His Generative Theory of Multimedia Learning (GTM) draws upon two major theories: Dual Coding Theory (Paivio, 1986) and Cognitive Load Theory (Chandler & Sweller, 1991). Paivio (1986) argues that processing systems are fed by two different types of information- verbal and visual- and they are represented separately. Although one can act without the other, they are also interconnected in that one can

activate the other. Paivio suggests that when both verbal and visual channels are used to encode the same information, performance is most likely to be better as there will be two representations of the same information. On the other hand, the Cognitive Load Theory suggests that working memory is limited in its capacity to hold information. That is why learners attend to parts of information selectively. Therefore, it is necessary to present information in such a way to reduce cognitive load so that learners can learn most of it.

Mayer (1997) proposes several design principles based on three assumptions deriving from the theories outlined above. The assumptions are dual channels assumption, limited capacity assumption and active processing assumption. These assumptions imply that learners select relevant visual and verbal information and organize it into a whole and integrate visual and verbal representations with each other and their prior knowledge.

In this study, what these theories come together on is cognitive load. The annotations help students use bottom up processes faster. That is, they decode the unknown words more easily and rapidly with the help of verbal and visual annotations. When the bottom up processes take place more rapidly, more cognitive resources are left available for top down processing. Being able to use top down processes more efficiently such as making use of background knowledge allow learners to process the text better, which is crucial for the comprehension of the text when the limited capacity of working memory is taken into account. In sum, it can be said that annotations ease the cognitive load indirectly and reserve more cognitive resources for active processing, which is in line with Mayer's theory of multimedia learning.

Purpose of the Study

The aim of this study is to investigate the potential effects of presentation mode of annotations on reading comprehension and incidental vocabulary learning of intermediate learners of English at a state school. Although Mayer's (1997) theory attracted considerable attention in SLA, mostly the multimedia principle and the individual differences principle are investigated. Research on the multimedia principle has shown that presenting the same information in both verbal and visual format enhances learning. However in these studies verbal and visual information were presented successively to the learners. This study goes one step further and explores another important design principle- the contiguity principle- which requires simultaneous presentation of verbal and visual information.

In particular, the study is concerned with the effects of simultaneous or successive presentation of annotations on reading comprehension and incidental vocabulary learning.

CHAPTER II

REVIEW OF LITERATURE

This chapter deals with the theoretical background of the present study and provides a review of relevant studies. The current study relates to L2 reading, L2 incidental vocabulary learning, learning in multimedia environments and multimedia glosses. In the first section, current models of L2 reading that are relevant to the study are discussed with an emphasis on interactive models of reading. The second section presents incidental vocabulary acquisition in L1 and its extensions to L2. After noting on different levels and definitions of vocabulary knowledge, the issue of how to measure that knowledge is briefly touched upon. The process and rationale of L1 incidental vocabulary acquisition is followed by L2 incidental vocabulary acquisition and theories that support it. Related studies and their findings are presented next. In the last section of this chapter, theories concerned with learning in multimedia environments are discussed. Particular emphasis is on Mayer's Generative Theory of Multimedia Learning. The section and the chapter conclude with multimedia aids and studies exploring the effectiveness of them.

Theories of L2 Reading

This section discusses three reading models which were developed to account for L1 reading behavior and extended to L2 reading. Developed as process models, these three models are bottom up, top down and interactive models of reading. Among these three models, the most widely accepted model is the interactive model of

reading as it is considered to account for the nature of reading process more adequately than the other two.

Bottom up Models

Movements in science affected the way researchers conceptualize reading and the way they did so affected the models they proposed. The first model developed on the basis of -behavouristic movement of 1940s and 1950s was bottom up models. The most important feature of behaviorism was the focus on the observable and this was reflected in the bottom up models of reading. This model was concerned with the visible part of the reading process and therefore referred as data-driven, text based, explicit, intellectual and external as well as bottom up (Bernhardt, 1998). In this model, the reader is considered to decode letters into phonemes, phonemes into words and words into sentences (Urquhart & Weir, 1998). What is more crucial to the process is the argument that this decoding process takes place in successive stages. The linear nature of bottom up process implies that lower level units are encoded and built upon higher level units, which is expected to result in meaning extraction. Readers are expected to modify their prior knowledge on the basis of information presented in the text (Carrell, 1988). However, higher level processes cannot feed back into lower level processes (Alderson, 2000). This is referred as the unidirectional nature of the model.

Proponents of bottom up models of reading argued that the meaning is in the text and what a reader needs to do is to recover what the author is trying to say using his/her linguistic knowledge with little or no help from existing knowledge structures

(Grabe & Stoller, 2002). This assumption led them to propose that unsuccessful comprehension results from deficiencies or inadequacies in the linguistic knowledge.

Bottom up models of reading have been criticized on several grounds. The first one is the serial processing argument. Urquhart and Weir (1998) assert that if the letters were decoded sequentially, then recognizing a word would take longer than recognizing a single letter. However this is not the case. Another example they provide to disprove the serial and unidirectional nature of processing is that readers make use of syntactic information to disambiguate the meanings of words. Further evidence they provide suggests that readers wouldn't know where to stop to comprehend the meaning of the sentences if they were to decode all the words in a sentence before syntactic processing began. Another aspect of bottom up models that usually receives criticism is that it deemphasizes the role of the reader and what s/he brings to the text in the reading process (Samuels & Kamil, 1988).

Top down Models

When the heyday of behaviourism was over, researchers proposed new models of reading based on the influential movement of 1970s- cognitive psychology- that replaced behaviourism. The new model proposed was top-down models and in contrast to earlier bottom up models, its emphasis was on the reader and what s/he brings to the text. Urquhart and Weir (1998) point out that using the term top down as opposed to bottom up may be misleading in that it is almost impossible to start with the whole text and then move to smaller units such as sentences, words and letters. Therefore they suggest using "reader-driven" instead of top down as apposed to "data-driven" bottom up processes. Other labels attached to the process are

conceptually driven, social, implicit, non-visible, affective, internal and knowledge-based. As all the names imply, top down models are associated with the importance of the role schemata play in comprehending the reading texts. The process is considered to be cyclical in the sense that it starts with sampling from the present text and goes on with predicting on the basis of existing background knowledge, confirming formed hypotheses or correcting them in case of a mismatch with the input and forming new ones until the reading task is completed (Goodman, 1988). Because of this guessing cycle, Goodman describes reading as "psycholinguistic guessing game" referring to readers' attempts to guess what is to come in the reading text with the help of prior knowledge. In this model, what good readers do is that they try to comprehend the text by making maximum use of prior knowledge and minimum use of textual information.

The model became quite popular and influential at the time as it was in accord with the argument of texts' being "degenerate" and requirement of the readers' use of background knowledge to complete the gaps (Urquhart & Weir, 1998). However, it received criticisms, too. First of all it was criticized on the grounds that it deemphasized the role of word recognition and did not account for the processes poor readers and readers who do not have the relevant prior knowledge might go through (Eskey, 1988; Samuels & Kamil, 1988). Furthermore, in the model it was suggested that good readers are good guessers. However, Urquhart and Weir (1998) argue on the basis of available research that good readers are less dependent on context than poor readers and good readers utilize their automatic word recognition skills more. In a similar vein, Samuels and Kamil (1988) assert that for efficient reading, good readers prefer to recognize words rather than form predictions since the latter is more time consuming.

Interactive Models

The criticisms the bottom-up and top-down models received indicated that they could not account for the reading process adequately on their own. This led to the emergence of interactive models which combine the characteristics of both models. In doing so, they were regarded as models that better explain the nature of L2 reading. Before moving onto the assumptions of the interactive models, it is important to note what is meant by the term "interactive". Firstly, it has to do with the interaction between the reader and the text. Grabe (1988) asserts that reading is a dialogue between the text and the reader implying the reconstruction process of meaning by using what a reader knows to understand and interpret what the text says. Secondly, it implies the interaction between bottom up and top down processes to interpret the text (Eskey, 1988). On the whole it can be said that interactive models allow the information at higher levels to influence lower level processes while also taking into account the reader characteristics. Processing of the input takes place on the basis of information coming from different knowledge sources simultaneously (Samuels & Kamil, 1988).

The first interactive model was that of Rumelhart's (1977). In his model, processing is considered to be parallel implying the synthesis of information available from various sources continuously and simultaneously. Another interactive model was proposed by Stanovich (1980). He termed his model as "interactive compensatory model" as its main difference from Rumelhart's was the assumption that weakness in one part of a skill may be compensated by the strength in another skill (Urquhart & Weir, 1998). That is to say that readers who lack relevant background knowledge may use their rapid and accurate word recognition skills to

comprehend the text while readers that have poor word recognition skills may use their background knowledge to compensate for their inadequacies and to comprehend the text (Alderson, 2000). However, Clarke (1988) and Devine (1988) note that there is a certain level of linguistic proficiency referred to as "threshold level" which is necessary for the strength in one component to compensate for the weakness in the other. Below this threshold level of linguistic proficiency, readers cannot make use of their background knowledge, reading skills and strategies. It should be kept in mind, though, that this threshold level of proficiency changes depending on the text and the prior knowledge available to the reader. Clarke (1988) asserts that:

> (…) limited language proficiency appears to exert a powerful effect on the behaviors utilized by the readers. (…) the role of language proficiency may be greater than has previously been assumed; apparently, limited control over the language "short circuits" the good reader's system causing him/her to revert to poor reader strategies when confronted with a difficult and confusing task in the second language. This suggests that it may be inaccurate to speak of "good readers" and "poor readers". Perhaps there are not "good readers" and "poor readers" but merely "good" and "bad" reading behaviors which characterize most readers at different times. (p.120)

Yet another interactive model was proposed by Bernhardt (1998). Instead of using top down and bottom up, she utilizes the terms reader driven and text driven respectively to classify the processes involved in reading comprehension. Text driven processes involve word recognition, phonemic/graphemic decoding and syntactic features recognition which have to do with the visible part of the reading process as in the case of bottom up model of reading. Reader driven processes, on the other hand, involve intra-textual perception, metacognition and prior knowledge. Text driven and reader driven processes act simultaneously and interactively. However, it is not possible to determine where one component starts to influence the

other in the reconstruction process (Bernhardt, 1998). It will change depending on readers and texts.

An important component of interactive models that needs to be drawn attention to is background knowledge. Also referred as "schemata", background knowledge is previously acquired world knowledge that readers have. Background knowledge affects what readers understand from the text. Readers integrate the new information from the text into their schemata. Schemata not only influence the way readers recognize information but also how they store it (Alderson, 2000). Readers become active in the process of relevant schema activation. When readers lack the relevant schemata or fail to activate them, they may have difficulties in processing the text and become overreliant on the text for comprehension (Carrell, 1988).

All in all interactive models suggest that reading is the reconstruction of meaning from the text with the help of background knowledge available to the reader who makes use of bottom up or top down processes continuously and simultaneously and who uses one to make up for the weakness in the other when necessary. Interactive models are regarded as the best models fitting to L2 reading which is not the same as L1 reading. There are various factors contributing to L2 reading such as L1 reading strategies, L2 proficiency and culture specific knowledge. Interactive models of reading try to account for such factors, how they are incorporated into the process and how they affect it. On the point Eskey and Grabe (1988) note:

> An interactive model of reading is better able to account for the role of certain bottom up skills that are important to successful reading acquisition. In a model that accounts for both fluency and acquisition, issues of different scripts and other L1 interference factors can be better understood. (p.225)

As argued above, in acquiring a second language, learners need both bottom up and top down skills to be able to make sense of the text in the new language. Therefore an interactive approach to reading helps us better understand the reading process in L2.

L2 Vocabulary Learning

This section first discusses dimensions of vocabulary knowledge and how to measure it. Next, incidental vocabulary acquisition in L2 and theories that support it follow. Finally, findings of previous research are presented.

L2 Vocabulary Learning

Teaching and learning vocabulary has received considerable amount of attention in the past few decades in L2 studies. It has been fully recognized that vocabulary is a major concern in learning a second language as well as the four skills- reading, writing, listening and speaking. To be able to talk about vocabulary knowledge, we first need to define what it means to know a word.

What It Means to Know a Word

Meaning and form are the two dimensions one could come up with when confronted with the question of what it means to know a word. However it is not as simple as that. Nation (2001, p. 23) states that "words are not isolated units of language and there are many things to know about any particular word." Therefore knowledge of a

word exists on different levels and in different degrees. Taylor (1990) proposes seven components for word knowledge: frequency, register, collocation, morphology, semantics, polysemy and mother tongue equivalent. A very similar component list comes from Nation (1990). The levels of word knowledge he suggests are form (written and spoken), collocations, frequency, associations, register, grammatical behaviour of the word and its meaning. Nation (1990) notes that although words may exist on one, two or more of these levels, knowing all the words at all levels given is not possible most of the time, even with native speakers. They are not learnt at the same time and there is not a strict sequence. In fact there are no studies that looked into the sequence of word knowledge at all levels (Hulstijn, 2001). However, it is not possible to learn collocational uses of a word before learning its meaning. Schmitt (2000) asserts that the process of learning a word is not an all-or-nothing phenomenon but rather a gradual and an incremental one. When encountered with words in new contexts, one expands and reshapes his already existing knowledge of the words. It is not possible, even for a native speaker, to know for instance colloquial uses of every word or their associations. It is a matter of encounter. Furthermore, it is not rare to see a native speaker pronouncing a word but not being able to spell it correctly.

Henriksen (1999), Nation (1990, 2001) and Schmitt (2000) mention a continuum which the levels mentioned above comprise: receptive and productive knowledge dimension. Receptive knowledge is defined as understanding a word when heard or seen while productive knowledge is being able to use it in spoken or written form . Although it is generally assumed that receptive knowledge precedes productive knowledge, this is not necessarily the case at all times (Schmitt, 2000).

Henriksen (1999) mentions two other dimensions: partial-precise knowledge dimension and the depth of knowledge dimension. The former is also known as "breadth" and refers to the continuum which begins with no or incomplete knowledge of a word (partial knowledge) and ends with precise command of it (Henriksen, 1999). Breadth is the size of one's vocabulary knowledge and has to do with referential meanings. Depth, on the other hand, is how well words are known- the quality of one's vocabulary knowledge (Qian, 2002) and has to do with collocational and associational relations of the words with each other as well as the relations between words and their referents.

How to Measure Vocabulary Knowledge

It is clear from the above literature survey that knowing a word is more than the link between meaning and form. Therefore it is suggested that a variety of tests tapping different levels of vocabulary knowledge should be used in studies to measure vocabulary knowledge (Henriksen, 1999). However, most of the time this is not the case. Vocabulary tests usually focus on the connection between form and meaning. Paribakht and Wesche (1993, 1996) developed a vocabulary test- Vocabulary Knowledge Scale (VKS) claiming it measures different levels of vocabulary knowledge. On the other hand, Laufer and Goldstein (2004) argue that VKS is an indirect test of word meaning, not a test of vocabulary knowledge depth as claimed. Moreover, they argue that the most important component of vocabulary knowledge is the link between form and its meaning, and measuring varying levels of that knowledge should be the primary concern of tests. Therefore they offer active/passive recognition and production tests to measure that knowledge. In the

present study, similar tests measuring recognition of word form, meaning and production of the meaning conveyed by the particular context (Knight, 1994; Laufer & Goldstein, 2004; Rott, 1999; Waring & Takaki, 2003) have been used as knowing a word is defined as knowing its form and meaning.

Incidental Vocabulary Learning

Majority of researchers acknowledge that it is not possible to explain the large amount of vocabulary knowledge children have by formal instruction (Coady, 1997; Nagy & Herman, 1987; Nation, 2001; Schmitt, 2000). Parents do not teach their children every single word, how it is used, its collocations and the like. Neither do they correct every mistake their children make using a particular word. Even if they did, children might not attend to and understand what is being corrected. Therefore researchers contend that they learn these words not through formal instruction but through exposure- oral and written discourse contexts. For L1 vocabulary acquisition, oral context is seen as the primary source, at least for the first one or two thousand words (Nation & Coady, 1988; Schmitt, 2000). These words are regarded as high frequency words often occurring in every day speech and usually learnt before low-frequency words which can be met in written discourse contexts.

Second language learners experience a similar process. Although they are not exposed to L2 input all the time to "pick up" the words through exposure, their vocabulary knowledge cannot be explained by direct teaching per se. It is unlikely for them to acquire so many words by asking someone or consulting a dictionary every time they encounter an unknown word. As it is the case in L1 vocabulary

acquisition, oral and written discourse contexts account for the mismatch in L2 vocabulary acquisition, too. However, written contexts have the primary role here. L2 learners acquire words while reading (Horst, Cobb, Maera, 1998; Nagy & Herman, 1987; Nation, 2001; Nation & Coady, 1988; Qian, 2002; Sternberg, 1987). Nevertheless, it should be remembered that vocabulary acquisition is incremental and full mastery of a word requires multiple encounters in different contexts (Nation & Coady, 1988; Paribakht & Wesche, 1997). Taking all these into account, single exposure to a word may result in some kind of learning at one of the levels of vocabulary knowledge mentioned before (Schmitt, 2000).

Learning words from context during reading is seen as "incidental". However there is some controversy among researchers as to what is meant by incidental. It is mostly defined as by product of the main activity learners are indulged in. In other words, learners' attention is mainly focused on a task, not on vocabulary learning (Gass, 1999; Huckin & Coady, 1999; Hulstijn, 2001; Krashen, 1989; Swanborn & Glopper, 1999; Wesche & Paribakht, 1999). Similarly, Ellis (1994 cited in Huckin and Coady, 1999) assert that incidental learning involves learners' peripheral attention. Focal attention is focused on something else. Hulstijn (2001), Laufer and Hulstijn (2001) and Swanborn and Glopper (1999) also mention that incidental learning is experimentally defined as not informing students about a subsequent test of vocabulary. Hulstijn (1996) cited in Gass (1999), N. Ellis (1994) and Wesche and Paribakht (1999) provide another definition indicating that it is learning without specifically intending to learn. This is not to say that students do not notice the target vocabulary forms. It is only to point out that their attention is directed at something else rather than learning the words in question. N. Ellis (1994) warns that incidental learning should not be confused with implicit learning in which

learning takes place "totally unconsciously" as a result of repeated exposures in a variety of contexts. As Gass (1999) points out that it is difficult to define 'incidental' since it is hard to prove that a word is learnt incidentally. This is because learning is a cognitive activity and not directly accessible. Nevertheless, what above definitions have in common, at least minimally, is that vocabulary learning via reading needs to take place when students are primarily and mainly concerned with comprehending the text and are not foretold that a vocabulary test will follow. The definition of incidental adopted in the current study complies with this common view.

Research on L2 Incidental Vocabulary Learning

Incidental learning of vocabulary from context has its roots in Krashen's (1982) Input Hypothesis. Krashen (1989) argues that the best way to learn vocabulary is through comprehensible input in the form of reading. He asserts that this incidental process of learning vocabulary is identical to acquisition process in which conscious focus is on the message, not form. Reviewing 144 studies, Krashen contends that more comprehensible input results in more and deeper vocabulary knowledge; particularly when encountered in different contexts which makes it possible for learners to acquire semantic and syntactic properties of the words. Support for the claim that incidental vocabulary learning occurs while reading without an intention to learn the unknown words came from a number of studies (Horst, Kobb, Maera, 1998; Joe, 1995; Newton, 1995; Rott, 1999; Waring & Takaki, 2003).

Horst, Kobb & Maera (1998) in a replication study provided 34 low-intermediate learners with a simplified novel consisting of 21.232 words. In the six classroom sessions held for the study, students were asked to read the text aloud to

ensure that they were all exposed to the whole reading text. The text was handed out before each session and collected afterwards. This was to prevent students from studying the text outside the classroom and looking up the meanings of unfamiliar vocabulary items, which could lead to more gains in vocabulary knowledge. When the reading sessions came to an end, learners were presented with two vocabulary tests, a multiple choice test and a word association test. The multiple choice test had 45 items and required learners to choose the correct definition of the words. There were 13 items on the word association test and students needed to cross the odd one out among three words. Findings of the study provided support for incidental vocabulary learning and indicated that the gains are even better when students are provided with longer texts. Another important point results of the study revealed is that general frequency of a word does not necessarily mean better learning while the frequency of occurrence in the text matters. This is contrary to Brown's argument (1993 cited in Paribakht and Wesche, 1999) which asserts that general frequency of a word makes it easier to learn as the chances of seeing that word before in some other contexts are more likely.

Another study investigating the role of reading as a source of input in vocabulary learning is that of Rott (1999). Ninety-five intermediate learners of German were provided with six paragraphs specifically written for the subjects to make sure that target vocabulary items were included. Immediately after reading the paragraphs, learners were asked to recall the content of the passage in question as much as possible to make sure that what students focused on was comprehending the text. After students encountered the target words (3 groups with 2, 4, and 6 exposure frequencies) in different paragraphs over a period of six weeks, they were asked to engage in two vocabulary tests: supply definition (production in L1) and select

definition (recognition) from four options. Results revealed that reading while the attention is on comprehension results in significant vocabulary learning, especially when the target words are at least encountered twice.

Joe (1995) looked into the effect of performing a read and retell task on incidental vocabulary learning of an L2 learner of English in a case study. The subject was required to read an expository text comprising of 338 words and asked to retell the information. He had access to the reading text while retelling. Two multiple choice tests were administered involving similar items. However, difficulty level of distractors varied. Easier one was used to credit partial knowledge of a word such as its general meaning. In the more difficult one learners needed to distinguish between distractors with closer meanings. Test results indicated that vocabulary learning occurred as a result of a text-based task, i.e., retelling. The author concludes that higher levels of production promote greater vocabulary knowledge gains.

In another case study, Newton (1995) investigated the effects of four communication tasks on incidental vocabulary learning. An adult learner of English did two split information tasks and two shared information tasks. In split information tasks, learners were required to read the situations presented and exchange information to complete the tasks while in shared information tasks they worked together to solve a problem. A post-test was administered three days later. Findings suggest that considerable amount of incidental vocabulary learning occurs via communication tasks. The learner acquired the words that were used in interaction. Surprisingly, negotiation of the word meanings and learners personal involvement in the negotiation process did not lead to greater vocabulary knowledge gains.

Waring and Takaki (2003) studied the possibility of vocabulary learning from a graded reader with 15 intermediate Japanese students. Learners were provided with three vocabulary tests immediately after reading, word-form recognition, prompted and unprompted meaning recognition tests. They concluded that it is possible to learn words incidentally. However, the chances are rather low. For better vocabulary knowledge gains, frequency matters as more frequent words were learnt better and were not forgotten as easily as less frequent ones as shown by tests of retention conducted after one week and three months.

Swanborn and Glopper (1999) conducted a meta-analysis involving 20 experiments on incidental vocabulary learning and concluded that reading contributes to vocabulary growth as 15 % of the words encountered were learnt during reading. They also pointed out that since learning words from reading texts incidentally is an incremental process, it is not surprising that recognition tests gave out larger effect sizes.

Swanborn and Glopper (1999) also draw attention to the density of unknown words in a text as another factor affecting the likelihood of learning words from a reading text. Similarly, Hsueh-chao and Nation (2000) found that 98 % of the words in a text need to be familiar to the students for unassisted comprehension. It is also necessary for students to be able to infer the meanings of unknown words from the context. Nation and Coady (1988) also argue that:

> The very redundancy or the richness of the information in a given context which enables a reader to guess an unknown word successfully could also predict that the same reader is less likely to learn the word because he or she was able to comprehend the text without knowing the word. (p.101)

Thus, providing a poor or quite rich context may both result in unwanted outcomes, i.e., no learning. Although there is not a hundred percent of agreement as to what the

appropriate density is, most researchers agree on the necessity of knowing 95-98 per cent of words in a text which is almost equal to 1 unknown word in 20-25 running words (Hsueh-chao & Nation, 2000; Nation, 1990, 2001; Nation & Coady, 1988). Qian (2002), however, notes that not only size but also the depth of known vocabulary affects reading comprehension and therefore both size and depth are necessary.

Unknown vocabulary density is only one of the problematic features of learning words from context. Researchers agree that extensive reading do not automatically result in learning and there are other factors contributing to the process (Huckin & Coady, 1999). Nation and Coady (1988) and Sternberg (1987) provide a list of variables that affect word learning through reading. These factors include unknown word density, frequency in the text, variety of contexts, relevance and importance of the words for the task at hand, closeness of contextual information to the relevant word and finally the extent to which prior knowledge helps. It has already been noted that a reasonable unknown word density might be obtained in texts in which 98 per cent of the words are familiar. In terms of second factor, frequency, it was pointed out that frequency of occurrence in a text matters for the successful inference of meaning and learning of a new word. Nation (1990, 2001) and Summers (1988) mention the importance of another factor, that is, meeting the words in a variety of contexts; they assert that repeated exposure is obligatory to get a word in one's active vocabulary and the effort given to learn the new words will be of no use unless they are met again in different contexts. Gass (1999) draws attention to yet another point. She states that learners do not try to infer the meanings of all the unknown words they encounter. They tend to infer the meanings of words they deem relevant to the comprehension of the text and ignore others.

What is more, context may lead to incorrect guesses (Bensoussan & Laufer, 1984). Even correct guesses do not result in retention since the immediate need to comprehend the text is met (Paribakht & Wesche, 1996). It is relevant to note here the distinction Lawson and Hogben (1996) makes between acquisition of meaning from context and comprehension of meaning in context. Nation (1990) makes a similar distinction between increasing vocabulary and establishing vocabulary. The former refers to introducing new words to students' lexicon while the latter refers to consolidation and expansion of the initial vocabulary knowledge.

As is clear from the discussion above, learning words from context poses problems and difficulties. However, this is not to say that context does not aid vocabulary acquisition. It is only to say that there are many factors contributing to the process of successful guessing of word meaning from context; and gains might differ depending on texts, tasks and learners. It should be remembered that vocabulary learning is an incremental process and composed of varying degrees of word knowledge which are not learnt all at once. Researchers allowed learners to use dictionaries in order to compensate for incorrect guesses, ignoring the unknown words, and unsuccessful comprehension outcomes. Summers (1988) emphasizes the importance of using dictionaries as a useful strategy indicating that all meaning cannot be inferred or guessed accurately.

Knight (1994) conducted a study on the effects of dictionaries on incidental vocabulary learning. 105 learners of Spanish were grouped on the basis of their verbal ability level (as high and low verbal ability groups) and randomly assigned to dictionary access or no dictionary access groups. Participants were asked to read two texts and write a recall protocol. Following recall protocols, students were administered two unannounced vocabulary tests- supply and select definition.

Results of the study suggest that incidental vocabulary learning occurs and students who are exposed to words in context (reading) performed better on subsequent retention tests of vocabulary. Moreover, students who had access to a computer dictionary while reading performed even better. The gains in vocabulary knowledge and comprehension were greater for low verbal ability learners. Knight's findings provided evidence for the usefulness of dictionaries in incidental vocabulary learning while reading.

A similar finding was obtained by Hulstijn (1993). He found that students mostly looked up the words they considered most relevant to the reading task. He noted that students looked up words that could easily be inferred as much as the words that were difficult to infer. This indicated that students resort to dictionaries to confirm their guesses even after making a reasonable guess in the context they have available.

Another strategy that enhances incidental vocabulary learning gains from reading is suggested by Paribakht and Wesche (1997). 38 adult learners of English from different L1 backgrounds were exposed to two treatments: reading plus and reading only. In the reading plus condition, students read the selected texts and answered comprehension questions at home and did follow up vocabulary exercises in the class. Students in the reading only condition similarly read the text and answered comprehension questions at home. However, they did further reading in the class instead of vocabulary exercises. Results suggested that reading plus and reading only conditions both resulted in vocabulary growth. Although vocabulary gains in reading only condition were more than expected, reading plus condition led to greater vocabulary gains indicating the usefulness of supplementary activities for learning words incidentally from context.

Another strategy used to help learners' incidental vocabulary learning process is the use of glosses. Glosses are definitions or translations of the unknown words in a text which are usually presented at the end of the text or near the unknown words defined. Nation (2001) mentions several advantages of glosses:

> Firstly, it allows texts to be used that may be too difficult for learners to read without glosses. This means that unsimplified and unadapted texts can be used. Secondly, glossing provides accurate meanings for words that might not be guessed correctly; this should help vocabulary learning and comprehension. Thirdly, glossing provides minimal interruption of the reading process, especially if the glosses appear near the word being glossed. Dictionary use is much more time consuming. Fourthly, glossing draws attention to the words and thus may encourage learning. (p.175)

There are many studies providing evidence for the positive effects of glosses on vocabulary learning (Al-Seghayer, 2001; Chun & Plass, 1996a, 1996b; Davis, 1989; DeRidder, 2002; Hulstijn, Hollander and Greinadus, 1996; Watanabe, 1997).

Davis (1989) compared preteaching vocabulary and glossing conditions and found glossing condition contributing to vocabulary learning more. Hulstijn et al. (1996) found that marginal glosses increased the likelihood of word learning from reading as learners in the glossing condition performed better on retention tests than dictionary and no dictionary groups.

All in all glossing as an input modification technique may prevent incorrect guesses and help vocabulary learning. It is a useful tool in the incremental process of vocabulary growth.

Multimedia and Learning

In simplistic terms, multimedia is defined as the combination of different types of media (static and dynamic) in an interactive computer application (Hasebrook,

1997). It is also defined as presentation of information to different senses (Kozma, 1991). Mayer (1997) also notes on this second definition and distinguishes between delivery media and presentation mode. He asserts that delivery media is what is used to present information such as books and computers whereas presentation mode is how this information is presented (in verbal or pictorial form) to different processing systems (acoustic or visual). Therefore, he contends that it might be better to use "multimodal" learning instead of multimedia learning. In this study, they are used interchangeably.

Most researchers agree that multimedia has a lot to offer in the field of education. The fact that it may appeal to multiple "senses" as Kozma (1991) put it has made it more fascinating for educators and researchers who are trying to create learning environments all learners could benefit from. However, there seems to be some controversy among researchers as to the benefits or potentials multimedia has to offer learning. Based on his meta-analysis, Clark (1983) contends that multimedia does not make a difference. He claims that obtained learning gains or benefits, if there are any, are the results of instructional methods employed in the studies that support the cognitive processes necessary for achievement or else novelty effect that increases students' attention to new media (Clark & Craig, 1992), not the media type(s) used. For Clark, media type is just the delivery system employed. It does not influence learning.

In response to Clark's contention that (multi)media are nothing more than mere vehicles that deliver information and it is the instructional methods that make a difference in the learning benefits, Kozma (1991) asserts that a good design should integrate the medium and the method; therefore it is unnecessary to try to distinguish between the learning benefits resulting from media or method used. Some of the

benefits could be attributed to the media and some to the method. They are interrelated. An effective method makes use of the capabilities of the medium it employs. It is those capabilities and the symbol systems (modes in which information is introduced such as words, pictures) employed to promote certain cognitive processes that influence learning. If they are not used effectively for the given situation, task, and learners, the medium then becomes just a "truck" that delivers information.

According to Kozma, not all media have the same capabilities. Therefore it is important to emphasize the technology, symbol systems and processing capabilities media have. Kozma (1991) defines technology of a medium as the mechanical features that determine its functions. Symbol systems are the ways information is presented to learners. For instance; the information may be presented in the form of printed text or pictures. Processing capabilities are how those symbols are processed in the mind. For instance, transformation capabilities of computers make the connection between symbols and real world direct by helping learners to elaborate on their mental models, which result in better performance (Kozma, 1991). This is not a feature of books; therefore any medium does not influence learning exactly in the same way.

Another point Kozma (1991) makes is that the advantages that multimedia offers might depend on the characteristics of the learners such as age and prior knowledge. For instance, novice learners who lack the necessary schemata to understand a text might find it more useful if the medium used is stable or the pace of the transient medium could be slowed down as they are likely to go back and forth over the text, between the text and pictures and slow down the rate of processing.

Support for Kozma comes from Shea's review (1996) of the studies that suggest that multimedia have the potential to support the meaningfulness principle which he argues as necessary for learning to occur. He suggests that media have the potential to provide opportunities to teach the different types of skills needed for communicative competence. That is because the mode of media is likely to affect the language learning process and make it more meaningful and appealing to the learners. The theory that grounded such arguments on solid basis came from Paivio in 1986 with his Dual Coding Theory (DCT). This theory formed the basis of Mayer's Generative Theory of Multimedia Learning (GTM), which is the latest theory of multimedia learning (1997, 2001).

Mayer (1997) claims that studies conducted to answer the traditional question of whether one medium is better than the other has been fruitless; and therefore argues that the question to be asked is under what conditions and for whom multimedia presentation is effective. To be able to answer these questions plausibly, he bases his theory of multimedia learning, which he simply defines as learning from words and pictures (Mayer, 2001, 2005), on how the human brain works for meaningful learning to occur. In that, he combines three theories: Dual Coding Theory of Paivio (1986), Cognitive Load Theory of Chandler and Sweller (1991) and Constructivist Learning Theory.

In his Dual Coding Theory, Paivio proposed that verbal and visual information is represented differently and processed in different processing systems. The verbal system deals with the language specific representations while the visual system deals with the processing of images and their representation in the brain. These two systems are independent in the sense that one can be activated separately; and they are interconnected implying that information in one can activate the other.

It is the interconnectedness between those two systems that leads to long term retention of the information presented as it allows cueing from one system to the other and relates new information to the already existing knowledge in long term memory. Paivio (1991) calls this referential processing. In sum, DCT suggests that it is easier to retain and retrieve information when it is represented in both systems since one, then, has two mental representations of the same information instead of one. This implies that using more than one channel in learning could result in better performance.

Another theory Mayer's GTM draws upon is Cognitive Load Theory (CLT) proposed by Chandler and Sweller (1991). The main assumption of this theory is that both verbal and visual working memories are limited in their capacities to process information at any one time. Bannert (2002) states three sources of cognitive load: intrinsic cognitive load that is related to the characteristics of the subject matter to be learnt, extraneous cognitive load that's related to the design (the way in which material is presented) and germane cognitive load which is related to using working memory for deeper activation and construction of schemata. In short, if learners are presented with too much information to be processed in either working memory (visual or verbal) coming from either sources (intrinsic or extraneous), they find it difficult to process some of the information due to cognitive load.

Mayer (1997), in his GTM, adopts the view that presenting information in more than one modality leads to better performance based on DCT's *dual channels assumption* and the view that working memory is limited in its capacity to process information based on CLT's *limited capacity assumption* and proposes instructional multimedia design principles that would result in better performance. He points out that for meaningful learning to occur learners need to select relevant information

from what is presented (verbal and visual representations separately), organize it into a coherent whole (verbal and pictorial model) and integrate these two models with each other (see Figure 1)

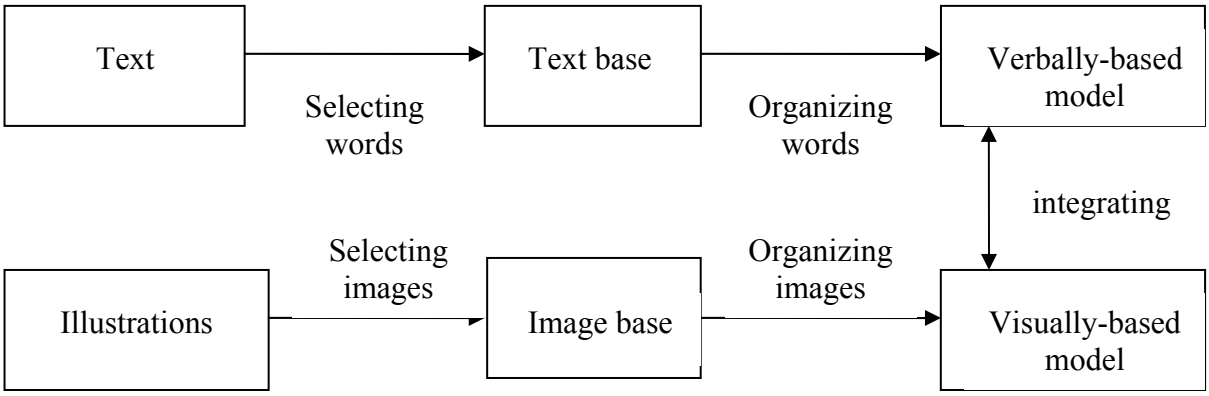


Fig. 1: Mayer's model of multimedia learning (Mayer, 1997)

The third assumption of multimedia learning coined as "active processing assumption" by Mayer (2001) proposes that learners are active constructors of knowledge, which has its roots in constructivist learning theory. In his revised model of multimedia learning, Mayer (2001) adds prior knowledge as a new component. (see Figure 2).

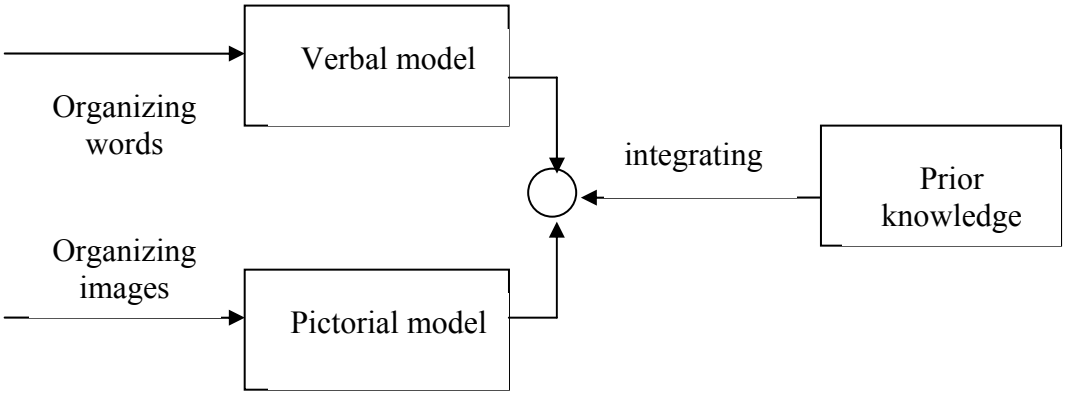


Fig. 2: Mayer's model of multimedia learning (Mayer, 2001)

This is due to the contention that integration not only takes place between the two models created (verbal and visual) but also between these two models and already existing schemata in long term memory.

Multimedia Design Principles

Mayer and Moreno (2002a) derived five principles on the basis of theory of multimedia learning discussed above: multiple representation principle, contiguity principle, coherence principle, modality principle and redundancy principle. These principles, discussed below, were tested and confirmed by the studies they conducted.

The assertion that people learn better with words and pictures than either alone forms the basis of multimedia learning theory. This assertion is termed as the "multimedia principle"- the first principle of the theory. Other principles draw upon this one and the question of how to present words and pictures (i.e. simultaneously, successively, visually or auditorily). This principle is in line with the DCT, which advocates for making use of both verbal and visual channels. The idea that underpins the DCT is that when learners are provided with both pictures and words, they are better able to build referential connections between verbal and visual representations. When they are provided with either words or pictures, they need to create the other mentally. Support for this principle comes from the studies of Mayer and Anderson (1991, 1992). In the four experiments they conducted with college students, they studied the performances of the students using tests of retention and transfer. One group of students viewed a narrated animation while the other group

listened to the narration only. They found that the former group outperformed the latter indicating a case for multimedia principle.

The second principle termed as the "contiguity principle" asserts that people learn better when corresponding words and pictures are presented contiguously in time and space. It is based on the rationale that presenting words and pictures at the same time makes it easier for learners to build mental connections between the two representations since they are held in working memory at the same time, reducing cognitive load. This rationale derives from both DCT and CLT. This principle is divided into two in itself: spatial and temporal contiguity.

Spatial contiguity principle suggests that words and related pictures should be presented next to each other rather than far from each other to allow learners to make connections between the two more easily. It is argued that if presented separately, learners need to hold the firstly presented material (text or images) in working memory until they have access to the other (text or images), which may be very difficult when the limited capacity of working memory is taken into consideration. Several studies supported the principle. In a series of experiments in the field of maths and engineering, Sweller, Chandler, Tierney and Cooper (1990) found that multiple sources of information (text-diagram, text-text), which split learners' attention, should be integrated for better learning as physical integration frees up the cognitive resources needed for mental integration. This results in reducing cognitive load. Mayer (1997) and Moreno and Mayer (1999) also came up with similar findings in their studies in which they compared the retention and transfer performances of two groups, one of which is presented with text and illustrations of lightning formation separately while the other group had the same information in an integrated way. Mayer and Moreno (2003) also proposed that integrating disparate

sources of information physically referred as “aligning words and pictures” (p.49) as one of the nine ways of reducing cognitive load.

The temporal contiguity principle, which is also of particular interest to this paper, propose that presenting verbal and visual information simultaneously results in better performances than when they are presented successively. The theoretical rationale for this proposition is the same with spatial contiguity’s. That is, having access to both modes of information at the same time results in having them in working memory at the same time which in turn makes it easier for learners to build referential connections between the two. Otherwise learners will try to integrate the two sources of information themselves and use already limited cognitive resources for this integration process, inhibiting learning. Mayer and Anderson (1991) conducted two experiments to test these hypotheses. College students viewed animations either in “words-with-pictures” or “words-before-pictures” format. They found that simultaneous presentation of animations and related explanation resulted in better learner performances on tests of retention and transfer of information for problem-solving than the successive presentation. Mayer and Sims (1994) obtained similar findings. In two experiments, they compared the performances of a concurrent group that viewed an animation and listened to a narration simultaneously explaining how a pump or human respiratory system work with a successive group that received the animation and listened to the explanation successively. The concurrent group was more successful on tests of transfer in which they were required to create solutions to problems. However, in later studies Mousavi et al. (1995) and Moreno and Mayer (1999) could not find temporal contiguity effects. Moreno and Mayer (1999) explained this contradictory result in terms of element interactivity, which is defined as the “number of elements that must be

simultaneously processed in working memory because they interact" (Low & Sweller, 2005, p.154). They concluded that successive presentation both in their study and Mousavi et al.'s study (1995) was shorter compared to those in Mayer and Anderson (1991) and Mayer and Sims (1994). That is to say; small segments of successive presentation do not result in high cognitive load and learners could easily integrate the two sources of information themselves resulting in performance comparable to that of simultaneous group. Evidence for this explanation came from the study of Mayer, Moreno, Boire and Vagge (1999), who compared five groups: a concurrent group who had the narration and animation on lightning formation or how car brakes work simultaneously, two successive large bites groups who had the animation before or after the whole narration and two successive small bites groups who had small segments of narration before or after the corresponding segments of animation. The groups were compared on tests of retention, matching and problem-solving. Results confirmed their expectations; the successive small bites group and the concurrent group did not differ significantly from each other while the successive large bites groups performed significantly poorer than the other two groups. Temporal contiguity principle is also mentioned as one of the nine ways of reducing cognitive load in Mayer and Moreno (2003) under the name of "synchronizing".

The third principle of Mayer's theory is the modality principle which concerns the way verbal information is presented. The principle suggests that it is better to present words auditorily rather than visually. The theoretical rationale is that presenting words visually overloads the visual channel as images also use the visual channel. The two need to compete for visual attention, which is termed as "split-attention". This attention split makes processing in visual working memory hard as its capacity is severely limited. Therefore using the auditory channel eases

the load on the visual channel, which is considered to result in better performance. Studies conducted to test this principle consistently showed that it was the case. Mousavi et al. (1995), Mayer and Moreno (1998), Moreno and Mayer (1999) found that when words are provided as aural input, students performed significantly better on tests than when they are provided as visual input along with pictures. The results are pointed out as consistent with dual processing of working memory, which has visual and auditory channels separately. This is another principle mentioned as one of the nine ways of reducing cognitive load in Mayer and Moreno (2003) and termed "off-loading".

Another principle of the theory is the redundancy principle. When learners are provided with narration, animation and on-screen text altogether, on-screen text becomes redundant as it may get in the way of learners' processing attempts of the presented information. This happens because of the same reasons mentioned in the modality effect. Students may ignore the auditory input and split their attention between the two visual inputs- text and images, which could result in poorer learning. Supporting studies came from Mayer et al. (2001). In their study on lightning formation, Mayer et al. found that the group that had narration and animation performed better than the group that had narration, animation and on-screen text.

The fifth principle of the theory is the coherence principle. It suggests that providing students with extraneous words, sounds or videos to make the information more interesting and motivating results in poorer performance compared to concise narration and animation where input unnecessary for learning is excluded. The rationale is that extraneous material makes selecting process (one of the required cognitive processes for meaningful learning to occur) harder for learners by

attracting their attention to irrelevant material. Attending to irrelevant material loads working memory which already has limited capacity and leaves less cognitive resources for learners to build connections between the relevant materials (Mayer and Moreno, 2002b). Coherence is yet another principle considered as one of the ways of reducing cognitive load in Mayer and Moreno (2003) and is mentioned as "weeding".

Another principle mentioned in Mayer and Moreno (2002b) is the personalization principle. The assumption is that presenting narration and animation in a conversational style results in deeper learning than presenting them in a formal style. Mayer and Moreno argues that students try harder to understand the presented material when they are personally involved. A series of experiments confirmed their arguments. In the five experiments they conducted, they used first and second person constructions to make students feel that they were being talked to in explanations of lightning formation and plant growth. In all experiments, students who had the explanations in conversational style performed better.

Multimedia Aids in Foreign/Second Language Learning

In multimedia environments, verbal information can easily be supported with visuals. There are several ways of presenting visual and verbal information. Verbal messages can take the form of on-screen texts or sounds while visual messages can take the form of static (picture, photo) or dynamic (animation, video) images. All these can be called multimedia aids and each may contribute to language learning in different ways. Mostly researched among the potentials of multimedia aids is the effect of visuals on learning. Early studies conducted on the effects of visuals on language

learning have shown that pictures made a difference in students' vocabulary learning (Kellogg & Howe, 1971) and reading comprehension (Omaggio, 1979). Another commonly researched multimedia aid in SLA and of concern to this paper is annotations. Hypermedia makes annotations available in a more efficient way and provides students with opportunities to facilitate their reading comprehension and vocabulary learning in a second language. Annotations were first referred as glosses by Hüllen (1989), which were used by learners of Latin to aid their learning. In time, they became teacher-generated word lists and finally dictionaries. Now computer technology makes it much easier to provide glosses (annotations) along with (hyper)text. Students have the chance to access a variety of annotations such as definitions, pictures and pronunciation of the words immediately, as often as they like with just one click. This immediacy and ease of access lessens the distraction caused by the use of traditional dictionaries while reading and makes them more preferable (Roby, 1999). This feature makes them as much important to vocabulary learning as they are to reading. It is also suggested that providing annotations is more useful compared to simplifying the text (Widdowson, 1984).

As Roby (1999) suggests, glosses can be generated by learners or professionals. They can be presented before or while reading to clarify meanings, highlight important points and provide definitions. They can take the form of verbal, visual or audio glosses either in first or second language providing textual or extra-textual information. Moreover, Al-Seghayer (2003) notes that the position of the glosses (they must appear in a separate area), number of words to be annotated (not all the words), which words to annotate (the ones crucial to the meaning of the text), highlighting available glosses, quality of glosses (especially visual ones), using a tracking device to view the learners' interaction with the glosses and training learners

on how to use the software are important points to bear in mind while annotating a text to increase the effectiveness of glosses.

Glosses, as a means of making texts comprehensible, have been regarded as of particular benefit to L2 vocabulary learning and reading comprehension in L2 learning. Early studies compared the effects of access versus no access to a dictionary or glossing versus no glossing conditions on vocabulary learning and reading. When glosses become computerized, studies on multiple types of glosses (visuals, sound as well as text) followed. Most of the studies on vocabulary learning with glosses reported that glosses helped vocabulary learning especially when the word definitions were accompanied by visuals (Akbulut, 2005; Al Seghayer, 2001; Chun & Plass, 1996a). In terms of reading comprehension, however, results are not as conclusive (Chun, 2006). The following section provides a review of relevant studies.

Research on the Effectiveness of Glosses

One of the studies that focused on the performance differences between students who had access to a dictionary and those who did not in terms of vocabulary knowledge was that of Lupescu and Day (1993). They concluded that access to a bilingual dictionary while reading facilitates vocabulary learning of L2 learners. A similar finding was obtained by Knight (1994) using a computer dictionary. She contended that dictionary use while reading helps students acquire vocabulary. A third study is that of Hulstijn (1993). He also found that students preferred to use dictionaries most probably to confirm their guesses even when the words were easily inferable from the context.

Hulstijn, Hollander and Greidanus (1996) compared marginal glosses, dictionary and control conditions in a study on incidental vocabulary learning via reading. They pointed out that marginal glosses aided vocabulary acquisition more than dictionary. They further indicated that that was because students seldom used the dictionaries. This finding draws attention to the efficiency of glosses in terms of ease and immediacy of access. It makes students more willing to check the meanings of unfamiliar words even when they could infer them from the context. In another study, Watanabe (1997) focused on the effects of modifying a text using appositives (the meanings of the words were written immediately after them in commas) and marginal glosses as well as a task (translation) on incidental vocabulary learning. He obtained similar findings to Hulstijn et al.'s study. Gloss groups in which students had access to the restatements of the words in single or multiple choice format performed much better than appositives and no cues groups in vocabulary tests. There was not a significant difference between multiple choice and single marginal gloss groups.

Positive results were also obtained by Lyman-Hager and Davis (1996). They compared computerized glosses with printed glosses. Results showed that students in the computer gloss condition retained significantly more words than those in the printed gloss condition. In terms of comparing online glosses, Nagata (1999) investigated the effectiveness of single versus multiple-choice glosses involving translations of target words and grammatical structures. Results indicated a better performance in favour of multiple-choice gloss group. The results were explained by the "depth of processing hypothesis", i.e, when a person pays more attention to and invest more mental effort in presented information in an attempt to learn or understand it, the likelihood of retention is higher.

A contrary finding came from Koren's study (1999) in which students' performance in vocabulary tests was analyzed to determine the effectiveness of glosses. Again, in line with "depth of processing hypothesis", it was expected that retention of the inferred words in no gloss condition would be higher than the glossed words. Expectation was confirmed. However, in no gloss condition, students were provided with cues to make the inference easier. Furthermore, they had a "correct reply" button to check their inference, which they could access without trying to infer the meanings of the words. Therefore, what students did might not be pure inference and this might explain the contradictory results.

The studies mentioned above but the last one provided evidence that glossing- especially online glossing- helps students acquire new vocabulary in a second language more than dictionaries and no glossing. As for when students look up the meanings of unfamiliar words and consult glosses, Hulstijn (1993) mentions three reasons: relevance, difficulty of inference from the context, and vocabulary knowledge. Students look up more words when they deem the words as relevant to the goal of reading, when they think they are relevant but cannot be inferred from the surrounding context and lastly in general when they haven't got enough knowledge.

When it comes to comparing the effects of glossing on reading comprehension to no glossing or dictionary use, studies revealed similar results to those on vocabulary learning. Davis (1989) found that providing students with glosses before or during reading facilitated reading comprehension and resulted in better recall of the passage. As a result of his study on the effects of electronic glossary versus traditional bilingual dictionary on reading comprehension of beginner students, Leffa (1992) indicated that electronic glossary aided students to

understand 38 % more of the passage in 50 % less time than traditional bilingual dictionaries.

Lomicka (1998) also contends that glosses help students comprehend the text in question more deeply. Findings of her study, though must be approached with caution due to small sample size (12), indicated that students in the full gloss (English and French definitions, images, pronunciation) condition generated more causal inferences. Chun (2001) obtained similar findings. Students performed better in reading comprehension test and recalled significantly more propositions when they had accessed to both an internal glossary and external dictionary (online dictionary) than when they had only external dictionary.

Thus, these studies provide evidence that students perform better when they have access to glosses (usually definitions) both in vocabulary learning and reading. An important issue that needs to be investigated in terms of electronic glosses is the effectiveness of different types of glosses. As an extension of Mayer's theory of multimedia learning, several studies investigated whether the multimedia principle also applied to L2 vocabulary learning and reading comprehension. As mentioned above this principle asserts that presenting the material to be learnt both visually and verbally results in better learning.

Chun and Plass (1996a) studied the effectiveness of different types of annotations for vocabulary acquisition and found that when glosses are available both as text and picture, students performed better on vocabulary tests than when they are available as text and video or only text. The results were explained in terms of dual coding assumption of multimedia learning theory. Students were better able to build referential connections when both verbal and visual modes are available.

Plass et al. (1998) also found that students performed better on vocabulary tests when they selected both visual and verbal annotations than either alone or neither.

On the contrary, Al-Seghayer (2001) found that when words were annotated with text and video, they were remembered better in vocabulary tests than when they were annotated with texts and still picture or only text. The researcher attributed the results to the assertion that video is contextually richer and therefore builds a mental image better than picture.

Akbulut (2005) also found that students performed better on vocabulary tests when the words were annotated with definition and video than when they were annotated with definition and picture. However this difference did not reach significance. Yet, difference between both visually and verbally annotated words (definition-plus-movie and definition-plus-picture) and only verbally (definitions) annotated words was significant both on the immediate and delayed post tests with the exception of performance on meaning recognition immediate post test on which students performed similarly.

When it comes to the effect of providing glosses visually as well as verbally on reading comprehension, Chun and Plass (1996b) found that when students had access to both verbal and visual annotations, they had better overall comprehension scores than when they had access to only verbal annotations or no annotations at all. However, Sakar and Ercetin's study (2005) revealed that annotation use affected reading comprehension negatively- especially sound (audio-recordings and pronunciations) and video annotations.

Ariew and Ercetin (2004) and Akbulut (2005) observed no relationship between annotations and reading comprehension scores of advanced learners of English while there was a negative relationship between visual annotation use and

reading comprehension for the intermediate group in Ariew and Ercetin (2004)- a similar result to Sakar and Ercetin (2005). Ariew and Erçetin explained that findings revealed no relationship between annotation use and reading comprehension of advanced learners; because advanced learners did not heavily depend on annotations to comprehend the text. Akbulut (2005), however, attributed the nonsignificant relationship to the small sample size because of low power (.41).

Although contradictory findings were obtained in terms of reading comprehension and annotations, studies on annotations and vocabulary learning in L2 learning provided support for the multimedia principle of Mayer's theory of multimedia learning.

Another principle of multimedia learning theory that was of interest to L2 researchers was individual differences principle. According to the principle, low prior knowledge and high-spatial ability learners are affected more by design than high prior knowledge and low spatial ability learners (Mayer, 2001). In other words, low-knowledge and high-spatial ability learners benefit more from an effective multimedia presentation. Although it was not in a multimedia format, glossary use in Knight's study (1994) was more beneficial for low verbal ability learners as they are more dependent on vocabulary knowledge for reading comprehension. Yeung (1999) conducted three experiments with 5th grade, 8th grade and university students. They were to read a glossed text and take reading comprehension and vocabulary tests. Glosses were either integrated in the passage (written above the words they define) or given as a list at the end of the text. Yeung observed that for less experienced readers (5th grade students), glosses which were integrated within the text resulted in redundancy effects and therefore poorer performance in terms of vocabulary learning compared to glosses provided at the end of the text. With regard

to reading comprehension, integrated glosses prevented attention split and resulted in better performance. Just the opposite was true for more experienced learners (8th grade and university students). They benefited more from a separate glossing for reading comprehension while integrated format helped them for better vocabulary gains.

Another dimension of individual differences is preference for visual or verbal annotations. Plass, Chun, Mayer and Leutner (1998) pointed out that visual annotations do not help low-spatial ability learners. Low-verbal ability learners, on the other hand, benefit more from textual annotations than high ability learners. However, they perform poorly when they have both verbal and visual annotations due to high cognitive load resulting from visual annotations (Plass et al., 2003). In the same study both visualizers (those who prefer visually presented information) and verbalizers (those who prefer verbally presented information) understood the reading text better when they accessed their preferred mode of annotations.

Plass et al.'s (2003) study showed that low ability learners (low-verbal and low-spatial ability) perform poorly in vocabulary texts when they receive visual annotations. For reading comprehension, all learners performed the worst when they received visual annotations. According to the authors of the study, visual annotations induce high cognitive load as they are needed to be attached meanings. They point out that without words the meanings of the words may be ambiguous and attaching a meaning to the pictures might require additional mental effort and cognitive resources.

Another individual difference variable that was researched was working memory capacity. Chun and Payne (2004) found a relationship between look up behaviour and phonological working memory capacity (PWMC). Results showed

that students who had low PWMC looked up more words to compensate for their memory limitations while reading.

In the studies mentioned so far, different types of annotations were presented successively rather than simultaneously. To the researcher's knowledge, effects of simultaneous presentation of multimedia glosses on reading comprehension and incidental vocabulary learning in a second language have not been investigated. Presenting verbal and visual information contiguously in time is the temporal contiguity principle in Mayer's theory of multimedia learning. Thus, this study aims to investigate the effects of presenting verbal and visual information simultaneously versus successively. It tests the hypothesis that having verbal and visual information in working memory at the same time helps learners build referential connections more easily and reduces cognitive load, thus leads to better reading comprehension and incidental vocabulary learning.

Conclusion

This chapter has discussed the theoretical background of the study in terms of L2 reading comprehension, incidental vocabulary learning and learning in multimedia environments.

An overview of related reading theories suggested that the model of reading that best accounts for the nature of L2 reading is the interactive one. In interactive models, top down and bottom up processes were considered complementary while taking into account what the reader brings to the text. Glosses are thought to serve both processes as they can be used to provide textual as well as contextual

information which are crucial for decoding and schema activation processes respectively.

Previous research on incidental vocabulary learning has shown that it is possible to learn new vocabulary through oral and written contexts particularly when the words in question occur frequently in those contexts. However, this was not without its drawbacks. First of all, it is not possible to control for the frequency of occurrence of a word in a particular context if authenticity is not to be distorted. Secondly, the context surrounding the unknown word may not provide enough clues to infer the meaning; or the learner may not need to infer the meaning of a word since adequate comprehension is possible without it. To compensate for such drawbacks, consulting dictionaries or glosses was suggested. Since dictionaries were considered to be more disruptive than glosses, glossing the unknown vocabulary was preferred. Moreover, glossing was thought to prevent incorrect guesses and result in better vocabulary gains. Research on the effectiveness of hypermedia glosses have shown that they make authentic texts easier to understand, allow learners to access further information more easily and lessen the disruption caused by consulting a source to better understand the texts. What is more, they are more facilitative when they present the same information in at least two modalities (verbal and visual).

Since the study is concerned with learning in multimedia environments, Mayer's (1997) Generative Theory of Multimedia Learning has been reviewed along with other cognitive theories it draws upon. Based on three assumptions (dual channels assumption, limited capacity assumption and active processing assumption), the theory suggests that meaningful learning occurs when learners select relevant verbal and visual information from what is presented and organize it into a coherent whole and integrate them using existing schemata. On the basis of

these assumptions, Mayer proposes several design principles which are argued to result in better learning.

This study is concerned with the contiguity principle of the theory which predicts that presenting verbal and visual information at the same time leads to better learning than when they are presented successively for it is easier to build connections between the two modes of the same information in that way. The aim of the study is to see the effect of presentation mode of annotations on L2 reading and incidental vocabulary learning in the light of the contiguity principle. The research questions and the procedures followed to answer them are presented in detail in the next chapter.

CHAPTER III

METHODOLOGY

This chapter presents the methods and procedures employed in the study. Research questions, participants and materials used to collect data are presented respectively. Data analysis procedures follow.

Research Questions

The study aims to explore the effect of presentation mode (simultaneous versus successive presentation) of verbal and visual annotations on reading comprehension and incidental vocabulary learning. The following research questions were investigated:

1. What is the effect of presentation mode of verbal and visual annotations on reading comprehension of intermediate level Turkish learners of English?
2. What is the effect of presentation mode of verbal and visual annotations on incidental vocabulary learning of intermediate level Turkish learners of English?

Participants

The research has been carried out in grade 9 in a state high school in İstanbul. The participants were considered to be intermediate level learners of English. They had all studied intensive English for one year after grade 8. During this year, they had

studied English for 24 hours a week. Three course books of different levels (starter, elementary and pre-intermediate respectively) had been covered taking the students from beginner to intermediate level. When the study was carried out, they were in the ninth grade where eight hours of English per week was allocated. 43 female and 39 male students participated in the study. Their age ranged between 15 and 16 years.

Treatment

An authentic text was chosen and turned into a hypertext. The text "*What's up with the Weather*?" comprising 980 words comes from an educational web site called *pbs.org* (see Appendix A). To determine the text, students were provided with a list of topics taken from *pbs.org, cnn.com, national geographic and discovery channel* websites and were asked to rate them on a 5 point scale where 1 indicated no interest while 5 indicated full interest (see Appendix B). There were four texts that had an average rating above 3.5. Although the text chosen did not have the highest rating (3.8), it was chosen because the students had background knowledge about the topic which would lessen the frustration of dealing with an authentic text for the learners. The text was also more suitable to annotate.

The text was piloted with 29 intermediate level students who did not take part in the actual study to determine the words to be annotated. Those students were enrolled at another state high school. The students were asked to read the text and underline every unknown word. No time limit was set and 123 words were underlined. The words underlined only once or twice were omitted and 85 words were annotated in the study.

For each word, 3 or 4 pictures were found. All the pictures were printed in colour and shown to 7 English teachers. They were asked to choose the picture they think that describes the word in question best. There were discrepancies as to which picture represents the related word best. In such cases, the pictures with the highest rating were chosen.

For verbal annotations, definition of each word was obtained from Oxford's Advanced Learner's Dictionary. The definitions were kept as short as possible as there were a lot of words to be annotated. For the words that did not lend themselves to be described with a picture, only verbal annotations were used.

Once the pictures and definitions were determined, they were incorporated into a hypertext software and shown to 3 English teachers to check the definitions and quality of images. No changes were necessary. The software used was designed by Ariew (1999) and modified for the study to allow simultaneous presentation of verbal and visual annotations. It recorded the total time spent in reading, the frequency of access to annotations and the order in which they were accessed via its built-in tracking tool.

Two versions of the same text were prepared. Both versions included verbal and visual annotations and annotated words were highlighted in blue. The difference between the two was the presentation mode of annotations. In the successive version, definitions and pictures were presented successively (see Figure 1).

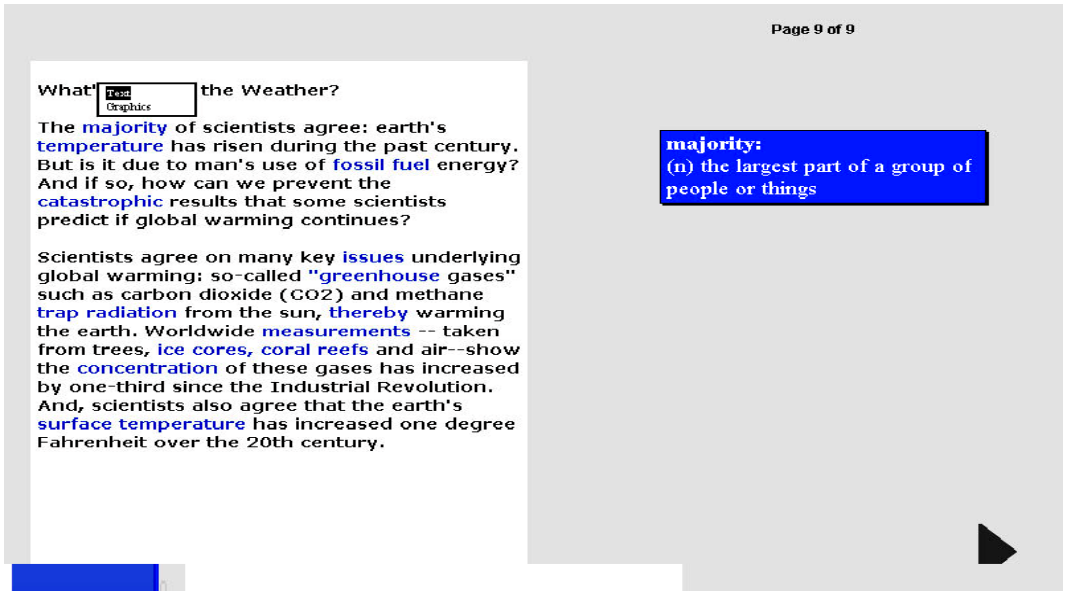


Fig. 1: A screen shot showing the layout of successive version

As Figure 1 shows, when the participants clicked on a highlighted word, they had two options: graphics and text. They were free to choose only one of them or both. When they chose the "text" option, they were provided with the definition of the highlighted word and its grammatical form. When the "graphics" option was chosen, a picture illustrating the meaning of the highlighted word appeared on the right side of the screen. Sometimes pictures were accompanied by a sentence that aimed to help participants interpret the picture and focus their attention on the related meaning of the word.

In the simultaneous version (see Figure 2), when the participants clicked on a highlighted word, they were immediately presented with the pictures and definitions at the same time. There was no menu to choose the annotation type from. The pictures were presented at the top right and the definitions just below them.

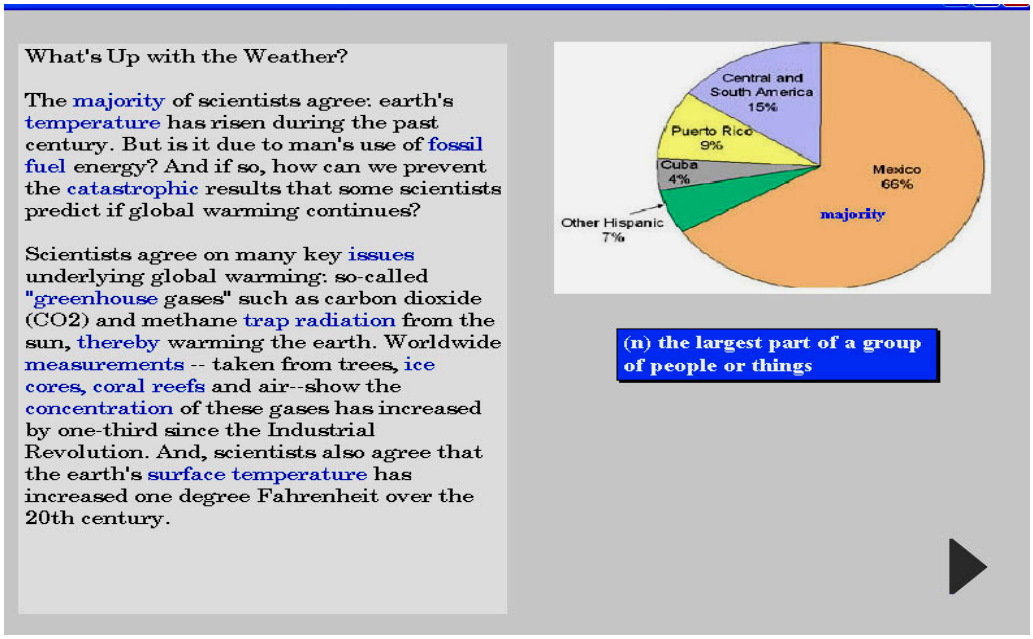


Fig. 2: A screen shot showing the layout of simultaneous version

The text comprised 9 pages presented linearly. Students were free to go back and forth using the buttons provided on the right of the screen at the bottom. They also had the chance to reread the text before they quit by clicking "Yes, I want to start from the beginning" option provided on the last page.

Data Collection

Several tests were developed by the researcher. Two reading tests, four vocabulary tests and a prior knowledge test were used. In the vocabulary tests, only the words annotated both verbally and visually were included.

Reading Tests

Bernhardt (1998) points out that there is no perfect assessment mechanism that measures all processes involved in reading comprehension. Alderson (2000) also suggests using more than one method as it is inadequate to measure comprehension by one method. Furthermore, every technique has its drawbacks; therefore two different assessment techniques were utilized to measure reading comprehension.

Recall was chosen as one of the measurement techniques since reading process is seen as reconstructing the message of the text with the help of reader's background knowledge (Bernhardt, 1998). Meaning is created in the interaction between a reader and a text and reader's knowledge and experience influence this creation process (Alderson, 2000).

Another reason for employing recall was that the context allowed the use of native tongue while writing the protocols. Bernhardt considers recalls to be a better measurement of reading comprehension if learners are allowed to write in their L1. Thus, the recall procedure removed the linguistic barrier to express reading comprehension for intermediate level students in this study.

For the scoring of recall protocols, propositions based on pausal units were analyzed. A pausal unit is defined as a proposition that has a pause at the beginning and end during normal oral reading (Alderson, 2000). To decide on the pausal units, two native speakers of English were asked to read the text aloud. They were videotaped and then the text was divided into pausal units on the basis of their pauses. There was 83 percent agreement between the native speakers as to where the pause is. For the discrepancies, the researcher preferred the shorter idea units and used judgement to decide if there was really a proposition in that pausal unit.

Another rater also analyzed the reading-alouds and there was 86 percent agreement between the raters. The two raters got together to determine where the pausal unit was or should be whenever there was a discrepancy. A total of 203 idea units were identified (see Appendix C).

While scoring students' recall protocols, two independent raters scored 5 protocols together. Then they individually scored the same 20 protocols. The inter-rater reliability coefficient was .97. The rest of the protocols were scored only by the researcher.

The other technique used to measure reading comprehension was a *multiple choice test* consisting of 15 questions (see Appendix D). Since the study required students to indulge in careful reading to complete the tasks, the construct of reading comprehension comprised skills and strategies for careful reading both at the local and global level. In other words, not only micro but also macro processes were involved. Therefore, there were analysis and synthesis questions as well as reference and paraphrase. Each question had one correct option and three distractors. The multiple choice test was piloted and after the pilot study item difficulty and discrimination analyses were carried out. The items that had not performed well were modified or rejected according to their item facility or discrimination values. Students spent 6 minutes on this test in the pilot study; therefore test time was determined as 10 minutes for the actual study. The test gave out a reliability coefficient of .648 for the pilot study. It was .628 for the actual study.

Vocabulary Tests

Four vocabulary tests were developed based on the tests used in studies by Knight (1994), Laufer & Goldstein (2004), Rott, 1999 and Waring & Takaki (2003)). These tests included a checklist, a production, a definition match and a bilingual synonym match test. All of the tests were given unannounced as they aimed to measure incidental vocabulary learning.

The *checklist* (see Appendix E) was a form recognition test in which students were given all 35 target items and 15 distractors and were asked to choose the ones they had seen in the text. After piloting the test with 29 intermediate level students, reliability and distractor efficiency analyses were carried out. A reliability coefficient of .671 (Cronbach Alpha) was obtained. Some of the items were modified since item facility and discrimination values were not between the accepted limits. It took students 3 minutes to complete the test, so it was decided to allot 5 minutes in the actual study. The reliability coefficient of the actual study turned out to be .670.

Production test (see Appendix E.01) was a passive recall test as Laufer and Goldstein (2004) put it. Students were provided with all 35 items and their grammatical forms and were asked to write L1 translations. In this section, the highest possible score was 70 as each correct answer was awarded two points and incomplete answers 1. Inter-rater reliability coefficient turned out to be .99. Pilot study gave out a reliability coefficient of .652 while a coefficient of .781 was obtained in the actual study. Students completed this task in 10 minutes in the pilot study; therefore 13 minutes were allotted for the test in the actual study.

Definition match (see Appendix E.02) was an active meaning recognition test where students were provided with the definitions and asked to supply the target word. 15 (out of 35) of the target vocabulary and 15 distractors were included in this test. The test was divided into three sections according to words' grammatical categories to make the matching easier for students. There were 3 verbs, 3 adjectives and 9 nouns tested in this section; therefore 3 of the distractors included were verbs, three of them were adjectives and 9 of them were nouns. Definitions used in the test were the same as the ones used in the annotations. In the pilot test, in the text given to students, annotated words were in bold and the definitions of these words were provided as a glossary. The students were asked to read the text and check the glossary paper for the meanings of the words. When the group was presented with the definition match test, it took them 7 minutes to complete the test, so the test time for the actual study was determined as 10 minutes. After the pilot study, distractor efficiency analyses were carried out and options preferred occasionally or never were modified or removed. A Cronbach Alpha reliability coefficient was calculated and .679 was obtained. In the actual study, it was .614.

Bilingual synonym match (see Appendix E.03) was a passive meaning recognition test. It aimed to test the 20 target words that were not included in the other meaning recognition test (definition match). It was a multiple choice test where target words were presented in L2 in the stem. Students had four options presented in L1 to choose the correct option from. In the pilot study, students completed the task in 7 minutes; therefore students were given 10 minutes in the actual study. Some distractors were modified after a distractor efficiency analysis and reliability analysis revealed an alpha of .695. However this decreased to .422 in the actual study.

Prior Knowledge Test

Although students were randomly assigned to groups and random assignment is considered to equalize the groups, a prior knowledge test (see Appendix F) was designed and administered a day before the treatment. The need to test prior knowledge despite random assignment arose from the fact that the topic was familiar to all of the students as it was a current issue and there was a unit in their course book on environmental problems including global warming. The researcher took into consideration the fact that the teachers instructing the classes that took part in the study might have put different amount of emphasis on the issue and wanted to assure that there was not a significant difference between the groups in terms of prior knowledge. Therefore, 6 open-ended questions were prepared that asked about most salient features of global warming and a 7^{th} question was included which requested students to add anything they knew about global warming that was beyond the scope of the first 6 questions. Each correct proposition was awarded 1 point and there was no highest possible score. Students mentioned 23 propositions at most.

An independent samples t-test was conducted to see if the groups were alike in terms of prior knowledge. The results showed that the mean of the successive group (M=11.95, SD=4.09) was slightly higher than that of the simultaneous group (M=11.31, SD=3.16). However, this difference between the groups was not significant (t_{80}=.784, p=.435). Therefore, it was concluded that the groups did not differ in terms of prior knowledge.

Data Collection Procedures

The participants were at three different classes and the researcher was instructing one of them. She worked cooperatively with the English teachers instructing other two classes to prepare the participants for the study. Since the participants were not familiar with the test technique to be employed in the study, which was recall, they were trained by using three different texts. Two of the texts were not authentic since it was the participants' first encounter with recall and it would be hard for them to cope with an authentic text and an unfamiliar test technique at the same time. However, since they were going to be provided with an authentic text in the actual study, the last text used in the training was authentic. These texts were given as extra reading texts to be dealt with at regular class hours with one week intervals. Regular reading and vocabulary activities were conducted; but for comprehension check, the recall procedure was used. They were instructed to write whatever they remembered and understood in their mother tongue.

Students were also taken to the computer lab once to check basic computer skills needed for data collection although most of the students had personal computers or access to computers outside the school.

The participants were given a prior knowledge test one day before the treatment. Geography teachers administered the test and told the students that the purpose of the test was to check the students' knowledge on global warming and asked them to write whatever they know about it. The reason geography teachers administered the prior knowledge test was to make sure that the students did not relate it to the reading tests they were to take. Students were randomly assigned to

groups. Groups were also assigned to treatments randomly. There were 41 participants in each group.

Both versions of the program were installed to the twenty computers in the lab. The treatment was given in the spring semester of 2006, in May as the reading exam to ensure that students pay attention and complete the tasks carefully. First, the successive group was taken to the lab. They were demonstrated how to use the software. Before they began to read, they were told that they were going to write whatever they remembered and understood from the text in their mother tongue, Turkish. They were also reminded that it would be easier for them to understand the text if they looked up the annotations. When they finished reading, they were taken to their class accompanied by a teacher. They started to take the tests while another group was taken to the lab. Each group was given exactly the same instructions in the lab and oriented with software demonstration. The students were not released until the last group was taken to the lab to prevent interaction among the students. Five teachers helped the researcher with the administration of the tests since the researcher had to be in the lab to explain how to use the software.

After the treatment, the participants were first given the announced recall test and told that they had 20 minutes to complete this task. Then they were given the unannounced vocabulary tests which lasted 38 minutes- 5 minutes for form recognition, 13 minutes for production and 10 minutes for definition match and another 10 minutes for bilingual synonym match test. When they finished the vocabulary tests, they were given the second reading comprehension test which consisted of 15 multiple choice questions. The students had 10 minutes for that test as well.

Data Analysis

The groups were assumed to be equal as the students were randomly assigned to the groups and the groups were randomly assigned to the treatment conditions. Therefore no further inspections regarding equality on confounding variables were considered necessary. However, as it was already mentioned, the groups were compared in terms of prior knowledge. This was done due to the possibility of different amount of prior topical knowledge students might have as a result of different amount of emphasis teachers might have placed on the topic in class. An independent samples t-test was conducted to check this possibility. Results indicated that groups were not significantly different in terms of prior knowledge.

The groups were compared on two variables: reading comprehension measured by recall and multiple choice tests and incidental vocabulary learning by form recognition (checklist), meaning production (production), active and passive form recognition (definition match and bilingual synonym match respectively) tests.

The first research question is concerned with the effects of presentation mode of annotations on reading comprehension measured by two tests. Since there was not a significant difference between the groups in terms of prior knowledge, a one-way multivariate analysis of variance (MANOVA) was conducted instead of a multivariate analysis of covariance (MANCOVA) using presentation mode (successive versus simultaneous) as the between groups variable and reading comprehension scores obtained from multiple choice and recall tests as dependent variables.

The second research question was concerned with the effects of presentation mode of annotations on incidental vocabulary learning. To investigate this, a one-

way multivariate analysis of variance was conducted on vocabulary measures (checklist, production, definition match and bilingual synonym match tests) as the dependent variables and presentation mode (successive versus simultaneous) as the between groups variable.

Summary

The research questions, data collection and analysis methods are summarized in the table below.

Table 1: Summary of Research Questions and Related Procedures

Research Questions	Instruments	Data Analysis	Hypotheses
What is the effect of presentation mode of verbal and visual annotations on reading comprehension of intermediate level Turkish learners of English?	Two reading comprehension tests: recall protocol and multiple choice tests.	One-way MANOVA	The simultaneous group was expected to perform better on tests as suggested by Generative Theory of Multimedia Learning (Mayer, 1997).
What is the effect of presentation mode of verbal and visual annotations on incidental vocabulary learning of intermediate level Turkish learners of English?	Four vocabulary tests: form recognition, meaning production, active and passive meaning recognition tests given immediately after the treatment.	One-way MANOVA	The simultaneous group was expected to perform better on tests as suggested by Generative Theory of Multimedia Learning (Mayer, 1997).

CHAPTER IV

RESULTS

This chapter presents the results of the analyses conducted to answer the research questions discussed in the preceding chapter. Quantitative analyses were carried out and statistical tests were used to examine the effects of presentation mode of annotations on reading comprehension and incidental vocabulary learning.

Effects of Presentation Mode of Annotations on L2 Reading Comprehension

The first research question investigates whether presentation mode of verbal and visual annotations have an effect on reading comprehension measured through recall and multiple choice reading comprehension tests. First, groups were compared on prior knowledge to ensure that they were not significantly different from each other. An independent samples t-test revealed that groups were alike in that respect. Therefore, a one-way multivariate analysis of variance (MANOVA) was conducted instead of a multivariate analysis of covariance (MANCOVA). Means and standard deviations of the groups for reading comprehension scores on both tests are given in Table 2.

Table 2: Means and Standard Deviations for Reading Comprehension Tests

Group	Recall		Multiple choice	
	M	SD	M	SD
Successive	26.34	11.27	4.24	1.52
Simultaneous	25.65	13.09	5.92	3.12

There seems to be slight differences between the groups in terms of reading comprehension scores on both tests. Nevertheless, to see whether these differences were statistically significant, a one-way MANOVA was conducted. Since the sample size is large enough and groups are equal in number (41 participants in each group), test results were considered to be robust to violations of assumptions of normality and homoscedasticity. MANOVA results indicated significant differences between groups on the combined dependent variable, Wilks' Λ=.891, F(2,79)=4.849, p<.05, partial η^2 =.109. Analysis of variance was conducted on each dependent variable as a follow up test to MANOVA.

Table 3: Summary of MANOVA for Reading Comprehension Scores

Source	SS	df	MS	F
Recall	9.561	1	9.561	.064
Error	11940.439	80	149.255	
Multiple Choice	58.061	1	58.061	9.590**
Error	484.341	80	6.054	

*p<.05, **p<.01, ***p<.001

As the table shows, group differences were significant for multiple choice test, F(1,80)=9.590, p<.05, partial η^2 =.107; but not for recall, F(1,80)=.064, p=.801. In other words, simultaneous group scored significantly higher on the multiple choice test of reading comprehension than the successive group. However, both groups performed similarly on recall.

Effects of Presentation Mode of Annotations on Incidental Vocabulary Learning

The second research question investigates the effects of presentation mode of annotations on L2 incidental vocabulary learning measured by four different tests.

As can be seen from Table 4, the groups differed on their performances across the tests.

Table 4: Means and Standard Deviations for Vocabulary Tests

Tests	Successive Group		Simultaneous Group	
	M	SD	M	SD
Checklist	14.53	4.80	17.34	3.65
Production	7.90	3.91	15.00	7.49
Definition match	5.00	2.26	6.51	2.07
Bilingual synonym match	10.12	2.89	10.63	2.50

The differences between the groups were larger on tests of form recognition (checklist), meaning production and active meaning recognition (definition match) than on the test of passive meaning recognition test (bilingual synonym match test). There was a slight difference between the groups on the bilingual synonym match test. To see whether those differences reached significance, a one-way MANOVA was conducted. MANOVA results gave out significant differences between the groups on the combined dependent variable, Wilks' Λ=.676, F(4,77)=9.245, p<.05, partial η^2 =.324. Analysis of variance (ANOVA) was conducted on each dependent variable as a follow up test to MANOVA.

Table 5: Summary of MANOVA for Vocabulary Scores

Source	SS	df	MS	F
Checklist	161.280	1	161.280	8.853**
Error	1457.415	80	18.218	
Production	1032.695	1	1032.695	28.911***
Error	2857.610	80	35.720	
Definition match	46.878	1	46.878	9.915**
Error	378.244	80	4.728	
Bilingual synonym match	5.378	1	5.378	.732
Error	587.902	80	7.349	

*p<.05, **p<.01, ***p<.001

As the table indicates, group differences were significant for form recognition test, $F(1,80)=8.853$, $p<.05$, partial $\eta^2=.100$ indicating that simultaneous group performed significantly better than the successive group on this test. Similar results were obtained with regard to meaning production test. Simultaneous group performed significantly better, $F(1,80)= .28.911$, $p<.05$, partial $\eta^2=.265$. The same was true for active meaning recognition test, $F(1,80)=.9.915$, $p<.05$, partial $\eta^2=.110$. However, the difference in the means on passive meaning recognition test did not reach significance, $F(1,80)= .732$, $p=.395$ with an observed power of .135, demonstrating that simultaneous and successive groups performed similarly in relation to bilingual synonym match test.

Conclusion

The results indicate that the group that received the annotations at the same time (simultaneous group) performed better on multiple choice reading comprehension test as well as on form recognition, meaning recognition, and meaning production tests. No differences were observed between the simultaneous and successive presentation modes on recall and on bilingual synonym match tests.

CHAPTER V

DISCUSSION AND CONCLUSION

The purpose of the study was to examine the effect of presentation mode of verbal and visual annotations on reading comprehension and incidental vocabulary learning of intermediate level L2 learners of English. There were two experimental groups. One of the groups viewed verbal and visual annotations simultaneously on the screen upon clicking on a word while reading the text while the other group viewed them one after another (i.e. successively). The study was particularly concerned with the scores obtained by both groups on recall and multiple choice tests for reading. The other concern was scores on tests of form recognition, passive and active meaning recognition and meaning production for vocabulary learning.

Since random assignment was realized when assigning participants to groups and treatment conditions, groups were considered to be equal on confounding variables before they were exposed to the treatment.

In this chapter, the results that were presented in the previous chapter will be discussed in relation to the theories that they fit into. Firstly, the findings regarding the effect of presentation mode of annotations on reading comprehension and incidental vocabulary learning will be discussed. Implications drawn based on the results, limitations of the study and the recommendations for further research will follow respectively.

Discussion

Findings of the study in relation to the first research question suggest that allowing students to have access to verbal and visual annotations at the same time result in better reading comprehension than allowing successive access. Nevertheless, it should be pointed out that this was the case in multiple choice reading comprehension test but not in recall. In the latter the groups performed similarly implying that receiving annotations in simultaneous or successive mode did not make a difference in terms of the amount of information that was recalled from the text. The recall scores were obtained by calculating the number of propositions the participants remembered whereas in multiple choice test they had to answer synthesis as well as inference questions. In other words the multiple choice test measured deeper level understanding. Hence, it could be suggested that there might not be a difference between simultaneous and successive presentation modes when lower level knowledge was called into question. On the other hand, when deeper level knowledge is questioned, simultaneous access to both types of annotations definitely leads to better performance.

These findings are in line with those of Mayer's findings from L1 studies. In his studies, Mayer used two kinds of tests: retention and transfer. Retention tests measured the ability to remember important information from multimedia presentations while transfer tests measured participants' ability to use the information they got from multimedia presentations to solve various related problems. In some of his experiments (Mayer & Anderson, 1991, 1992), Mayer could not find a significant difference between the groups on tests of retention but transfer. The difference between the formats of multimedia presentations surfaced

when deeper level knowledge was needed to accomplish the task like transfer tests in Mayer's studies and multiple choice tests in the current study.

Similar findings were obtained with regard to second research question that sought to examine the effect of presentation mode of annotations on incidental vocabulary learning. Participants were tested by using four different vocabulary tests, each measuring different levels of vocabulary knowledge. On three out of four tests, simultaneous group performed significantly better than the successive group. Those tests were form recognition, active meaning recognition and meaning production tests. On the last test, which was labeled as passive meaning recognition test (bilingual synonym match test), groups performed similarly. That is to say that viewing verbal and visual annotations simultaneously while reading an expository text result in better vocabulary gains as suggested by the results of three tests but one-bilingual synonym match test. The reason why groups did not differ in their performances on this test might be that bilingual synonym match test was a passive meaning recognition test. As Laufer and Goldstein (2004) point out, this test measures low level vocabulary knowledge. As it was the case in recall, passive meaning recognition test may not detect the difference between simultaneous and successive presentation mode of annotations as it does not require deeper level knowledge. What is more, the fact that the test was bilingual (prompt was in English, options were in Turkish) may have helped the participants while doing the test by reducing text anxiety, eliminating the interference of knowledge of another language and thus by making them feel more comfortable.

Findings of the study in relation to reading comprehension and incidental vocabulary learning are both in accord with Mayer's Generative Theory of Multimedia Learning and its assumptions. The first assumption "dual channels

assumption" suggests that presenting information in more than one modality (in visuals as well as words) leads to better performance and is met by the presentation format both groups were exposed to. What created the difference between the groups was the second assumption- limited capacity assumption- of the theory according to which working memory is limited in its capacity to process information at any one time. In the successive group, participants viewed one type of annotations at a time and needed to hold that information in working memory until the same information is received in different modality. This is likely to cause cognitive load when the limited capacity of working memory is taken into account. On the other hand, the simultaneous group had the same information in both modalities at a time which made it easier for them to build referential connections between the two as they were held in the working memory at the same time. Building referential connections between visual and verbal input more easily by means of simultaneous presentation frees up cognitive resources that had to be reserved to hold the information presented in one modality while information in other modality gets into working memory and makes them available for active processing. Thus the simultaneous group performed better than the successive group, particularly when deeper levels of knowledge are required to perform on tasks.

Conclusion

The present study is based on the findings of previous research on multimedia principle which has suggested that using visuals alongside words lead to better vocabulary learning (Akbulut, 2005; Al-Seghayer, 2001; Chun & Plass, 1996a,

1996b). Since no research has been conducted on the contiguity principle in L2, this study takes the findings of research on multimedia principle one step further and suggests that it is important to present verbal and visual annotations simultaneously rather than successively while reading an expository text as it leads to better reading comprehension and vocabulary gains.

Implications

Findings of the study suggest important implications for the design of hypermedia presentations in L2 reading and vocabulary learning.

In the field, several advantages of hypermedia environments such as provision of individualized learning, ease and speed of access to information and providing contexts for meaningful learning are noted. Of concern here is the freedom of choice under individualized learning. In other words, learners can choose the kind of multimedia aids according to their needs and learning styles. However, findings of the study suggest that it would be better if the choice is provided in a principled, not a haphazard way. Presenting definitions of words with their associated pictures simultaneously instead of successively may force a presentation mode on the reader. Yet, this results in better learning as the results of this study imply. Therefore, material developers as well as teachers who are interested in developing their own or supplementary materials on the basis of their students' needs should take this into account. While preparing multimedia presentations that aim to take advantage of using visual as well as verbal material to explain the same information, it is important to keep in mind that they are likely to result in better learning when presented simultaneously.

Limitations and Suggestions for Further Research

The study has several limitations and therefore the findings should be interpreted cautiously.

First of all, the target population of the study was intermediate level Turkish learners of English. 82 intermediate level EFL learners attending a state high school comprised the sample of the study. To be able to generalize the findings of the study to a larger population, it should be replicated with learners at different levels of proficiency and from different contexts. Therefore findings need to be interpreted taking the individual differences principle of multimedia learning theory into account.

Secondly, although students had visual support in the reading text, the tests they took did not involve those materials. Therefore, using tests that make use of visual as well as verbal elements would yield more valid results.

Thirdly, due to time constraints, effects of presentation mode of annotations on the retention of incidental vocabulary gains could not have been investigated. Whether the advantageous effects of simultaneous presentation on vocabulary gains on immediate post tests last over a certain period of time should be investigated in a further study.

Finally, the study was a cross-sectional one in which data was collected at one time. More valid and illuminating results would be obtained with longitudinal studies that look into the effects of presentation mode of annotations on reading and vocabulary learning.

Appendix A

The text

What's Up with the Weather?

The **majority** of scientists agree: earth's **temperature** has risen during the past century. But is it due to man's use of **fossil fuel** energy? And if so, how can we prevent the **catastrophic** results that some scientists predict if global warming continues?

Scientists agree on many key **issues** underlying global warming: so-called "**greenhouse** gases" such as carbon dioxide (CO_2) and methane **trap radiation** from the sun, **thereby** warming the earth. Worldwide **measurements** -- taken from trees, **ice cores**, **coral reefs** and air--show the **concentration** of these gases has increased by one-third since the Industrial Revolution. And, scientists also agree that the earth's **surface** temperature has increased one degree Fahrenheit over the 20th century.

But a **fierce debate** centers on whether this warming is a natural **phenomenon** or the result of man's burning of fossil fuels like **coal** and oil, which increase the amount of CO_2 in the atmosphere. Leading scientists, **policymakers** and fuel industry **representatives** have **sharply** different **viewpoints**.

Those who believe human activity is **contributing** to global warming say the problem is **compounded** because most people are **unaware** of their own role in global warming--due to their **dependency** on fossil fuels for energy. It's a dependency which could affect the planet's **fate**, say greenhouse **proponents**.

The United States, for example, is responsible for one quarter of the world's energy **consumption**, the vast majority of which is **generated** by burning fossil fuels. As a result, each American is directly or indirectly responsible for the **release** of 20 tons of CO_2 each year. We are all aware that our cars burn gas like it is their business (well, it is their business). And we know heating and lighting our homes takes a **significant** amount of energy. But what about video games? **Fish tanks**? Computers? How **efficient** are we? A typical U.S. family spends close to $1,300 on **home utility** bills, much of which is spent on wasted energy. By taking some simple steps, it is possible to **drastically** reduce the amount of energy you use - saving money on your next utilities bill and easing up on the CO_2 we are **pouring** into the atmosphere.

"If the planet warms too much, we are going into unknown **territory**," says Tom Wigley, senior scientist for the National Center for Atmospheric Research (NCAR). "If we were to warm the world by five degrees, I strongly believe that large parts of the Antarctic ice sheet would **flow** into the ocean, melt, and cause sea level to rise by many meters."

That could mean **disastrous flooding** of **coastal** areas. Other scientists predict **intense storms**, **droughts, famines**, the **spread** of **infectious diseases**, and the **wholesale destruction** of species and habitats.

But others aren't so sure. A direct connection between man and the earth's warming has yet to be proven, say scientists such as Fred Singer, an atmospheric physicist. He suggests that the earth's increased temperature is due to natural causes and argues that increased levels of CO_2 in the atmosphere are actually a good thing. Fred

Palmer, another **skeptic**, argues that inexpensive fossil fuels such as coal are an **essential component** of U.S. economic success and **cutting back** fossil fuel use would seriously affect the world's social and economic progress.

Who's right? Scientists on both sides of the global warming debate are building **sophisticated** computer models to predict various climatic scenarios. But, the **slightest** change in one **variable** produces a range of possible climatic **outcomes**, resulting in even more speculation about global warming's real **impact.**

This scientific uncertainty fuels political uncertainty, as the United States **struggles** to decide what, if any, action to take. The 1997 **Kyoto Protocol commits** the United States and other industrial nations to significant **cutbacks** in greenhouse gas **emissions**. Critics argue that the cutbacks will harm the U.S. economy, particularly since developing nations have not agreed to cut their own growing use of fossil fuels.

The possibilities--and **challenges**--in turning to non-carbon energy sources includes nuclear power and "**renewable** energies." The first alternative, renewables include **solar** energy in its various forms, **biomass** energy, wind power. Sometimes **geothermal** energy is included in that as well. But all of these sources of solar energy **tend to** be very **episodic** -- they're not always there -- and the power **density** is low, that is, the number of watts **per** square meter is pretty low. The fact that it's episodic is important. We can **convert** solar energy in **photovoltaic cells** with an **efficiency** of maybe 15 or 20 percent, but most people want to turn on the lights at night, and the sun isn't shining at night. So we need some kind of a system that will **distribute** the available renewable energy to the place where it's needed.

In contrast to renewable energy, nuclear power is a very high-density source of energy. Biomass energy per unit area can produce a few watts per square meter. By contrast, the **boiler** of a nuclear power **plant**, where the nuclear energy is being converted into **steam**, produces tens or hundreds of thousands of watts per square meter. However, nuclear power as you know, has been a very **contentious** issue in the United States and in other parts of the world. Since the Three Mile Island and Chernobyl nuclear accidents, no nuclear power plants have been built, and there are many, many sets of issues having to do with the **disposal** of radioactive materials and the **proliferation** of weapons-grade material and so forth.

Scientists also hold out hope for developing unimagined new technologies that will replace fossil fuels.

"There comes a point when you can't escape the idea that you're having serious climatic **consequences**," says Richard Somerville of the Scripps Institution of Oceanography. "The issue becomes one of whether we get **wise** before that day or whether we have to wait for some perhaps quite **unanticipated** climate surprise that wakes us all up."

Appendix B
The questionnaire used to choose the text

Below are topics that are taken from several magazines and web sites. Read them and then decide whether you find them

1) NOT INTERESTING AT ALL
2) SLIGHTLY INTERESTING
3) SOMEWHAT INTERESTING
4) INTERESTING
5) VERY INTERESTING

He Rex or She Rex? Experts Find a Way to Tell Dino Gender
Scientists found a way to tell the genders of dinasours which is also seen as evidence that birds descended from dinasours. (*National Geographic*)

The Marijuana Debate: Healing Herb or Dangerous Drug?
Some argue that marijuana is a dangerous drug and should remain illegal while others argue that it has healing effects and doctors should be able to prescribe it. (*National Geographic*)

What's up with the Weather?
What is the reason behind global warming? The hot discussion. Is it due to natural causes or man's actions? (*PBS)*

Warming to Cause Catastrophic Rise in Sea Level?
What could be the consequences of melting ice as a result of global warming for us and for future generations? *(National Geographic)*

Life is Confusing for Two-headed Snakes
How do they become two headed and how does this affect their ability to hunt and mate? *(National Geographic)*

The Worst Flu Season
What are the symptoms of ways to prevent from flu and cold? *(CNN)*

Bullying and the Prevention of School Violence
What is bullying, signs of it and ways to prevent or reduce it? *(PBS)*

Tattoos and Piercings
Why do people get tattoos and piercings? The risks involved when getting a tattoo or piercing and the consequences (diseases one might get). *(PBS)*

Vitamins: Is Supplementation Necessary?
Are the vitamins we get from what we eat sufficient or is it necessary to supplement and how? (*PBS)*

Eating Disorders in Women
The kind of disorders women have and the ways to treat them. *(Discovery Channel)*

Appendix C
Pausal Units

What's Up with the Weather?

1. The majority of scientists agree:
2. earth's temperature
3. has risen
4. during the past century.
5. But is it due to man's
6. use of fossil fuel energy?
7. And if so,
8. how can we prevent the catastrophic results
9. that some scientists predict
10. if global warming continues?

11. Scientists agree on many key issues
12. underlying global warming:
13. so-called
14. "greenhouse gases"
15. such as carbon dioxide (CO_2)
16. and methane trap
17. radiation from the sun,
18. thereby warming the earth.
19. Worldwide measurements –
20. taken from trees,
21. ice cores,
22. coral reefs
23. and air—show
24. the concentration of these gases
25. has increased
26. by one-third
27. since the Industrial Revolution.
28. And, scientists
29. also agree
30. that the earth's surface temperature
31. has increased one degree Fahrenheit
32. over the 20th century.

33. But a fierce debate
34. centers on
35. whether this warming
36. is a natural phenomenon
37. or the result of man's burning of fossil fuels
38. like coal
39. and oil,
40. which increase the amount of CO_2 in the atmosphere.
41. Leading scientists,
42. policymakers

and fuel industry representatives
have sharply different viewpoints.

Those who believe human activity is contributing to global warming
say the problem is compounded
because most people are unaware of their own role in global warming—
due to their dependency on fossil fuels
for energy.
It's a dependency
which could affect the planet's fate,
say greenhouse proponents.
The United States,
for example,
is responsible for one quarter of the world's energy consumption,
the vast majority of which
is generated
by burning fossil fuels.
As a result,
each American is
directly
or indirectly
responsible for the release of 20 tons of CO_2 each year.
We are all aware that our cars burn gas
like it is their business
(well, it is their business).
And we know heating and lighting our homes
takes a significant amount of energy.
But what about video games?
Fish tanks?
Computers?
How efficient are we?
A typical U.S. family spends close to $1,300
on home utility bills,
much of which is spent on wasted energy.
By taking some simple steps,
it is possible to drastically reduce the amount of energy you use –
saving money on your next utilities bill
and easing up on the CO_2
we are pouring into the atmosphere.
"If the planet warms too much,
we are going into unknown territory,"
says Tom Wigley,
senior scientist for the National Center for Atmospheric Research (NCAR).
"If we were to warm the world by five degrees,
I strongly believe
that large parts of the Antarctic ice sheet
would flow into the ocean,
melt, and

cause sea level to rise by many meters."

That could mean disastrous flooding of coastal areas.
Other scientists predict
intense storms,
droughts,
famines,
the spread of infectious diseases,
and the wholesale destruction of species
and habitats.
But others aren't so sure.
A direct connection between man and the earth's warming
has yet to be proven,
say scientists
such as Fred Singer,
an atmospheric physicist.
He suggests that
the earth's increased temperature
is due to natural causes
and argues that increased levels of CO_2 in the atmosphere are
actually a good thing.
Fred Palmer,
another skeptic,
argues that inexpensive fossil fuels
such as coal
are an essential component of U.S. economic success
and cutting back fossil fuel use
would seriously affect the world's social and economic progress.
Who's right?
Scientists on both sides of the global warming debate are
building sophisticated computer models
to predict
various climatic scenarios.
But, the slightest change in one variable
produces a range of possible climatic outcomes,
resulting in even more speculation
about global warming's real impact.
This scientific uncertainty
fuels
political uncertainty,
as the United States struggles to decide
what,
if any,
action to take.
The 1997
Kyoto Protocol
commits the United States
and other industrial nations
to significant cutbacks

in greenhouse gas emissions.
Critics argue that
the cutbacks
will harm the U.S. economy,
particularly since
developing nations
have not agreed to cut their own growing use of fossil fuels.

The possibilities—
and challenges-
-in turning to non-carbon energy sources
include
nuclear power and
"renewable energies."
The first alternative,
renewables
include
solar energy in its various forms,
biomass energy,
wind power.
Sometimes geothermal energy
is included in that as well.
But all of these sources of solar energy
tend to be very episodic –
they're not always there –
and the power density is low,
that is,
the number of watts per square meter
is pretty low.
The fact that it's episodic
is important.
We can convert solar energy in photovoltaic cells
with an efficiency of maybe 15 or 20 percent,
but most people want to turn on the lights at night,
and the sun isn't shining at night.
So we need some kind of a system
that will distribute the available renewable energy to the place where it's needed.
In contrast to renewable energy,
nuclear power
is a very high-density source of energy
Biomass energy per unit area
can produce a few watts per square meter.
By contrast,
the boiler of a nuclear power plant,
where the nuclear energy is being converted into steam,
produces tens or hundreds of thousands of watts
per square meter.
However, nuclear power

as you know,
has been a very contentious issue in the United States
and in other parts of the world.
Since the Three Mile Island
and Chernobyl nuclear accidents,
no nuclear power plants have been built,
and there are many, many sets of issues
having to do with the disposal of radioactive materials
and the proliferation of weapons-grade material and so forth.
Scientists also hold out hope
for developing unimagined new technologies that will replace fossil fuels.
"There comes a point
when you can't escape the idea that
you're having serious climatic consequences,"
says Richard Somerville of the Scripps Institution of Oceanography.
"The issue becomes one of whether we get wise before that day
or whether we have to wait for some perhaps quite
unanticipated climate surprise
that wakes us all up."

Appendix D
Reading Comprehension Test

Answer the questions below

1) One can understand the changes in climate by looking at _____.
   a) solar system
   b) industrial changes
   c) earth's surface
   d) ice cores
2) Greenhouse gases warm the earth by _____.
   a) catching radiation from the sun
   b) increasing the amount of CO2
   c) decreasing the amount of CO2
   d) releasing radiation into the air
3) People contribute to global warming in many ways EXCEPT _____.
   a) using air-conditioners
   b) using mobile phones
   c) using central heating systems
   d) using refrigerators
4) Some scientists suggest that 5 degree temperature rise may result in _____.
   a) melting of ice sheet
   b) more earthquakes
   c) increase in CO2 level
   d) more use of solar energy
5) Each of the following is a predicted result of sea rise EXCEPT _____.
   a) drought
   b) infectious diseases
   c) earthquakes
   d) intense storms
6) The Kyoto Protocol aims to _____.
   a) reduce radiation
   b) increase methane release
   c) reduce carbon release
   d) use coal and oil for energy
7) Non-carbon energy sources include _____.
   a) coal
   b) oil
   c) natural gas
   d) nuclear energy
8) Each of the following is a type of renewable energy EXCEPT _____.
   a) wind power
   b) geothermal energy
   c) biomass energy
   d) fossil fuels

9) Among the problems with nuclear power is _____.
   a) carbon emission into the air
   b) dumping radioactive materials
   c) the fact that it is not always available
   d) steam release in to the air
10) Majority of scientists agree that _____.
   a) global warming is the result of human actions
   b) global warming is the result of natural causes
   c) earth has been warming up
   d) earth has been cooling off
11) Scientists use _____ to make their predictions about future climate change.
   a) barometers
   b) thermometers
   c) computer models
   d) satellite views
12) Which one of the following is a greenhouse gas?
   a) Hydrogen
   b) Oxygen
   c) Methane
   d) Helium
13) Which one of the following increases the carbon dioxide in the atmosphere?
   a) Aerosols
   b) Cars
   c) Sprays
   d) Acid rain
14) Which of the following statements suggest(s) a problem with solar energy?
   I) They are not always available
   II) Their power density is low
   III) They emit carbon
   b) Only I
   c) Only III
   d) I,II
   e) I,II,III
15) What is the advantage of nuclear power?
   a) Its power density is high
   b) It is a cheap source of energy
   c) Its intensive use in weapon production
   d) It is available everywhere

Appendix E-Vocabulary Tests

Vocabulary Checklist

Please circle the words/phrases you saw in the text!

Trap
Generate
Arctic
Release
Contribute
Pour
Iceberg
Cut back
Distribute
Hurricane
Proliferation
Celsius
Catastrophic
Slight
Struggle
Extinction
Surface
Majority
Famine
Solar
Density
Convert
Drought
Thermometer
Measurement
Coral reef
Atom bomb
Renewable
Hydropower
Consumption
Proponent
Emission
Politician
Natural gas
Debate
Destruction
Recycle
Disposal
Contentious
Fierce
Exhaust fumes
Disease
Infectious
Consequence
Greenhouse effect
Ozone
Flood
Skeptic
Aerosols
Temperature

Appendix E.01

Production Test

Please write down the meaning of the words/phrases below either in English or in Turkish.

Trap (v) _____

Generate (v) _____

Release (n) _____

Contribute (v) _____

Pour (v) _____

Cut back (v) _____

Distribute (v) _____

Density (n) _____

Proliferation (n) _____

Catastrophic (adj.) _____

Slight (adj.) _____

Struggle (v) _____

Surface (n) _____

Majority (n) _____

Famine (n) _____

Solar (adj.) _____

Convert (v) _____

Drought (n) _____

Measurement (n) _____

Coral reef (n) _____

Renewable (adj.) _____

Flood (v) _____

Skeptic (n) _____

Temperature (n) _____

Consumption (n) _____

Proponent (n) _____

Emission (n) _____

Debate (n) _____

Destruction (n) _____

Disposal (n) _____

Contentious (adj.) _____

Fierce (adj.) _____

Disease (n) _____

Infectious (adj.) _____

Consequence (n) _____

Appendix E.02

Definition Match Test

Match the definitions given in Column A with the words/phrases given in Column B.

A) To fill or cover with water (v)

B) To change or make something change from one form to another (v)

C) To reduce something (v)

D) To increase, improve or add to something (v)

E) Using the sun's energy (adj.)

F) (of energy and natural resources) that are replaced naturally or controlled carefully and can therefore be used without the risk of finishing it all. (adj)

G) Very small in degree (adj.)

H) A lack of food during a long period of time in a region (n)

İ) A long period of time when there is little or no rain (n)

J) The activity of finding the size, length or amount of something (n)

K) A long line of rocks formed from a hard material that is red, pink or white in colour that forms on the bottom of the sea from the bones of very small creatures. (n)

L) The degree of how hot or cold a thing or place is (n)

M) A person who usually doubts that claims or statements are true, especially those that other people believe in (n)

N) The act of letting a gas, chemical, etc. come out of the container where it has been safely held (n)

O) The act of throwing something away (n)

1) Flood (v) **(A)**
2) Generate (v)
3) Cut back (v) **(C)**
4) Replace (v)
5) Convert (v) **(B)**
6) Distribute (v)
7) Contribute (v) **(D)**
8) Trap (v)

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9) Solar (adj.) **(E)**
10) Disastrous (adj.)
11) Infectious (adj.)
12) Slight (adj.) **(G)**
13) Renewable (adj.) **(F)**
14) Contentious (adj.)

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15) Skeptic (n) **(M)**
16) Consumption (n)

17) Measurement (n) **(J)**
18) Density (n)
19) Majority (n)
20) Steam (n)
21) Surface (n)
22) Drought (n) **(I)**
23) Emission (n)
24) Temperature (n) **(L)**
25) Famine (n) **(H)**
26) Disposal (n) **(O)**
27) Impact (n)
28) Coral reef (n) **(K)**
29) Release (n) **(N)**
30) Representative (n)

Appendix E.03

Bilingual Synonym Match Test

Choose the option nearest in meaning to the word written in bold in each line.

1) TRAP			
CEZALANDIRMAK	**HAPSETMEK**	YASAKLAMAK	KOVMAK
2) DEBATE			
MÜCADELE	KARŞILAŞMA	DİRENİŞ	**TARTIŞMA**
3) GENERATE			
GELİŞTİRMEK	KEŞFETMEK	VAROLMAK	**ÜRETMEK**
4) POUR			
ATMAK	KIRMAK	**DÖKMEK**	DAĞITMAK
5) EMISSION			
DIŞARI VERME	TEKRAR ETME	DEVAM ETME	GERİ GÖTÜRME
6) DISTRIBUTE			
BAŞVURMAK	**DAĞITMAK**	KATILMAK	VEZGEÇMEK
7) DENSITY			
AĞIRLIK	ŞEFFAFLIK	KALABALIK	**YOĞUNLUK**
8) PROLIFERATION			
KEŞİF	**ARTIŞ**	ÜRETİM	TALEP
9) CATASTROPHIC			
YASAK	**FECİ**	ZEHİRLİ	TEHLİKELİ
10) PROPONENT			
SEYİRCİ	UZMAN	**TARAFTAR**	DANIŞMAN
11) STRUGGLE			
ÇABALAMAK	VURMAK	ZORLAMAK	UYGULAMAK
12) CONTENTIOUS			
PAZARLIĞA AÇIK	YORUMA DAYALI	İSTEĞE BAĞLI	**TARTIŞMAYA AÇIK**
13) SURFACE			
BÖLGE	**YÜZEY**	KATMAN	TABAN
14) MAJORITY			
TOPLULUK	BÜYÜKLÜK	**ÇOĞUNLUK**	YÜKSEKLİK
15) CONSUMPTION			
SATIŞ	**TÜKETİM**	İNDİRİM	MASRAF
16) DESTRUCTION			
ZARAR	KAYIP	ÇÜRÜME	**YIKIM**
17) DISEASE			
TEŞHİS	TEDAVİ	**HASTALIK**	BELİRTİ
18) CONSEQUENCE			
SONUÇ	ÇÖZÜM	ETKİ	KARAR
19) INFECTIOUS			
ÖLÜMCÜL	**BULAŞICI**	ZARARLI	TEHLİKELİ
20) FIERCE			
KABA	**SERT**	CİMRİ	İTİCİ

Appendix F

Prior Knowledge Test

İsim:

Sınıf:

Numara:

Aşağıdaki soruları cevaplayınız.

1) Küresel ısınmanın sebepleri nelerdir?
2) Küresel ısınmanın sonuçları nelerdir? (çevre, ekonomi ve toplum açısından)
3) Fosil yakıtlar nelerdir ve bunlara alternatif enerji kaynakları neler olabilir?
4) Sera etkisi nedir ve sera etkisi yaratan gazlar nelerdir?
5) Küresel ısınmanın en çok etkilediği yerler nerelerdir?
6) Küresel ısınmayı durdurmak için neler yapılabilir ve bunun için imzalanan antlaşma(lar) ne(ler)dir?
7) Bunların dışında küresel ısınmayla ilgili bildikleriniz varsa ekleyiniz.

Appendix F.01

Prior Knowledge Test

Name:

Class:

Number:

Please answer the following questions.

1) What are the causes of global warming?
2) What are the consequences of global warming? (in terms of environment, society and economy)
3) What are the fossil fuels? What can be the alternative sources of energy?
4) What is greenhouse effect? What are the gases that cause greenhouse effect?
5) What are the places that are affected most by global warming?
6) What can be done to prevent global warming and what is/are the treaty/treaties signed to stop global warming?
7) Please add anything you know that is not questioned above.

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