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Effects Of Student Response System Use On Student Learning And Verbal Participation For A Sixth-Grade Mathematics Unit

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EFFECTS OF TEXT, AUDIO, AND GRAPHIC AIDS IN MULTIMEDIA INSTRUCTION ON THE ACHIEVEMENT OF STUDENTS IN VOCABULARY LEARNING

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by

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CERTIFICATE OF APPROVAL

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ABSTRACT

English as a Foreign Language (EFL) learners often adopt various strategies to memorize vocabulary words in the second language (L2) such as word lists or paired associates, in which new words are presented with their translations. These strategies often require learners to memorize pair associations directly. L2 vocabulary learning studies in South Korea have often focused on learning based on visual text alone in printed materials.

A study was conducted at Myungin Middle School (MMS) in South Korea to explore the use of multimedia components in a Web-based self-instruction to increase the achievement of students on an English vocabulary test. The primary objective of this research was to study the effects of six methods of multimedia instruction in a Web-based self-instruction program. The six methods of Web-based self-instruction program were based on: (a) visual text, (b) visual text and adding spoken text, (c) visual text and adding graphics, (d) visual text, adding spoken text, and adding graphics, (e) reducing visual text and adding spoken text, and (f) reducing visual text, adding spoken text, and adding graphics. A total of 172 tenth-grade students in five classes participated in the study. Each group consisted of 22-43 students in non-English-teacher classes. Students were randomly assigned to one of the six study groups. Each student was required to complete several testing instruments such as a pretest, posttest, retention test, and student attitude inventory for the study.

The mixed factorial design (the split-plot analysis of variance) on data obtained from the scores of students who were taught under the six methods of multimedia instruction conditions as measured by student's raw scores and Shuford Admissible Probability Scores on the posttest and the retention test showed differences between the six methods of multimedia instruction at the .05 level of significance. The results indicate that students, in general, earned a higher score when they received "visual text and adding graphics" or "visual text, adding spoken text, and adding graphics" in their multimedia instruction than did students who received other types of instructions ("visual text", "visual text and adding spoken text", "reduced text and adding spoken text", or "reduced text, adding spoken text, and adding graphics"). In other words, when visual text was presented with graphics, students may be motivated to success and achievement in L2 vocabulary learning on the current vocabulary test.

In addition, the data from students' degree of certainty estimates show that students, in general, earned a higher score indicating that their degrees of belief probabilities increased when they received multimedia instruction.

Results of analyses of variance (ANOVA) on data obtained from the students who were taught under the six methods of multimedia instruction conditions as measured by time required to complete instruction and the student's attitude inventory showed that there were no differences between the six methods of multimedia instruction at the .05 level of significance. Thus, this result demonstrates that there were no significant differences among the six methods of multimedia instruction with respect to time to complete instruction and attitude toward multimedia instruction.

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Many individuals contributed either assistance with the study, suggestions for analyzing the data, or helpful editorial comments.

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Lastly, the author thanks God for the many people who, directly or indirectly, participated in the study.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1

INTRODUCTION

The Internet has become a common choice as a tool in higher education institutions (Anderson, Bauer, & Speck, 2002). Distance education offerings with on-line courses are becoming a standard part of most college undergraduate and graduate curricula (Cohen & Ellis, 2004). According to Blake and Gibson (2003), approximately 70% of higher education institutions in U.S had on-line courses in 2003, and this number is expected to grow to about 90 % by 2005. For instance, according to the Indiana Higher Education Telecommunication System (IHETS), enrollments in distance learning classes had reached almost 70,000 in 2003. This was a 42 % jump from 2001-02 and a 425 % increase larger than the past five years.

The variety of media, such as visual text, graphics (static or animated), spoken text, and video for delivering content, has attracted many students to use the Internet for distance education (Ali, 2003). These multimedia components get and hold students' interest, which many researchers believe is important when teaching today's video generation (Jonassen, 2000).

Advanced computer technologies such as chat room, discussion forum, and email help educators to design learning experiences that involve more interactions between learners and educational content (Reiser, 2001). For instance, course management systems such as Blackboard and WebCT, allow a student to interact in both synchronous (chat room) and asynchronous (discussion forum and email) fashions with the course materials, other students, and the instructors.

The growth of the Internet and wide-spread use of high-speed computers makes on-line learning available 24 hours a day, seven days a week, at multiple locations. The use of electronic text and graphics are popular tools in on-line learning. In many cases, graphics can represent important information and are often used to support visual text (Newby, Stepich, Lehman, & Russell, 1996). The most widely used asynchronous distance learning tools are on-line courses primarily posted in visual text and static graphics (Liles, 2004). The benefits of on-line learning, in general, are convenience, adaptability, comfort and interaction, the potential drawbacks are time lag when difficulties arise, lack of motivation on the part of students, and computer access (Blake & Gibson, 2003).

English as a Foreign Language (EFL) learners often adopt various strategies to memorize vocabulary words. For instance, second language (L2) vocabulary learning is often used with strategies, such as word lists or paired associates, in which new words are presented with their translations. These strategies often require learners to memorize pair associations directly (Sun & Dong, 2004). In Korea, L2 vocabulary studies have often focused on learning based on visual text alone in printed materials.

Recently, several studies have investigated the effects of presenting information using multimedia components, such as visual text, spoken text, graphics, and videos, on L2 learning (Al-Seghayer, 2001; Sun & Dong, 2004). Kost, Foss, and Lenzini (1999) found that EFL learners performed better on both production and recognition vocabulary tests when they were allowed to use a combination of visual text and graphics. The acquisition of new English vocabulary, one of the important skills necessary for EFL learners, frequently involves much representational learning. The full conceptual meaning of technical vocabulary may take years, and for some students little more than representational meaning may be achieved. When definitions for vocabulary words are learned by rote, representational learning does not automatically advance to conceptual learning. However, representational learning may provide language labels that serve to facilitate concept learning (Novak, 1998; Vygotsky, 1978). Unfortunately, for many students, much school learning that should be concept learning is little more than representational learning. Students learn definitions for concepts, but they do not acquire the meanings for the concepts. For instance, many students learn that a "family" is any group of people who are related to each other, especially a "mother," "father," and their "children," but learners often cannot explain what that definition means in ways that make sense to them (Kim, 2005).

Mayer and Moreno (2002) focused on a cognitive theory of multimedia learning which represents dual coding theory (Paivio, 1986; Sadoski & Paivio, 2001), cognitive load theory (Sweller, Van Merrienboer, & Paas, 1998), and constructivist learning theory (Novak, 1998; Vygotsky, 1978). Mayer and Moreno adopted this dual coding theory's idea that verbal stimuli and nonverbal stimuli that are detected by our sensory systems are processed in different processing systems (verbal system and nonverbal system). From cognitive load theory, Mayer and Moreno adopted the idea that "humans are limited in the amount of information that they can process in each channel at one time" (Mayer, 2001, p. 44). There is an essential limitation to the working memory in the learning process. In other words, students can learn more deeply when their working memory is not overloaded. Sweller et al.'s explained that redundant memory load caused by "the presentation format of instructions *extraneous load"* (Tabbers, Martens, & Merrienboer, 2004, p. 72). Mayer and Moreno finally concluded that "presenting too many elements to be processed in visual or verbal working can lead to overload" (p. 111). From constructivist learning theory, they take the idea that meaningful learning occurs when learners choose to relate new information, organize it into coherent representations, and integrate it with other knowledge. Rote learning occurs when the learner memorizes new information without relating it to prior knowledge (Novak, 1998).

In their experiments, Mayer and Moreno (2002) found the following interesting results:

- Proving words as narration (spoken text; verbal stimuli) and animation (graphics; nonverbal stimuli) helped students' performance rather than words alone (spoken text; verbal stimuli) alone.
- Reducing unneeded words (spoken text) and sounds helped students' performance rather than extraneous words and sounds.
- Proving words as narration (spoken text) helped students' performance rather than on-screen text (visual text).
- Proving words as narration (spoken text) and animation (graphics) helped students' performance rather than narration (spoken text), animation (graphics), and on-screen text (visual text).

They finally designed four principles: contiguity, coherence, modality, and redundancy. These principles reflect that students learn more deeply when their visual and/or verbal working memories are not overloaded. They found that the results are highly consistent with the basic tenets of cognitive load theory that working memory can process only a few elements at any one time.

Reducing the amount of visual text on a screen leaves more area available for graphics and labeled illustrations, which are necessary tools for teaching certain types of concepts. Some studies found that physically including the visual text in the illustration and labeling the illustrations improved learning (Koroghlanian & Klein, 2004). Based on the results obtained in their empirical work, both Sweller (1999) and Mayer (2001) claim that multimedia instruction will be more effective when the verbal information is presented in spoken text form instead of visual text. However, according Tabbers et al. (2004), both replacing visual text with spoken text and adding graphics to the visual text do not easily generalize to all educational settings.

Need for the Study

Mayer (2001) states, "…all multimedia presentation is not equally effective" (p. 79). For example, "Schnotz, Bannert, and Seufert (2002) reported situations in which some learners reduced the amount of attention they paid to text when pictures were added" (p. 79). Unfortunately, educational research has not yet identified how to design effective multimedia instruction. It is very important that educational researchers understand the effect of individual components of multimedia in multimedia instruction. By better understanding the effect of individual components of multimedia, researchers will be able to design effective multimedia instruction.

This study investigated the effect of multimedia components such as visual text, spoken text, and graphics in order to increase students' learning performance or decrease redundant memory load in a Web-based multimedia self-instruction program. The study was conducted at Myungin Middle School (MMS) in Korea to explore the use of multimedia components in a web-based self-instruction to increase the achievement of students on an English vocabulary test.

Statement of the Problem

The primary objective of this research was to study the effects of six methods of multimedia instruction in a Web-based self-instruction program. The six methods of Web-based self-instruction program were based on (a) visual text, (b) visual text and adding spoken text, (c) visual text, and adding graphics, (d) visual text, adding graphics, and adding spoken text, (e) reducing visual text and adding spoken text, (f) reducing visual text, adding graphics, and adding spoken text.

Research Questions and Hypotheses

The research questions for this study were:

1. What are the differences in original learning among students who are taught under the six methods of multimedia instruction conditions as measured by raw score, mean degree of certainty estimate, and an admissible probability scoring procedure?
2. What are the differences in time to complete instruction among students who are taught under the six methods of multimedia instruction?
3. What are the differences in students' attitude toward instruction among students who are taught under the six methods of multimedia instruction conditions as measured by their score on the student attitude inventory?

The following null hypotheses were tested during this study:

1. There are no differences in original learning among students who are taught under the six methods of multimedia instruction conditions as measured by raw score, mean degree of certainty estimate, and an admissible probability scoring procedure.
2. There are no differences in time to complete instruction among students who are taught under the six methods of multimedia instruction.
3. There are no differences in students' attitude toward instruction among students who are taught under the six methods of multimedia instruction conditions as measured by their scores on the student attitude inventory.

Definition of Terms

Visual text. This study used the term of "visual text" for text.

Graphics. Graphics were supporting visual text and are available for cueing the meaning of the English word from static or animated images. This study used the term of "graphics" for static or animated images.

Spoken text. Spoken text was used as narration to support visual text.

Reducing the amount of visual text. Reducing the amount of visual text on a screen left more area available for graphics and spoken text.

Multimedia. Multimedia may be defined in multiple ways, depending upon one's perspective. This study includes the following definitions:

- Multimedia often includes multiple representation forms in text, graphics, audio, or video.
- Multimedia is the use of multiple representation forms of media in a general presentation (Schwartz & Beichner, 1999).

- Multimedia, in general, contains a media element in addition to plain text (Greenlaw & Hepp, 1999).
- Multimedia often refers to the presentation of material using both words and pictures (Mayer, 2001).

For purposes of conducting research, this study does not focus on a video component in multimedia. This study focused on three views of multimedia message (Mayer, 2001). The views are listed in Table 1.1:

Table 1.1

Three Views of Multimedia Message

View	Definition	Example
Delivery media	Two or more delivery devices	Computer screen and amplified speakers; projector and lecturer's voice
Presentation modes	Verbal and pictorial representations	On screen text and animation; printed text and illustrations
Sensory modalities	Auditory and visual senses	Narration and animation; lecture and slides

Note. Adapted from "Three views of multimedia", by Mayer, R. E, 2001, *Multimedia learning,* Cambridge, UK: Cambridge University Press.

Achievement. For this study, students' achievements refer to the data learned on the vocabulary test. The measures of the data were raw score, mean degree of certainty estimate, admissible probability scoring procedure, and attitude inventory.

Assumptions

The participant responses on the instruction and the tests were honest and complete. The vocabulary test was a measure of the students' vocabulary achievement. Admissible probability measurement procedures are scoring systems with a very unique property that guarantees that any student can maximize his expected score if and only if the student honestly reflects his or her degree of belief probabilities (Shuford, 1966). The items of English vocabulary were of appropriate difficulty level for middle school Korean students.

Limitations

1. The study was restricted to those students who attended and agreed to participate in the study.
2. Students were required to have access to the technology necessary to complete the instruction. The requirements included a multimedia computer with a monitor, an Internet access, and a headset.

Delimitations

The participants in the study were 172 randomly selected students from Myungin Middle School (MMS) in Korea. Students were in classes of tenth-gràde students with a non-English-teacher and had no previous experience with computer-assisted instruction in English vocabulary learning. Due to all of these circumstances, it was felt that the MMS environment would provide a valuable opportunity to study the effect of multimedia components in a Web-based self-instruction.

Chapter 2

REVIEW OF RELATED LITERATURE AND RESEARCH

Vocabulary Learning Strategies

The acquisition of new English vocabulary, one of the important skills necessary for EFL learners, frequently involves much representational learning. The full conceptual meaning of technical vocabulary may take years, and for some students, little more than representational meaning may be achieved. When definitions for vocabulary words are learned by rote, representational learning does not automatically advance to conceptual learning. However, representational learning may provide language labels that serve to facilitate concept learning (Novak, 1998; Vygotsky, 1978). Unfortunately, for many students, much school learning that should be concept learning is little more than representational learning. Students learn definitions for concepts, but they do not acquire the meanings for the concepts. For instance, many students learn that a "family" is any group of people who are related to each other, especially a "mother," "father," and their "children," but learners often cannot explain what that definition means in ways that make sense to them (Kim, 2005).

English as a Foreign Language (EFL) learners often adopt various strategies to memorize vocabulary words. For instance, second language (L2) vocabulary learning is often used with strategies, such as word lists or paired associates, in which new words are presented with their translations. These strategies often require learners to memorize pair associations directly (Sun & Dong, 2004). Meara (1980) found that many L2 vocabulary learning studies have explored various methods of vocabulary presentation and their corresponding effectiveness in retention.

Some earlier studies found the following to be effective tips to help L2 vocabulary learning:

- The number of repetitions needed to learn a list (Crothers & Suppes, 1967).
- The optimum number of words to be learned at one time (Crothers & Suppes).
- Rote repetition appears less efficient than using spaced recall and structured review (Atkinson, 1972).
- Silent repetition and silent writing are less effective than repeating the words aloud (Meara, 1980).

For the learning of L2 vocabulary, Brown and Payne (1994) have identified five steps: (a) having sources for encountering new words, (b) getting a clear image, either visual or auditory or both, of the forms of the new words, (c) learning the meaning of the words, (d) making a strong memory connection between the forms and the meanings of the words, and (e) using the words.

Kost et al. (1999) found that EFL learners performed better on both production and recognition vocabulary tests when they were allowed to use a combination of visual text and graphics. Recently, several studies have investigated the effects of presenting information using multiple multimedia components, such as visual text, spoken text, graphics, and videos, on L2 learning (Al-Seghayer, 2001; Duquette & Painchaud, 1996;

Sun & Dong, 2004). In their studies, information presented in text, spoken text, graphics, and video formats can be integrated to create an authentic, attractive, and multi-sensory language context for EFL learners (Sun & Dong).

Furthermore, Sun and Dong (2004) have demonstrated that learning a second language (L2) vocabulary in context may require students to

> make informed guesses as to the meaning of a new word in light of available linguistic cues in the context as well as the relevant knowledge in the learner's mind, including general knowledge of the world, awareness of the situation, and relevant linguistic knowledge. (p. 132)

Theories of Multimedia Learning

Verbal presenting tools such as lectures and printed lessons have been the primary tools of explaining and teaching concepts of classes to learners for a long time. Recent advance graphic and animation tools have been designed and developed for helping humans understand nonverbal presentations. The study reviewed three theories of multimedia learning: dual-coding theory, cognitive load theory, and cognitive theory of multimedia learning.

Dual-coding Theory

Up to the early 1960s, research had been dominated by the view that performance in memory and other cognitive tasks was mediated by processes that are primarily verbal (Paivio, 1986). In Paivio's early study, *Imagery and verbal processes* (1971), the dual-coding theory was applied to perceptual, memory, and language-possessing tasks that were the focus of the empirical and theoretical issues of the day. Paivio's later study provided updated dual-coding theory that students can build both nonverbal and verbal groups of mental representation as well as connections between them. The structural assumptions of dual coding are summarized in Figure 2.1.

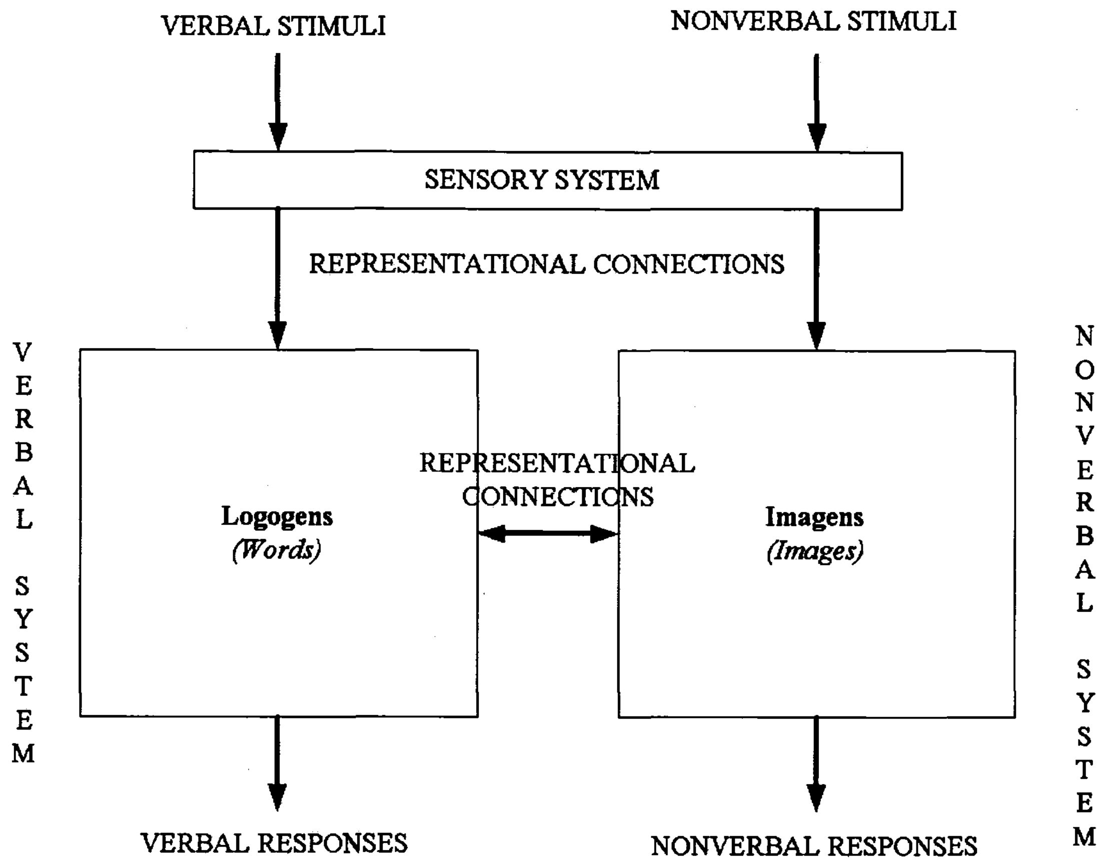


Figure 2.1. Paivio's dual coding theory. Modified from *Mental Representations: A Dual Coding Approach*, p. 67, by A. Paivio, 1986, New York: Oxford University Press.

The theory assumes that memory consists of two separate but interrelated systems for processing information (Rieber, 1995). The dual coding model shows the verbal and nonverbal systems including representational units and their between system and within system interconnections as well as connections to input and output system. The verbal and visual systems can be activated independently, but there are interconnections between the two systems that allow dual coding of information. The interconnectedness of the two systems permits cueing from one system to the other, which, in turn, facilitates the interpretation of our environment.

Since Paivio's idea was reported, some theories have attempted to identify the relationship between verbal explanations and nonverbal explanations. Figure 2.2 represents Sadoski and Paivio's model for describing the relation between verbal system and nonverbal system of how scientific systems work regarding to the English vocabulary word "taut."

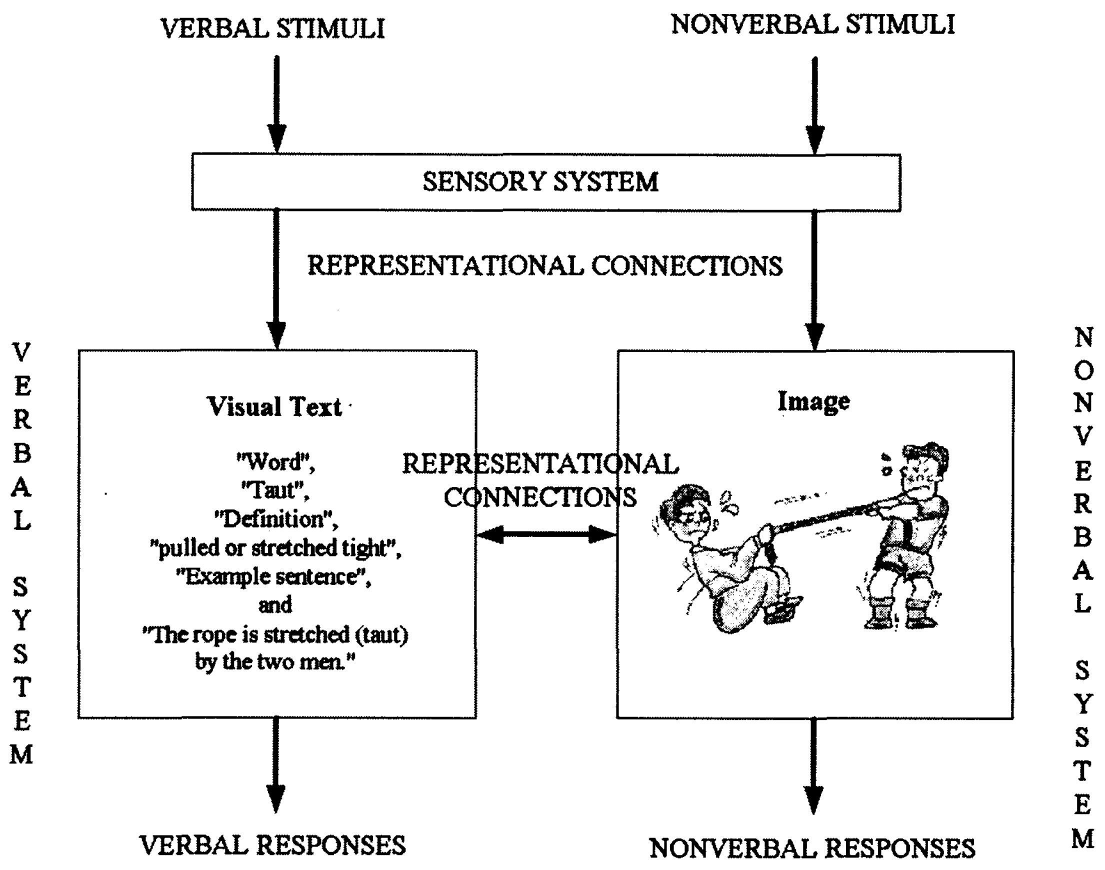


Figure 2.2. Example of dual-coding model for the English vocabulary "taut". Modified from Imagery and Text: A Dual Coding Theory of Reading and Writing, by Sadoski, M. and Paivio, A., p. 78.

The model contains three major component processes: Component 1 involves building representational connections between verbally presented information and a verbal representation, Component 2 involves building representational connections between visually presented information and a visual representation, and Component 3 involves building referential connections between elements in the verbal and visual representations.

Cognitive Load Theory

Koroghlanian and Klein (2004) claim, "Cognitive Load Theory (Sweller, 1988; Sweller et al., 1998) is based on the idea that people have a limited working memory (Miller, 1956) and a long term memory (Chase & Simon, 1973)" (p. 25).

Sweller's Cognitive Load Theory (1988) suggests that effective instructional material facilitates learning by directing cognitive resources toward activities that are relevant to *schema* acquisition (Cooper, 1990). Sweller, Chandler, Tierney, and Cooper (1990) defined that "a schema is a mental construct permitting problem solvers to categories problems according to solution modes" (p. 176).

Moreover, the theory attempts to explain why students may solve problems but learn little of their structure (Sweller, 1989). An example, Pillay (1997) claimed "...cognitive resources as the individual's cognitive ability to deal with a task, and cognitive load as the demand made by a task on the individual's mental effort for the successful completion of that task" (p. 289).

In a later study, Pillay (1997) claimed, "To reduce the cognitive load, it may not be possible to amend the load caused by difficulty inherent in a task, but instructional format can be manipulated to reduce the cognitive load imposed by poor instructional design" (p. 289). Pillay's idea explained that redundant memory load may be caused by poor instructional designs that present too many elements to be processed by students.

Cognitive load theory calls the unnecessary memory load caused by the presentation format of instructions irrelevant load (Sweller et al., 1998). As a result of their research, Sweller (1999) has constructed some instructional design recommendations:

- Change problem solving methods to avoid means-ends approaches that impose a heavy working memory load by using goal-free problems or worked examples.
- Physically integrate multiple sources of information whenever possible to eliminate the need for learners to have to mentally integrate that information which increases the load on working memory.
- Reduce redundancy and repetitive information whenever possible so that the load on working memory is lessened.
- Use auditory and visual information under conditions where both sources of information are essential (i.e. non-redundant) to understanding. This helps increase the capacity of working memory.

In conclusion, cognitive load theorists have been seeking recommendations to increase working memory by reducing cognitive load. Koroghlanian and Klein (2004) state

> This cognitive architecture implies that the biggest obstacle to effective learning is working memory's limited capacity. Cognitive load theorists seek techniques to increase working memory by reducing cognitive load, which, in turn, should

> result in improved instructional design, learning efficiency, and effectiveness. (p. 26)

As in Koroghlanian and Klein's statement, this study seeks techniques to increase working memory by reducing cognitive load, learning efficiency and effectiveness in multimedia vocabulary instruction.

Cognitive Theory of Multimedia Learning

Mayer and Moreno (2002) focused on a cognitive theory of multimedia learning which represents dual coding theory (Paivio, 1986; Sadoski & Paivio, 2001), cognitive load theory (Sweller et al., 1998), and constructivist learning theory (Novak, 1998; Vygotsky, 1978). They adopted a dual coding theory idea (Paivio; Sadoski & Paivio) that verbal stimuli and nonverbal stimuli, detected by our sensory systems, are processed in different processing systems (verbal system and nonverbal system).

From cognitive load theory, Mayer and Moreno (2002) adopted the idea that "humans are limited in the amount of information that they can process in each channel at one time" (Mayer, 2001, p. 44). Sweller et al. explained that redundant memory load caused by "the presentation format of instructions *extraneous load*" (Tabbers et al., 2004, p. 72). Mayer and Moreno finally concluded that "Presenting too many elements to be processed in visual or verbal working can lead to overload" (p. 111).

From constructivist learning theory Mayer and Moreno (2002) take the idea that meaningful learning occurs when learners actively select relevant information, organize it into coherent representations, and integrate it with other knowledge. Rote learning occurs when the learner memorizes new information without relating it to prior knowledge (Novak, 1998).

In Mayer and Moreno's experiments (2002), they found the following interesting results:

- Proving words as narration (spoken text; verbal stimuli) and animation (graphics; nonverbal stimuli) helped students' performance rather than words alone (spoken text; verbal stimuli) alone.
- Reducing unneeded words (spoken text) and sounds helped students' performance rather than extraneous words and sounds.
- Proving words as narration (spoken text) helped students' performance rather than on-screen text (visual text).
- Proving words as narration (spoken text) and animation (graphics) helped students' performance rather than narration (spoken text), animation (graphics), and on-screen text (visual text).

Reducing the amount of on-screen text (visual text) makes more area available for graphics and labeled illustrations, which are necessary tools for teaching certain types of concepts. Some studies indicated that physically including the visual text in the illustration and labeling the illustrations improved learning (Koroghlanian & Klein, 2004).

However, as Mayer (2001) states, all multimedia presentation is not equally effective. For example, "Schnotz, Bannert, and Seufert (2002) reported situations in which some learners reduced the amount of attention they paid to text when pictures were added" (p. 79). Tabbers et al. (2004) concluded that replacing visual text with spoken text and adding graphics to the visual text both do not easily generalize to non-laboratory settings.

Mayer's (2001) Cognitive Theory of Multimedia Learning is based on Paivio's Dual-coding Theory and it presents a cognitive model of multimedia learning intended to represent the human information processing system. Mayer provided his cognitive theory of multimedia learning. His cognitive theory of multimedia learning assumed the following elements:

> - *Dual channels.* Humans possess separate channels for processing visual and verbal information (Paivio, 1986).
> - *Limited capacity.* Humans are limited in the amount of information that they can process in each channel at one time.
> - *Active processing.* Humans engage in active learning by attending to relevant incoming information, organizing selected information into coherent mental representations, and integrating mental representations with other knowledge. (Mayer, 2001, p. 44)

Figure 2.3 presents a cognitive model of multimedia learning intended to represent the human information processing system. The model consists of four parts: multimedia presentation, sensory memory, working memory, and long term memory.

> Pictures and words come in from the outside world as a multimedia presentation (indicated in the left side of the figure) and enter sensory memory through the eyes and ears (indicated in the sensory Memory box). Sensory memory allows for pictures and printed text to be held as exact visual images for a very brief time period in visual sensory memory (at the top) and for spoken words and other sounds to be held as exact auditory images for a very brief time period in an

> auditory sensory memory (at the bottom). ...Working memory is used for temporarily holding and manipulating knowledge in active consciousness... Unlike working memory, long-term memory can hold large amounts of knowledge over long periods of time, but for a person to actively think about material in long-term memory, it must be brought into working memory (as indicated by the arrow from Long-Term Memory to Working Memory). (Mayer, 2001, pp. 43 - 45)

Mayer also described how multimedia learning occurs when the learner engages in five kinds of processing: selecting words, selecting images, organizing words, organizing images, and integrating. Figure 2.4 shows the path for processing of spoken text, visual text, and graphics in a cognitive theory of multimedia learning.

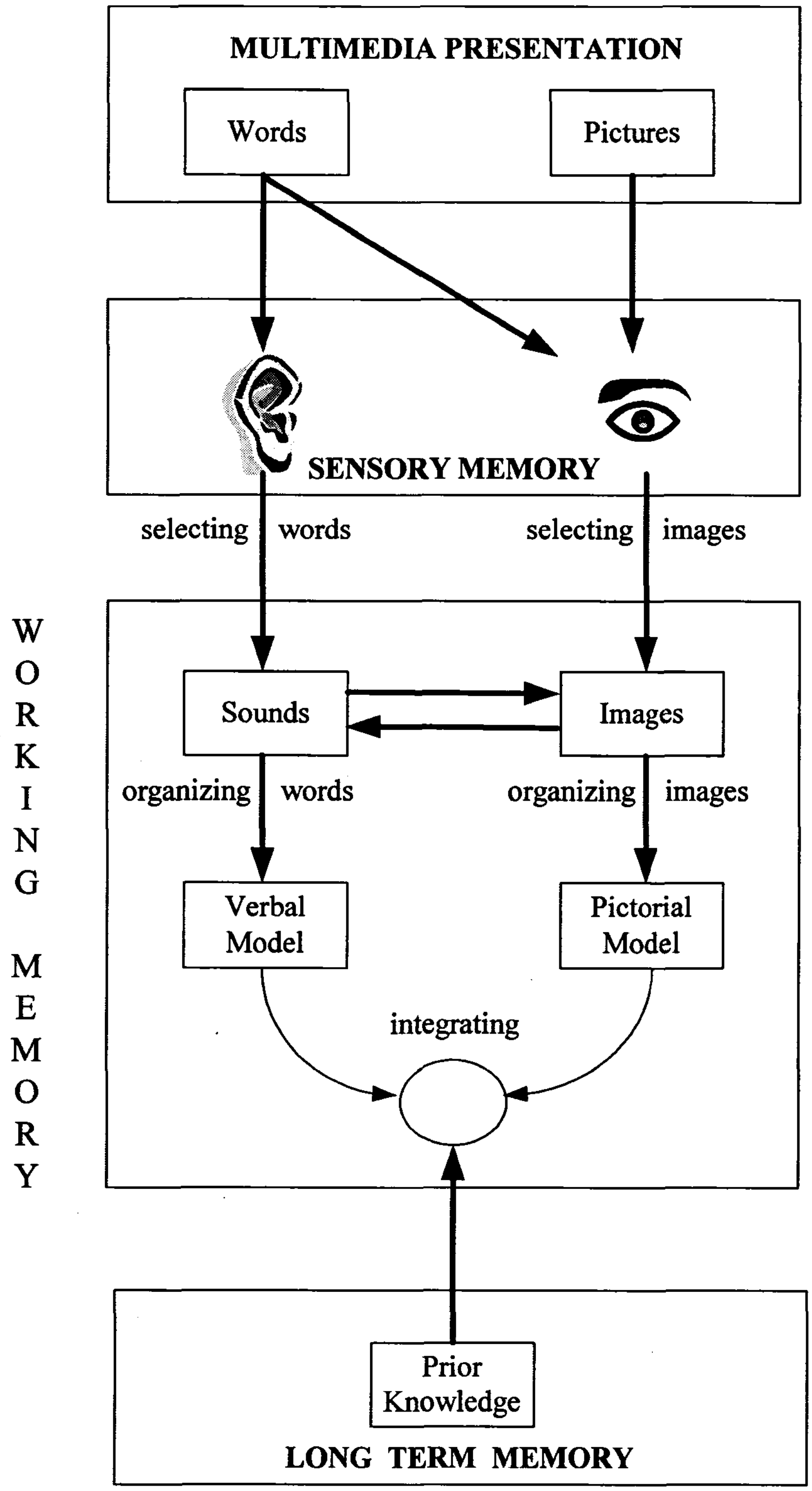


Figure 2.3. Cognitive theory of multimedia learning model. Modified from *Multimedia learning,* p. 44, by Mayer, R. E., 2001, Cambridge, UK: Cambridge University Press.

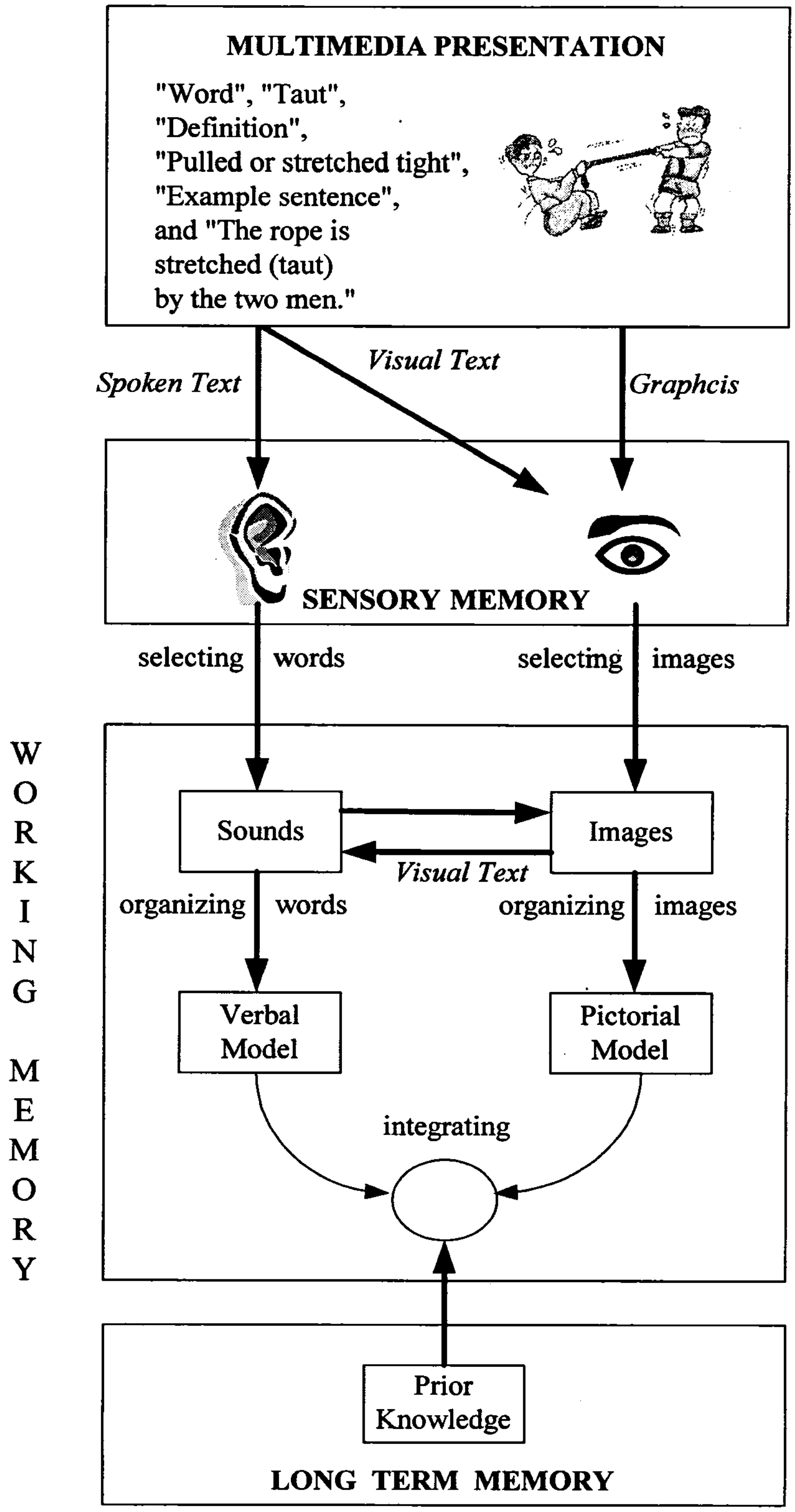


Figure 2.4. Example of cognitive theory of multimedia learning for the English vocabulary "taut."

Furthermore, some researchers say that it is better to understand when multimedia explanations include fewer rather than many extraneous pictures and words (Mayer & Moreno, 2002).

In conclusion, Mayer and Moreno (2002) state:

> ...The top row represents the verbal channel and the bottom row represents the visual channel. The boxes on the left represent the presentation groups for the multimedia instructional message: words are presented as narration and pictures are presented as animation. A cognitively active learner will pay attention to relevant portions of the narration (indicated by the 'select words' arrow) and hold these words in verbal working memory (indicated by the 'word base' box); similarly, the learner will pay attention to relevant portions of the animation (indicated by the 'select images' arrow) and hold these images in visual working memory (indicated by the 'image base' box). Next, a cognitively active learner will mentally build connections that organize the words (indicated by the 'organize words' arrow) into a cause-and-effect chain (indicated by the 'verbal mental model' box); similarly, the learner will mentally build connections that organize the images (indicated by the 'organize images' arrow) into a cause-and-effect chain (indicated by the 'visual mental model' box). Finally, a cognitively active learner will build referential connections between the visual and verbal mental models and with prior knowledge indicated by the 'integrate' arrows. (p. 111)

Effect of Multimedia Learning

Most early research on audio focused on the use of redundant audio. Hartman (1961) summarized and evaluated early audiovisual studies that looked at audio-print and print only presentation for instruction. He concluded that redundant audio-print instruction was more effective than either audio or print alone.

Some researchers focused on using pictures. Levin, Anglin, and Carney (1987) reported that pictures have the following effects:

- Minimize explanatory content by summarizing distinctive features or procedures,
- Facilitate interpretation by clarifying abstract concepts,
- Facilitate comprehension by eliminating the need to translate text into imagery, and
- Facilitate long-term memory by creating a memorable mnemonic.

Reducing the amount of text on a screen leaves more area available for graphics and labeled illustrations, which are necessary tools for teaching certain types of concepts (Barron & Alkins, 1994; Koroghlanian & Klein, 2004).

Some studies have indicated that physically including the text in the illustration and labeling the illustrations improved learning (Koroghlanian & Klein, 2004). Mousavi, Low and Sweller (1995) and Tindall-Ford, Chandler, and Sweller (1997) looked at static graphics, text and audio, and fond that shifting a portion of the text to the audio channel improved learning.

Video-based Instructional Tool

Video-based instruction has been applied to subjects such as science (Kumar & Bristor, 1999), physical education (Sariscsany & Pettigrew, 1997), and others. Mechling (2004) found the following:

> Video technology has been shown to be an effective medium for creating a learning environment which closely replicates the natural environment in which students will actually use skills, providing realistic representations, feedback, and repetition of instructional trials. (p. 23)

She also examined the effectiveness of a multimedia program (i.e., interactive computer program, video captions, and still photographs) to increase the fluency of three students with intellectual disabilities to grocery shop. Her result indicates that the multimedia program alone was effective in increasing the fluency with which students were able to read aisle signs and locate items without the use of an adaptive grocery shopping list.

Furthermore, some studies found that students learn more deeply when their visual and/or verbal working memories are not overloaded. Mayer and Moreno (2002) considered four principles – contiguity, coherence, modality, and redundancy – reflect that students learn more deeply when their visual and/or verbal working memories are not overloaded. Their results of the study are summarized in the four principles listed below in Table 2.1.

Table 2.1

Summarization of the Results from Mayer and Moreno's Research (2002)

Principles	The results
Contiguity Principle	• Students learn more deeply when they do not have to hold the entire animation in working memory until the spoken text as a narration is presented (or when they do not have to hold the entire spoken text in working memory until the animation is presented). • Compared to simultaneous presentation of animation and spoken text, successive presentation of animation and spoken is more likely to create cognitive overload — a situation that results in reduced levels of understanding as measured by problem-solving transfer.
Coherence Principle	• Students learn more deeply when they do not have to process extraneous words and sounds in verbal working memory or extra pictures in visual working memory. • Compared to a concise presentation of animation and/or spoken text, embellished presentation is more likely to create cognitive overload that results in reduced levels of understanding as measured by problem-solving transfer.
Modality Principle	• Students learn more deeply when visual working memory is not overloaded by having to process both animation and visual text. • When words are presented as visual text, they compete for processing resources with animation in visual working memory, thus resulting in less opportunity to build understanding. • When words are presented as spoken text, they do not overload visual working memory, thus allowing for deeper understanding.
Redundancy Principle	• The same reasoning applies to the redundancy principle in which presenting both animation and visual text (in redundant presentations) results in overloading visual working memory.

Their results are highly consistent with the basic tenets of cognitive load theory that working memory can process only a few elements at any one time. Some researchers conclude that it is better to understand when multimedia explanations include fewer rather than many extraneous pictures and words (Mayer & Moreno, 2002).

In conclusion, based on cognitive load theory (Sweller et al., 1998) and Mayer's theory of multimedia learning (Mayer, 2001), replacing visual text with spoken text ("the modality effect"), and adding visual cues relating elements of a picture to the text ("the cueing effect") all increase the effectiveness of multimedia instruction in terms of better learning results or less mental effort spent (Tabbers et al., 2004).

Shuford Admissible Probability Measurement (APM) Procedures

Multiple choice questions are usually used to test a student's ability to recall information, to interpret data or diagrams and to analyze and evaluate material. Shuford (1966) has developed an admissible probability measurement procedure to measure students' scores (Gilman, 1967). Shuford claims that admissible probability measurement procedures operate scoring systems with a very unique property that guarantees that any student can maximize his expected score if and only if the student honestly reflects his or her degree of belief probabilities.

The formula depends only on the probability assigned to the correct answer, and not on probabilities assigned to the other incorrect alternatives (Gilman, 1967). The score obtained from an expressed probability to a correct response (rk) is expressed as a function $g_k\,(r_k)$ such that

$$g_k\,(r_k) = \begin{cases} 1 + \log r_k & \text{for } 0.01 < r_k \leq 1 \\ -1 & \text{for } 0.00 \leq r_k \leq 0.01 \end{cases}$$

The possible scores range from minus one up to plus one and is fairly related to the practice of giving the student one point for each correct answer and subtracting one point for each incorrect answer in order to discourage guessing in multiple choice testing. The other words, a value of 1 indicates that the student's response is correct for a question and a value of -1 indicates that the student's response is incorrect for a question. For instance, if the student's responses are correct for a 30-item multiple choice test, he or she ultimately will receive 30 points for the test. If the student's responses are wrong for a 30-item multiple choice test, he or she ultimately will receive -30 points for the test.

The study adopted Shuford's Admissible Probability Measurement (APM) to reduce guessing scores on the multiple choice testing. With each multiple-choice question, there were two forms. The first form was for a student's response to each question (a, b, c, or d).

The second form required the learner to write a number from 0 to 100 which indicate how sure the student was that his or her response was correct. For instance, if the student was 100% sure that his or her response was correct, the second space on the test should contain 100. If he or she was not completely sure, the second space should contain a smaller number. This number constitutes the degree of certainty score.

From there, the admissible probability score is obtained by applying the formula listed above. For instance, if the student was 100 % sure and his or her response was correct for a question, his or her admissible probability score would be 1 for the question; if the student was 0% sure that his or her response was correct for a question, his or her admissible probability score would be -1 for the question. If the student's response was wrong for a question, his or her admissible probability score would be -1 for the question.

Mixed Factorial Design (The Split-Plot Analysis of Variance)

The split-plot analysis of variance (SPANOVA) used to analyze data from mixed designs – one within subjects factor (repeated measure) and one between-subjects factor (between groups).

Multivariate Tests

The multivariate tests table displays four multivariate tests of significance of each effect in the model: Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's largest Root. The study, in general, chose, Wilks' Lambda test of significance of each effect in the model. Lambda ranges between 0 and 1, with values close to 0 indicating means are different and values close to 1 indicating the means are not different.

Effect Size

Effect size measures are required for all publications following the American Psychological Association (2001) Publication Manual (5th Edition). The effect size, as measured by Partial Eta Squared ranges in value from 0 to 1; a value of 1 indicates that there are very significant differences between at least two of the means on the vocabulary test score and a value of 0 indicates that there are no differences on the scores within each of the groups. According to Green and Salkind (2000), in general, Eta square ranges in value of 0.01, 0.06, and 0.14 are by convention interpreted as small, medium, and large effect sizes, respectively.

Mauchy's Test of Sphericity

To determine whether each of the six samples had equivalent variances, Mauchly's test of Sphericity tests "the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix" (*SPSS 14.0*). This null hypothesis will be rejected if the significance value (Sig.) is less than .05. When this null hypothesis is rejected, Sphericity Assumption can not be assumed. In this case, an adjustment value ("epsilon") is needed for multiplying the numerator and denominator degrees of freedom in the F test. The significance of the F test would be evaluated with the new degrees of freedom. There are three possible values of epsilon, based on three different criteria: Greenhouse-Geisser, Huynh-Feldt, and Lower-bound.

Post Hoc Tests

For follow-up tests, post hoc tests, the study chose the Tukey, which known as Tukey's HSD for honest significant difference, since an omnibus test is conducted and is significant. The table displays comparisons of the differences between each pair of means. The asterisks (*) appear when the significance value is less than .05 in the table.

Profile Plots

Profile plots are used for comparing marginal means. A profile plot is a line plot in which each point indicates the estimated marginal mean of a dependent variable at one level of a factor. The levels of a second factor can be used to make separate lines. For two or more factors, parallel lines indicate that there is no interaction between factors, which means that you can investigate the levels of only one factor. Nonparallel lines indicate an interaction (*SPSS 14.0*). When an interaction is significant, the follow-up interaction comparisons are conducted. An interaction effect means that certain combinations of the levels of the first variable and the levels of the second variable have different effects than do other combinations of levels of the two variables. If there is no interaction effect then it is appropriate to merely interpret the main effects.

Chapter 3

METHOD OF RESEARCH

The primary objective of this research is to study the effects of six methods of a multimedia instruction in a Web-based self-instruction program. The six methods of Web-based self-instruction program were based on (a) visual text, (b) visual text and adding spoken text, (c) visual text, and adding graphics, (d) visual text, adding graphics, and adding spoken text, (e) reducing visual text and adding spoken text, and (f) reducing visual text, adding graphics, and adding spoken text.

The study investigated the use of multimedia components such as visual text, spoken text, and graphics in a Web-based self-instruction program to increase students' English vocabulary learning at Myungin Middle School (MMS) in Seoul, South Korea. By better understanding the effects of individual components of multimedia, researchers will be able to design effective multimedia instruction.

Restatement of Research Questions and Hypotheses

The research questions for this study were:

1. What are the differences in original learning among students who are taught under the six methods of multimedia instruction conditions as measured by raw score, mean degree of certainty estimate, and an admissible probability scoring procedure?

2. What are the differences in time to complete instruction among students who are taught under the six methods of multimedia instruction?
3. What are the differences in students' attitude toward instruction among students who are taught under the six methods of multimedia instruction conditions as measured by their scores on the student attitude inventory?

The following null hypotheses were tested during this study:

1. There are no differences in original learning among students who are taught under the six methods of multimedia instruction conditions as measured by raw score, mean degree of certainty estimate, and an admissible probability scoring procedure.
2. There are no differences in time to complete instruction among students who are taught under the six methods of multimedia instruction.
3. There are no differences in students' attitude toward instruction among students who are taught under the six methods of multimedia instruction conditions as measured by their score on the student attitude inventory.

Procedures

This chapter contains the procedures that were used in gathering data for the study and an explanation of these procedures.

The Experimental Groups

This study compared one control group (Group A) and five experimental groups (Groups B, C, D, E, and F). Students were enrolled in the computer classes at MMS. A total of 172 tenth-grade students in five classes participated in the study. All sampling procedures were random. The 172 students were separated into six groups, 43 students

(Group A), 22 students (Group B), 34 students (Group C), 24 students (Group D), 24 students (Group E), and 25 students (Group F). The groups that used spoken text format (B, D, E, and F) were smaller than the non-spoken text groups (A and C) because many computers in the classroom were not provided with a sound system with headset or speaker.

The students were in MMS with a non-English-teacher and had no previous experience with computer-assisted instruction in English vocabulary learning. MMS has established in 2001 as a public middle school. MMS consists of three grades levels with 1,268 students.

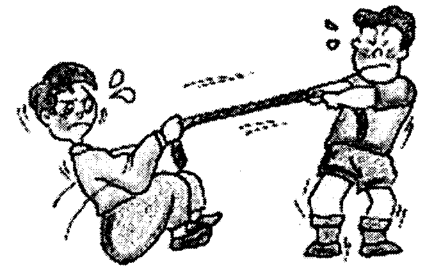
Materials

The topic of the Web-based self-instruction was English vocabulary learning. The design of the English vocabulary multimedia instruction was based on the following criteria:

1. The items of English vocabulary were of appropriate difficulty level for middle school Korean students.
2. Graphics supported visual text.
3. Graphics were available for cueing meaning of the word from static or animated images.
4. Spoken text was used as narration to support visual text.
5. Reducing the amount of visual text on a screen left more area available for graphics and spoken text.

The illustration of the criterion 3, 4, and 5 are shown in Figure 3.1 with one example.

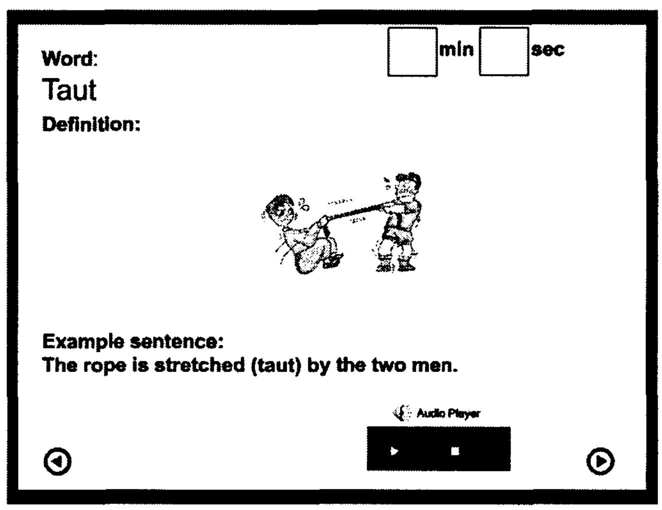
Adding graphic



Adding spoken text (Translation in English)

Narration1: "Word"
Narration2: "Taut"
Narration3: "Definition"
Narration4: "pulled or stretched tight"
Narration5: "Example sentence"
Narration6: "The rope is stretched taut by the two men"

Reducing visual text



*** Reduced text1: definition of the vocabulary
*** Reduced text2: definition of the example sentence

Figure 3.1. The example to describe criteria 3, 4, and 5

The items of English vocabulary to be learned by students on the Web-based self-instruction program were: 1) tether, 2) wither, 3) tumble, 4) separate, 5) gorge, 6) fetter, 7) beacon, 8) crest, 9) awl, 10) ditch, 11) entice, 12) taut, 13) quench, 14) wizen, and 15) waylay. In addition, the study provided an example sentence to show students how a word is used in context. L2 vocabulary learning in context often indicates that

Students have to make informed guesses as to the meaning of a new word in light of available linguistic cues in the context as well as the relevant knowledge in the learner's mind, including general knowledge of the world, awareness of the situation, and relevant linguistic knowledge. (Sun & Dong, 2004, p. 132)

The length of lesson time is a maximum of 30 minutes and the time was recorded by the computers. The frames of the Web-based self-instruction program were visual instruction on the computer screen as shown in Figure 3.2.

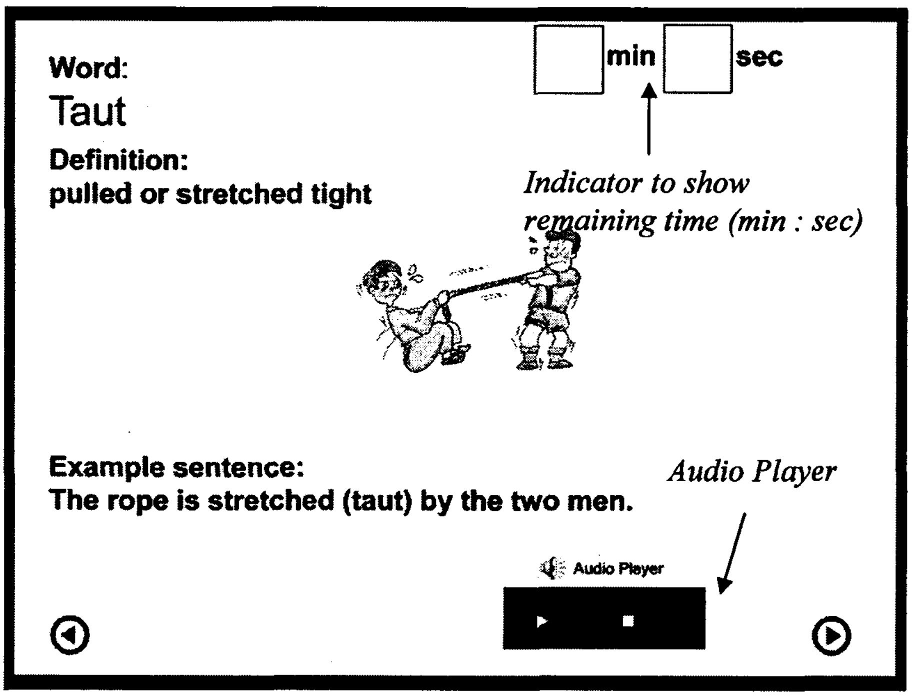


Figure 3.2. Illustration of one frame of Group D (Translation into English)

The six groups of Web-based self-instruction program were based on (a) visual text, (b) visual text and adding spoken text, (c) visual text, and adding graphics, (d) visual text, adding graphics, and adding spoken text, (e) reducing visual text and adding spoken text, (f) reducing visual text, adding graphics, and adding spoken text as shown in

Appendix A. Figure 3.3 presents an example showing frames of Groups A, B, C, D, E, and F from the multimedia instruction program.

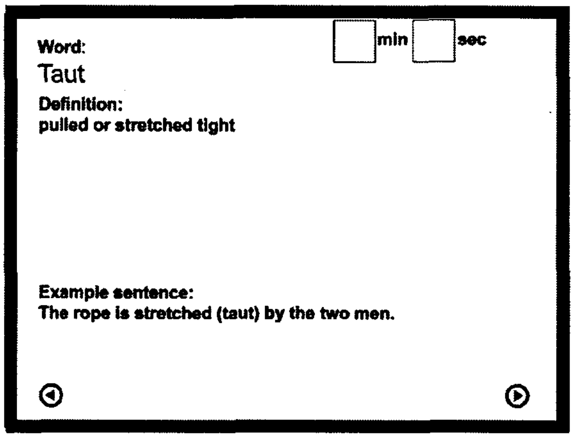
Equipment

The multimedia instruction of Web-based self-instruction program was managed under the control of computer-assisted instruction. Items of English vocabulary were presented on the computer screen at the computer lab in the school. The computer lab had 35 desktop computers with one projector. Each computer contained an Intel Pentium 4 processor, a 512 Ram, speakers, and was running Windows XP with a Flash Player. The students in three groups (Groups B, D, E, and F) were required to wear headsets by the non-English speaking teacher.

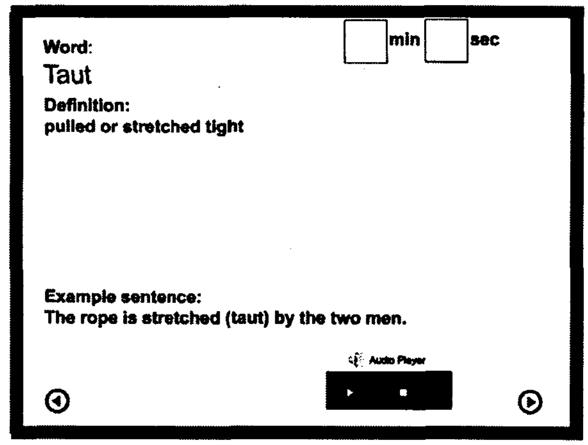
Tests

Each student was required to complete a pretest, posttest, retention test, and attitude inventory for the study. The items for all three tests are contained in Appendix A. In addition, the time to complete the instruction was recorded and used as another dependent variable.

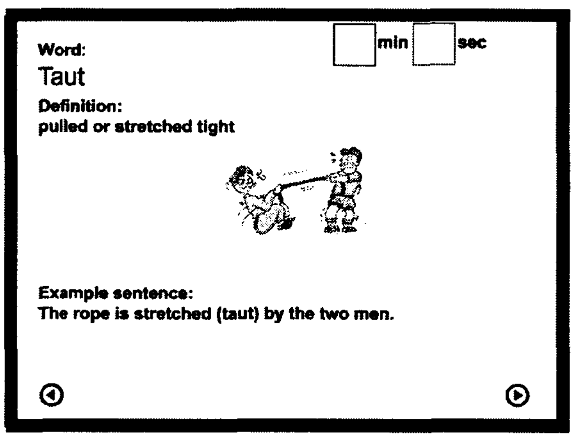
Pretest. The first test of the multimedia instruction program was only served as a pretest. The test was administered to 30 items from the vocabulary lesson on the computer screen as an online test. In addition to a response to each item, students also indicated their degree of certainty for each response by typing a number from 0 to 100.



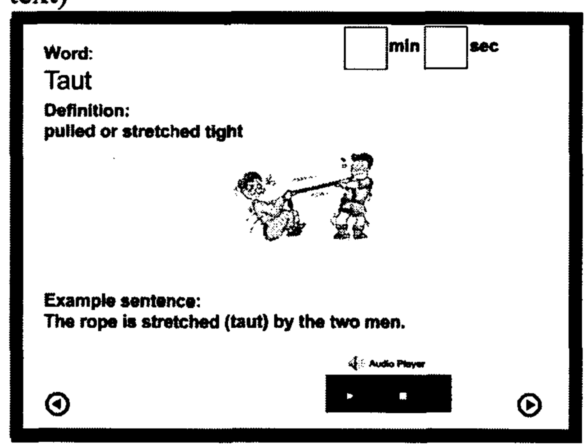
Group A (visual text)



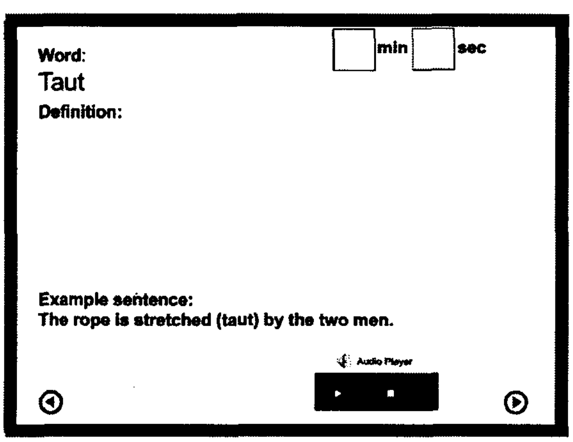
Group B (visual text and adding spoken text)



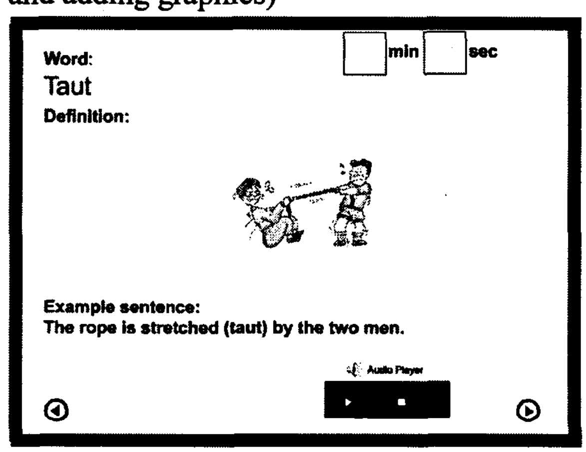
Group C (visual text and adding graphics)



Group D (visual text, adding spoken text, and adding graphics)



Group E (reducing visual text and adding spoken text)



Group F (reducing visual text, adding spoken text, and adding graphics)

Figure 3.3. An example showing frames of Groups A, B, C, D, E, and F (Translation into English)

Posttest. A posttest was administered immediately following the multimedia instruction. The items were same as the items in the pretest. The questions were designed to measure what students learned (or remembered) during the multimedia instruction. In addition to a response to each item, students also indicated their degree of certainty for each response by typing a number from 0 to 100.

Retention test. A retention test was administered one week after the instruction. The items were the same as the items in the pretest and posttest. In addition to a response to each item, students also indicated their degree of certainty for each response by typing a number from 0 to 100.

Attitude inventory. One of the criteria which relates to the "effectiveness" of instruction is the student's opinion of the instruction. The instrument is primarily designed to measure student's attitude to a multimedia instruction.

A 40 item Likert-type inventory (5 point scale from Strongly Agree to Strongly Disagree) developed by Gilman (1967) was used to measure the expressed attitudes of the students to computer-assisted instruction. The study adopted Gilman's attitude inventory and developed it to measure the expressed attitudes of the students to Web-based multimedia instruction. The items for the attitude inventory are contained in Appendix B. In addition, the data from the attitude inventory was recorded and used as another dependent variable.

Treatment

A pretest was administered to the participants one week prior to the study. All students among the six different groups were required to respond to 30 questions regarding the vocabulary with a number from 0 to 100 to indicate their degree of certainty on the pretest. One week later, all students among the six different groups received multimedia instruction from a Web-based self-instruction program. Vocabulary items of vocabulary were projected on the computer screen through the program, and all students among the six different groups were required to complete the instruction and respond to 30 questions regarding the vocabulary with a number from 0 to 100 to indicate their degree of certainty on the posttest.

Approximately one week later, all students among the six different groups were required to respond to 30 questions regarding the vocabulary with a number from 0 to 100 to indicate their degree of certainty on the retention test. In addition, all students were required to complete the 40 items of the student attitude inventory.

Analysis of Data

Scores and data from the Web-based self-instruction program and tests including the student attitude inventory were recorded and stored in the Web space (http://teacherportfolio.indstate.edu/daesang) of the Web-server at Indiana State University. The following criteria were measured:

1. Student's raw scores
2. Student's mean degree of certainty estimates
3. Shuford Admissible Probability Scores
4. Time required to complete multimedia instruction
5. Student attitude inventory

Analyses of variance (ANOVA) were conducted to evaluate the results from the study that involved two analyses: mixed factorial design (the split-plot analysis of variance) and one-way ANOVA.

Mixed factorial design. The split-plot analysis of variance was used to analyze data from mixed designs – one within-subjects factor and one between-subjects factor. The one-way analysis of variance was performed to determine whether differences existed between any of the treatment groups with respect to variances. In this design, the multivariate tests table displays four multivariate tests of significance on each effect in the model. The study, in general, chose, Wilks' Lambda test of significance of each effect in the model. Lambda ranges between 0 and 1, with values close to 0 indicating the group means are different and values close to 1 indicating the group means are not different.

The effect size, as measured by Partial Eta Squared, ranges in value from 0 to 1; a value of 1 indicates that there are very significant differences between at least two of the means on the vocabulary test score, and a value of 0 indicates that there are no differences on the scores within each of the groups.

Profile plots are used for comparing marginal means. When there was a significant interaction effect between the factors "test" and "group", the study chose to test the simple main effects for each factor. For conducting follow-up analyses of a significant interaction between the factors "test" and "group", the study, in general, chose one-way analysis of variance for the "group" factor on the levels of the "test" factor and one-way repeated measures analysis of variance for the "test" factor on the levels of the "group" factor. If the results of the one-way analysis of variance indicated that there was a significant ANOVA, the study chose the post hoc test, Tukey's HSD for multiple comparisons to determine where the differences need past of lie. In the one-way repeated measures analysis of variance, the study also chose a paired-samples *t* test for comparing test means on the levels of the "group" factor.

Chapter 4

RESULTS

Analyses of variance (ANOVA) were conducted to evaluate the results from the study that involved two analyses: mixed factorial design (the split-plot analysis of variance) and one-way ANOVA with regard to the following variables:

1. Student's raw scores on
   - Pretest
   - Posttest
   - Retention test
2. Student's mean degree of certainty estimates on
   - Pretest
   - Posttest
   - Retention test
3. Shuford Admissible Probability Scores on
   - Pretest
   - Posttest
   - Retention test
4. Time required to complete multimedia instruction
5. Student attitude inventory

Student's Raw Scores

All students were required to complete a pretest, posttest, and retention test. The test administered to 30 items from the vocabulary lesson.

The mixed factorial design (the split-plot analysis of variance) was used to analyze data from mixed designs – one within subjects' factor ("test") and one between-subjects factor ("group"). There were three levels of factor in the within-subjects design where subjects took all three tests (pretest, posttest, and retention test) and there were six levels of factor in the between-subjects design where subjects either belonged to Group A, B, C, D, E, and F as shown in Table 4.1.

The following null and alternative hypotheses were tested during this study:

H_{01}: $\mu_A = \mu_B = \mu_C = \mu_D = \mu_E = \mu_F$

There is no main effect for "group" factor.

H_{11}: $\mu_A \neq \mu_B \neq \mu_C \neq \mu_D \neq \mu_E \neq \mu_F$

There is a main effect for "group" factor.

H_{02}: $\mu_{\text{pretest}} = \mu_{\text{posttest}} = \mu_{\text{retention test}}$

There is no main effect for "test" factor.

H_{12}: $\mu_{\text{pretest}} \neq \mu_{\text{posttest}} \neq \mu_{\text{retention test}}$

There is a main effect for "test" factor.

H_{03}: interaction effect = 0

There is an interaction effect between factors "group" and "test".

H_{13}: interaction effect $\neq 0$

There is no interaction effect between factors "group" and "test".

Table 4.1

Descriptive Statistics for Student's Raw Scores

Test	Group	Mean	Std. Deviation	n
Pretest	Group A	10.67	5.43	43
	Group B	9.77	4.05	22
	Group C	9.65	3.01	34
	Group D	10.96	5.34	24
	Group E	10.71	3.45	24
	Group F	11.40	6.19	25
	Total	10.51	4.71	172
Posttest	Group A	25.21	6.30	43
	Group B	21.95	7.31	22
	Group C	27.44	3.90	34
	Group D	26.17	6.19	24
	Group E	21.08	6.85	24
	Group F	25.48	6.83	25
	Total	24.83	6.48	172
Retention test	Group A	21.35	8.37	43
	Group B	17.82	9.53	22
	Group C	23.97	7.47	34
	Group D	25.42	4.85	24
	Group E	18.42	8.77	24
	Group F	23.08	8.95	25
	Total	21.83	8.40	172

$*p < 0.05$.

The multivariate tests table displays four multivariate tests of significance of each effect in the model. The study chose, Wilks' Lambda test of significance of each effect in the model. Lambda ranges between 0 and 1, with values close to 0 indicating the group means are different and values close to 1 indicating the group means are not different. As indicated in Table 4.2, the repeated factor, "test", (Wilks' Lambda = .174, $F_{(2,165)}$ = 390.784, p = .000, effect size = .826) and the interaction between the factors "test" and "group" (Wilks' Lambda = .848, $F_{(10,330)}$ = 2.831, p = .002, effect size = .079) were statistically significant main effect on the dependent variable.

The effect size, "Partial Eta Squared" ranges in value from 0 to 1; a value of 1 indicates that there are very significant differences between at least two of the means on student's raw scores and a value of 0 indicates that there are no differences on student's raw scores within each of the groups.

Table 4.2

Multivariate Test for Student's Raw Scores

Source		Value	F	df	Sig.	Partial Eta Squared
Test	Wilks' Lambda	.174	390.784	2	.000	.826
test * group	Wilks' Lambda	.848	2.831	10	.002	.079

The study chose a profile plot for interpreting the interaction effect between the factors "test" and "group." Figure 4.1 shows the significant interaction effect between the factors "test" and "group" in estimated marginal means.

For conducting follow-up analyses on a significant interaction between the factors "test" and "group", the study chose one-way analysis of variance for the "group" factor on the levels of the "test" factor and one-way repeated measures analysis of variance for the "test" factor on the levels of the "group" factor.

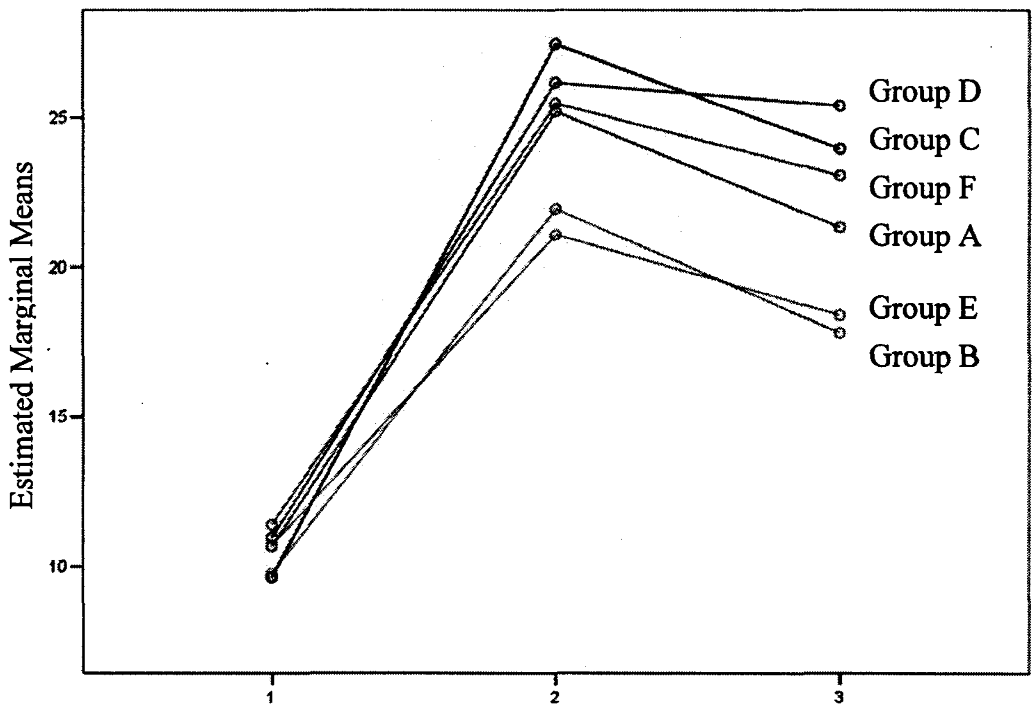


Figure 4.1. Profile plot for student's raw scores: Group A (visual text), Group B (visual text and adding spoken text), Group C (visual text and adding graphics), Group D (visual text, adding graphics, and adding spoken text), Group E (reducing visual text and adding spoken text), and Group F (reducing visual text, adding graphics, and adding spoken text).

As shown in Table 4.3, the ANOVA was not statistically significant, $F_{(5, 166)} = 0.570, p = .723$, effect size = .017. Thus, the result of the ANOVA demonstrates that there were not significant differences in student's raw scores between the groups on the pretest.

Table 4.3

ANOVA Summary Table for Student's Raw Scores on the Pretest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	18013.987	1	18013.987	802.343	.000	.829
group	64.007	5	12.801	.570	.723	.017
Error	3726.987	166	22.452			

However, the results of Table 4.4 indicate that the ANOVA was statistically significant in student's raw scores between the groups on the posttest, $F_{(5,166)} = 4.220$, $p = .001$, effect size = .113. The results of the follow-up test, Tukey's HSD indicate that there was a significant difference in means between the Groups (B and C, C and B, C and E, and E and C) as shown in Table 4.5.

Table 4.4

ANOVA Summary Table for Student's Raw Scores on the Posttest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	98022.463	1	98022.463	2552.885	.000	.939
group	810.251	5	162.050	4.220	.001	.113
Error	6373.860	166	38.397			

Table 4.5

Multiple Comparisons between the Groups with Significant for Student's Raw Scores on the Posttest

(I) group	(J) group	Mean Difference (I-J)	Std. Error	Sig.
Group B	Group C	-5.49(*)	1.695	.018
Group C	Group B	5.49(*)	1.695	.018
	Group E	6.36(*)	1.652	.002
Group E	Group C	-6.36(*)	1.652	.002

Based on observed means

These results indicate that student's raw scores were significantly higher in Group C (M = 27.44, SD = 3.90) than in Group B (M = 21.95, SD = 7.31) and Group E (M = 21.08, SD = 6.85) on the posttest.

As shown in Table 4.6, the ANOVA was statistically significant in student's raw scores between the groups on the retention test, $F_{(5,166)} = 3.487$, $p = .005$, effect size = .095. The results of the follow-up test, Tukey's HSD indicate that there was a significant difference in means between the Groups (B and D, D and B, D and E, and E and D) as shown in Table 4.7. These results indicate that student's raw scores were significantly higher in Group D ($M = 25.42$, $SD = 4.85$) than in Group B ($M = 17.82$, $SD = 9.53$) and Group E ($M = 18.42$, $SD = 8.77$) on the retention test.

Table 4.6

ANOVA Summary Table for Student's Raw Scores on the Retention Test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	76373.133	1	76373.133	1160.822	.000	.875
group	1147.250	5	229.450	3.487	.005	.095
Error	10921.517	166	65.792			

Table 4.7

Multiple Comparisons between the Groups with Significance for Student's Raw Scores on the Retention Test

(I) group	(J) group	Mean Difference (I-J)	Std. Error	Sig.
Group B	Group D	-7.60(*)	2.394	.022
Group D	Group B	7.60(*)	2.394	.022
	Group E	7.00(*)	2.342	.037
Group E	Group D	-7.00(*)	2.342	.037

Based on observed means

For one-way repeated measures analysis of variance, the study chose Wilks' Lambda test of significance for "test" factor at the levels of "group" factor. As shown in Table 4.8, the repeated factor, "test" was a statistically significant main effect for student's raw scores on all levels of "group" factor.

Table 4.8

Multivariate Tests for "Test" Factor Effect on the Groups

Group		Value	F	df	Sig.	Partial Eta Squared
Group A	Wilks' Lambda	.144	121.925[a]	2	.000	.856
Group B	Wilks' Lambda	.255	29.259[a]	2	.000	.745
Group C	Wilks' Lambda	.036	431.369[a]	2	.000	.964
Group D	Wilks' Lambda	.128	74.617[a]	2	.000	.872
Group E	Wilks' Lambda	.246	33.714[a]	2	.000	.754
Group F	Wilks' Lambda	.207	44.151[a]	2	.000	.793

a. Exact statistic

For follow-up analysis, the study chose a paired-sample *t*-test procedure to compare the means of the levels of the "test" factor as shown in Table 4.9.

The data, in general, show that students earned higher scores when they received multimedia instruction on the posttest. These results lead to the conclusion that there was a significant difference in means of student's raw scores between the groups when students received multimedia instruction.

Table 4.9

Paired-Samples t-Test for Student's Raw Scores among the Groups on the Levels of "Test" Factor

Group	(I) test	(J) test	*t*	df	Sig. (2-tailed)
Group A	Pretest	posttest	-13.667	42	.000
	Pretest	retention test	-7.638	42	.000
	posttest	retention test	5.275	42	.000
Group B	Pretest	posttest	-7.292	21	.000
	Pretest	retention test	-3.847	21	.001
	posttest	retention test	3.134	21	.005
Group C	Pretest	posttest	-28.232	33	.000
	Pretest	retention test	-12.004	33	. 000
	posttest	retention test	3.870	33	. 000
Group D	Pretest	posttest	-10.873	23	.000
	Pretest	retention test	-12.148	23	.000
	posttest	retention test	.775	23	.446
Group E	Pretest	posttest	-7.935	23	.000
	Pretest	retention test	-4.404	23	.000
	posttest	retention test	2.404	23	.025
Group F	Pretest	posttest	-9.192	24	.000
	Pretest	retention test	-6.825	24	.000
	posttest	retention test	2.992	24	.006

Student's Mean Degree of Certainty Estimates

Each student was required to write a number from 0 to 100 which indicate how sure the student was that his or her response was correct on the tests. This number constitutes the degree of certainty score.

The dependent variable was the student's mean degree of certainty estimate between the groups' conditions as measured on the pretest, posttest, and retention test. The mixed factorial design (the split-plot analysis of variance) was used to analyze data from mixed designs – one within subjects factor ("test") and one between-subjects factor ("group"). There were three levels of factor in the within-subjects design where subjects took all three tests (pretest, posttest, and retention test) and there were six levels of factor in the between-subjects design where subjects either belonged to Group A, B, C, D, E, and F as shown in Table 4.10.

The following null and alternative hypotheses were tested during this study:

H_{01}: $\mu_A = \mu_B = \mu_C = \mu_D = \mu_E = \mu_F$

There is no main effect for "group" factor.

H_{11}: $\mu_A \neq \mu_B \neq \mu_C \neq \mu_D \neq \mu_E \neq \mu_F$

There is a main effect for "group" factor.

H_{02}: $\mu_{\text{pretest}} = \mu_{\text{posttest}} = \mu_{\text{retention test}}$

There is no main effect for "test" factor.

H_{12}: $\mu_{\text{pretest}} \neq \mu_{\text{posttest}} \neq \mu_{\text{retention test}}$

There is a main effect for "test" factor.

H_{03}: interaction effect = 0

There is an interaction effect between factors "group" and "test".

H_{13}: interaction effect $\neq$ 0

There is no interaction effect between factors "group" and "test".

Table 4.10

Descriptive Statistics for Student's Mean Degree of Certainty Estimates

Test	Group	Mean	Std. Deviation	*n*
Pretest	Group A	.32	.29	43
	Group B	.33	.28	22
	Group C	.32	.28	34
	Group D	.24	.17	24
	Group E	.21	.21	24
	Group F	.35	.21	25
	Total	.30	.25	172
Posttest	Group A	.84	.26	43
	Group B	.77	.29	22
	Group C	.91	.17	34
	Group D	.90	.18	24
	Group E	.69	.31	24
	Group F	.85	.27	25
	Total	.83	.25	172
Retention test	Group A	.65	.39	43
	Group B	.56	.40	22
	Group C	.73	.34	34
	Group D	.81	.27	24
	Group E	.60	.35	24
	Group F	.77	.30	25
	Total	.69	.35	172

* $p < 0.05$.

As shown in Table 4.11, the repeated factor "test", (Wilks' Lambda = .236, $F_{(2,165)}$ = 267.809, p = .000, effect size = .764) was statistically significant main effect for the dependent variable. However, the interaction between the factors "test" and "group" (Wilks' Lambda = .908, $F_{(10,330)} = 1.630$, $p = .098$, effect size = .047) was not significant main effect on the dependent variable.

Table 4.11

Multivariate Test for Student's Mean Degree of Certainty Estimates

Source		Value	F	df	Sig.	Partial Eta Squared
Test	Wilks' Lambda	.236	267.809	2	.000	.764
test * group	Wilks' Lambda	.908	1.626	10	.098	.047

As shown in Table 4.12, the ANOVA was not statistically significant, $F_{(5, 166)} = 1.286$, $p = .272$, effect size = .037. Thus, the result of the ANOVA demonstrates that there were not significant differences in student's mean degree of certainty estimates between the groups on the pretest.

Table 4.12

ANOVA Summary Table for Student's Mean Degree of Certainty Estimates on the Pretest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	14.121	1	14.121	226.593	.000	.577
Group	.401	5	.080	1.286	.272	.037
Error	10.345	166	.062			

However, the results of Table 4.13 indicate that the ANOVA was statistically significant, $F_{(5, 166)} = 2.910$, $p = .015$, effect size = .081. The results of the follow-up test, Tukey's HSD indicate that there was a significant difference in means between the Groups (C and E and E and C) on the posttest as shown in Table 4.14. These results indicate that student's mean degree of certainty estimates were significantly higher in Group C (M = .91, SD = .17) than in Group E (M = .69, SD = .31) on the posttest.

Table 4.13

ANOVA Summary Table for Student's Mean Degree of Certainty Estimates on the Posttest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	111.148	1	111.148	1825.026	.000	.917
Group	.886	5	.177	2.910	.015	.081
Error	10.110	166	.061			

Table 4.14

Multiple Comparisons between the Groups with Significance for Student's Mean Degree of Certainty Estimates on the Posttest

(I) group	(J) group	Mean Difference (I-J)	Std. Error	Sig.
Group C	Group E	.2200(*)	.06579	.013
Group E	Group C	-.2200(*)	.06579	.013

Based on observed means

As shown in Table 4.15, the ANOVA was not statistically significant, $F_{(5,166)}$ = 1.953, p = .088, effect size = .056. Thus, the results demonstrate that there were not significant differences in student's mean degree of certainty estimates between the groups on the retention test.

Table 4.16 indicates repeated factor, "test" had a statistically significant main effect on the dependent variable on all levels of "group" factor.

Table 4.15

ANOVA Summary Table for Student's Mean Degree of Certainty Estimates on the Retention Test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	77.107	1	77.107	637.654	.000	.793
Group	1.181	5	.236	1.953	.088	.056
Error	20.073	166	.121			

Table 4.16

Multivariate Tests for "Test" Factor Effect on the Groups

Group		Value	F	df	Sig.	Partial Eta Squared
Group A	Wilks' Lambda	.216	74.582[a]	2	.000	.784
Group B	Wilks' Lambda	.427	13.420[a]	2	.000	.573
Group C	Wilks' Lambda	.146	93.882[a]	2	.000	.854
Group D	Wilks' Lambda	.076	133.461[a]	2	.000	.924
Group E	Wilks' Lambda	.228	37.152[a]	2	.000	.772
Group F	Wilks' Lambda	.278	29.805[a]	2	.000	.722

a. Exact statistic

As shown in Table 4.17, there were significant differences in levels of "test" factor on the Groups (A, B, C, D, E, and F).

These results lead to the conclusion that students in general earned higher scores, indicating that their degrees of belief probabilities increased when they received multimedia instruction.

Table 4.17

Paired-Samples t-Test for Student's Mean Degree of Certainty Estimates among the Groups on the Levels of "Test" Factor

Group	(I) test	(J) test	*t*	df	Sig. (2-tailed)
Group A	pretest	posttest	-11.182	42	.000
	pretest	retention test	-4.747	42	.000
	posttest	retention test	3.897	42	.000
Group B	pretest	posttest	-5.244	21	.000
	pretest	retention test	-2.781	21	.011
	posttest	retention test	2.899	21	.009
Group C	pretest	posttest	-13.915	33	.000
	pretest	retention test	-7.392	33	. 000
	posttest	retention test	3.749	33	. 001
Group D	pretest	posttest	-13.887	23	.000
	pretest	retention test	-8.742	23	.000
	posttest	retention test	2.974	23	.007
Group E	pretest	posttest	-8.760	23	.000
	pretest	retention test	-6.502	23	.000
	posttest	retention test	1.953	23	.063
Group F	pretest	posttest	-7.878	24	.000
	pretest	retention test	-6.490	24	.000
	posttest	retention test	1.813	24	.082

Shuford Admissible Probability Scores

The study adopted Shuford's Admissible Probability Measurement (APM) to reduce guessing scores on the multiple choice testing. With each multiple-choice question, there were two forms. The first form was for a student's response to each question. The second form required the learner to write a number from 0 to 100 which indicate how sure the student was that his or her response was correct. The admissible probability score was obtained by applying the formula listed in the previous chapter.

The mixed factorial design (the split-plot analysis of variance) was used to analyze data from mixed designs – one within subjects factor ("test") and one between-subjects factor ("group"). There were three levels of factor in the within-subjects design where subjects took all three tests (pretest, posttest, and retention test) and there were 6 levels of factor in the between-subjects design where subjects either belonged to Group A, B, C, D, E, and F as shown in Table 4.18.

The following null and alternative hypotheses were tested during this study:

H_{01}: $\mu_A = \mu_B = \mu_C = \mu_D = \mu_E = \mu_F$

There is no main effect for "group" factor.

H_{11}: $\mu_A \neq \mu_B \neq \mu_C \neq \mu_D \neq \mu_E \neq \mu_F$

There is a main effect for "group" factor.

H_{02}: $\mu_{\text{pretest}} = \mu_{\text{posttest}} = \mu_{\text{retention test}}$

There is no main effect for "test" factor.

H_{12}: $\mu_{\text{pretest}} \neq \mu_{\text{posttest}} \neq \mu_{\text{retention test}}$

There is a main effect for "test" factor.

H_{03}: interaction effect = 0

There is an interaction effect between factors "group" and "test".

H_{13}: interaction effect $\neq 0$

There is no interaction effect between factors "group" and "test".

Table 4.18

Descriptive Statistics for Student's Admissible Probability Scores

	Group	Mean	Std. Deviation	*n*
Pre Test	Group A	-16.11	11.48	43
	Group B	-16.58	9.70	22
	Group C	-17.75	7.66	34
	Group D	-16.68	9.58	24
	Group E	-20.10	9.04	24
	Group F	-13.15	13.08	25
	Total	-16.70	10.31	172
Post Test	Group A	17.34	16.61	43
	Group B	10.43	17.37	22
	Group C	23.72	9.49	34
	Group D	21.28	13.22	24
	Group E	6.34	17.41	24
	Group F	18.39	17.81	25
	Total	16.88	16.26	172
Retention test	Group A	5.70	22.71	43
	Group B	-1.58	24.03	22
	Group C	12.58	19.34	34
	Group D	17.70	13.31	24
	Group E	1.18	20.39	24
	Group F	13.28	19.59	25
	Total	8.27	21.08	172

* $p < 0.05$.

As indicated in Table 4.19, the repeated factor, "test" (Wilks' Lambda = .186, $F_{(2,165)} = 360.841$, $p = .000$, effect size = .814) and the interaction between the factors "test" and "group" (Wilks' Lambda = .845, $F_{(10,330)} = 2.9.4$, $p = .002$, effect size = .081) were statistically significant main effect on the dependent variable.

Table 4.19

Multivariate Test for Student's Admissible Probability Scores

Source		Value	F	df	Sig.	Partial Eta Squared
test	Wilks' Lambda	.186	360.841	2	.000	.814
test * group	Wilks' Lambda	.845	2.904	10	.002	.081

Figure 4.2 shows the significant interaction effect between the factors "test" and "group" in estimated marginal means. For conducting follow-up analyses on a significant interaction between the factors "test" and "group", the study, chose one-way analysis of variance for "group" factor on the levels of "test" factor and one-way repeated measures analysis of variance for "test" factor on the levels of "group" factor.

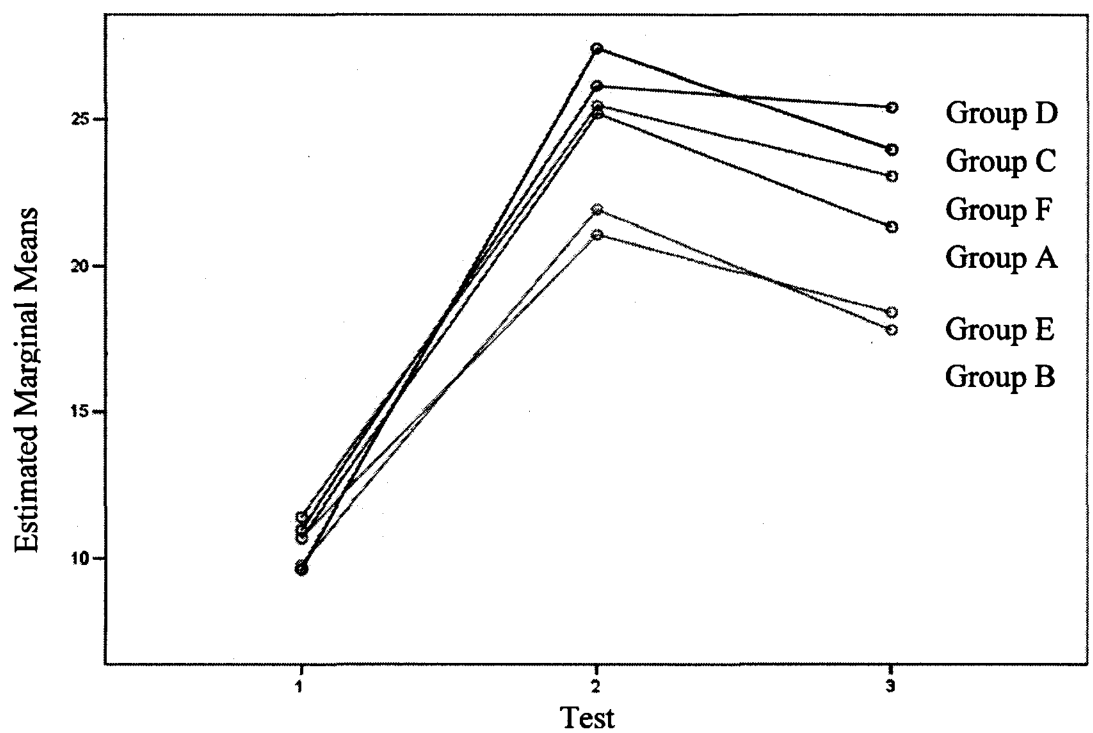


Figure 4.2. Profile plot for student's admissible probability scores: Group A (visual text), Group B (visual text and adding spoken text), Group C (visual text and adding graphics), Group D (visual text, adding graphics, and adding spoken text), Group E (reducing visual text and adding spoken text), and Group F (reducing visual text, adding graphics, and adding spoken text).

As shown in Table 4.20, the ANOVA was not statistically significant, $F_{(5,166)}$ = 1.222, p = .301, effect size = .036. Thus, the result of the ANOVA demonstrates that there were not significant differences in admissible probability scores between the groups on the pretest.

However, as shown in Table 4.21 indicate that the ANOVA was statistically significant, $F_{(5,166)}$ = 4.789, p = .000, effect size = .126. The results of the follow-up test, Tukey's HSD indicate that there was a significant difference in means between the Groups (B and C, C and B, C and E, D and E, E and C, and E and D) on the posttest as shown in Table 4.22. The results indicate that student's admissible probability scores were significantly higher in Group C (M = 23.72, SD = 9.49) than in Group B (M = 10.43, SD = 17.37) and Group E (M = 6.34, SD = 17.41). It also shows that student's admissible probability scores were significantly higher in Group D (M = 21.28, SD = 13.22) than in Group E (M = 6.34, SD = 17.41).

Thus, the results of the ANOVA demonstrate that there was a significant difference in means between the groups on the posttest.

Table 4.20

ANOVA Summary Table for Student's Admissible Probability Scores on the Pretest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	45482.477	1	45482.477	430.427	.000	.722
group	645.773	5	129.155	1.222	.301	.036
Error	17540.933	166	105.668			

Table 4.21

ANOVA Summary Table for Student's Admissible Probability Scores on the Posttest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	42924.970	1	42924.970	180.368	.000	.521
group	5698.941	5	1139.788	4.789	.000	.126
Error	39505.563	166	237.985			

Table 4.22

Multiple Comparisons between the Groups with Significance for Student's Admissible Probability Scores on the Posttest

(I) group	(J) group	Mean Difference (I-J)	Std. Error	Sig.
Group B	Group C	-13.29(*)	4.221	.024
Group C	Group B	13.29(*)	4.221	.024
	Group E	17.37(*)	4.113	.001
Group D	Group E	14.94(*)	4.453	.012
Group E	Group C	-17.37(*)	4.113	.001
	Group D	-14.94(*)	4.453	.012

Based on observed means

As shown in Table 4.23, the ANOVA was statistically significant difference, $F_{(5,166)} = 3.378$, $p = .006$, effect size = .092. The results of the follow-up test, Tukey's HSD indicate that there was a significant difference in means between Groups (B and D and D and B) on the retention test as shown in Table 4.24.

These results indicate that students' admissible probability scores were significantly higher in Group D ($M = 17.70$, $SD = 13.31$) than in Group B ($M = -1.58$, $SD = 24.03$) on the retention test. Thus, the results demonstrate that there was a significant difference in student's admissible probability scores between the groups on the retention test.

Table 4.23

ANOVA Summary Table for Student's Admissible Probability Scores on the Retention Test

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	10779.137	1	10779.137	25.940	.000	.135
group	7017.628	5	1403.526	3.378	.006	.092
Error	68980.771	166	415.547			

Table 4.24

Multiple Comparisons between the Groups with Significance for Student's Admissible Probability Scores on the Retention Test

(I) group	(J) group	Mean Difference (I-J)	Std. Error	Sig.
Group B	Group D	-19.28(*)	6.017	.020
Group D	Group B	19.28(*)	6.017	.020

Based on observed means

In the one-way repeated measures analysis of variance, the study chose Wilks' Lambda test of significance for "test" factor by the levels of "group" factor. Table 4.25 indicates repeated factor, "test" was a statistically significant main effect for the dependent variable on all levels of "group" factor.

For follow-up analysis, the study chose a paired-sample *t*-test procedure to compare the means of two levels of "test" factor as shown in Table 4.26.

Table 4.25

Multivariate Tests for "Test" Factor Effect on the Groups

Group	Effect		Value	F	df	Sig.	Partial Eta Squared
Group A	test	Wilks' Lambda	.179	93.901[a]	2	.000	.821
Group B	test	Wilks' Lambda	.325	20.754[a]	2	.000	.675
Group C	test	Wilks' Lambda	.047	322.757[a]	2	.000	.953
Group D	test	Wilks' Lambda	.103	96.216[a]	2	.000	.897
Group E	test	Wilks' Lambda	.287	27.273[a]	2	.000	.713
Group F	test	Wilks' Lambda	.232	37.977[a]	2	.000	.768

a. Exact statistic

The results shown in Table 4.26 indicate that there were significant differences in the tests on Groups A, B, C, E, and F. The results of Group D showed that there were not significant differences between the posttest and retention test. In other words, students in Group D earned higher scores on both posttest and retention test when they received the multimedia instruction.

These results lead to the conclusion that there was a significant difference in student's admissible probability scores between the groups when students received multimedia instruction.

Table 4.26

Paired-Samples t-Test for Student's Admissible Probability Scores among the Groups on the Levels of "Test" Factor

Group	(I) test	(J) test	*t*	df	Sig. (2-tailed)
Group A	pretest	posttest	-13.461	42	.000
	pretest	retention test	-6.059	42	.000
	posttest	retention test	4.203	42	.000
Group B	pretest	posttest	-6.498	21	.000
	pretest	retention test	-3.060	21	.006
	posttest	retention test	2.973	21	.007
Group C	pretest	posttest	-24.995	33	.000
	pretest	retention test	-10.135	33	. 000
	posttest	retention test	4.679	33	. 000
Group D	pretest	posttest	-14.082	23	.000
	pretest	retention test	-11.370	23	.000
	posttest	retention test	1.670	23	.108
Group E	pretest	posttest	-7.533	23	.000
	pretest	retention test	-5.652	23	.000
	posttest	retention test	2.198	23	.038
Group F	pretest	posttest	-8.519	24	.000
	pretest	retention test	-6.709	24	.000
	posttest	retention test	3.153	24	.004

Time Required to Complete Instruction

All students were required to type a number to indicate their time required to complete multimedia instruction on the posttest.

A one-way analysis of variance was conducted to evaluate the relationship between the Groups A, B, C, D, E, and F with regard to data from amount of time to complete instruction on the posttest alone as shown in Table 4.27.

The following null and alternative hypotheses were tested during this study:

H_{01}: $\mu_A = \mu_B = \mu_C = \mu_D = \mu_E = \mu_F$

There are no differences in the amount of time to complete instruction among students who are taught under the six methods of multimedia instruction conditions.

H_{11}: At least one group mean is different from another.

Table 4.27

Descriptive Statistics for Time Required to Complete Instruction

Group	*n*	*M*	*SD*
Group A (visual text)	43	676.21	182.52
Group B (visual text + spoken text)	21	740.00	275.45
Group C (visual text + graphics)	33	675.97	301.59
Group D (visual text + spoken text + graphics)	23	725.39	187.26
Group E (reduced visual text + spoken text)	23	786.22	249.37
Group F (reduced visual text + spoken text + graphics)	24	758.71	187.61
Total	167	717.96	233.72

As indicated in Table 4.28, the ANOVA was not statistically significant, F (5, 161) = 1.070, p = .379, effect size = .032. The p value is higher than 0.05; the study failed to reject the null hypothesis that there are no differences in the amount of time to complete instruction among students who are taught under the six methods of multimedia instruction conditions.

Table 4.28

ANOVA Summary Table for Time Required to Complete Instruction among the Groups

Source	*df*	*Mean Square*	*F*	*Sig.*	*Partial Eta Squared*
Intercept	1	82816719.458	1519.283	.000	.904
Group	5	58323.870	1.070	.379	.032
Error	161	54510.388			

Student Attitude Inventory

All students were required to complete the 40 items of the student attitude inventory.

A one-way analysis of variance was conducted to evaluate the relationship between the Groups A, B, C, D, E, and F with regard to data from scores on the student attitude inventory in Table 4.29.

The following null and alternative hypotheses were tested during this study:

H_{01}: $\mu_A = \mu_B = \mu_C = \mu_D = \mu_E = \mu_F$

There are no differences in attitude toward instruction among students who are taught under the six methods of multimedia instruction conditions.

H_{11}: At least one group mean is different from another.

As indicated in Table 4.30, the ANOVA was not statistically significant, F (5, 163) = .175, p = .972, effect size = .005. The p value was larger than 0.05; the study failed to reject the null hypothesis that there are no differences in attitude toward instruction among students who are taught under the six methods of multimedia instruction conditions.

Table 4.29

Descriptive Statistics for Students' Attitude Inventory Scores

Group	*n*	*M*	*SD*
Group A (visual text)	42	91.29	15.312
Group B (visual text + spoken text)	21	92.52	9.053
Group C (visual text + graphics)	34	92.12	14.466
Group D (visual text + spoken text + graphics)	23	92.00	7.141
Group E (reduced visual text + spoken text)	24	93.46	9.771
Group F (reduced visual text + spoken text + graphics)	25	90.64	8.087
Total	169	91.92	11.743

Table 4.30

ANOVA Summary Table for Students' Attitude Inventory Scores among the Groups

Source	*df*	*Mean Square*	*F*	*Sig.*	*Partial Eta Squared*
Intercept	1	1348460.304	9537.795	.000	.983
group	5	24.757	.175	.972	.005
Error	163	141.381			

Chapter 5

DISCUSSION, SUMMARY, AND RECOMMENATION

The statement of each null hypothesis is following by a discussion of the results related to that hypothesis and conclusions based on those results.

Hypothesis 1

Ho: There are no differences in original learning among students who are taught under the six methods of multimedia instruction conditions as measured by raw score, mean degree of certainty estimate, and an admissible probability scoring procedure.

Student's Raw Scores

As discussed in the previous chapter, the repeated factor, "test", and the interaction between the factors "test" and "group" were statistically significant main effects for the dependent variable, "student's raw score".

The results of ANOVA tests were statistically significant on the posttest, $F_{(5, 166)}$ = 4.220, p = .001, effect size = .113, as well as on the retention test, $F_{(5, 166)}$ = 3.487, p = .005, effect size = .095. The results of the follow-up Tukey' HSD indicate that there were significant differences in means between the groups on the posttest and the retention test. These results lead to the conclusion that there was a significant difference in means of student's raw scores between the groups when students received multimedia instruction.

Figure 5.1 shows that the students in Group C (visual text and adding graphics) and Group D (visual text, adding graphics, and adding spoken text) learned and retained English vocabulary more effectively than students who received the other types of instruction.

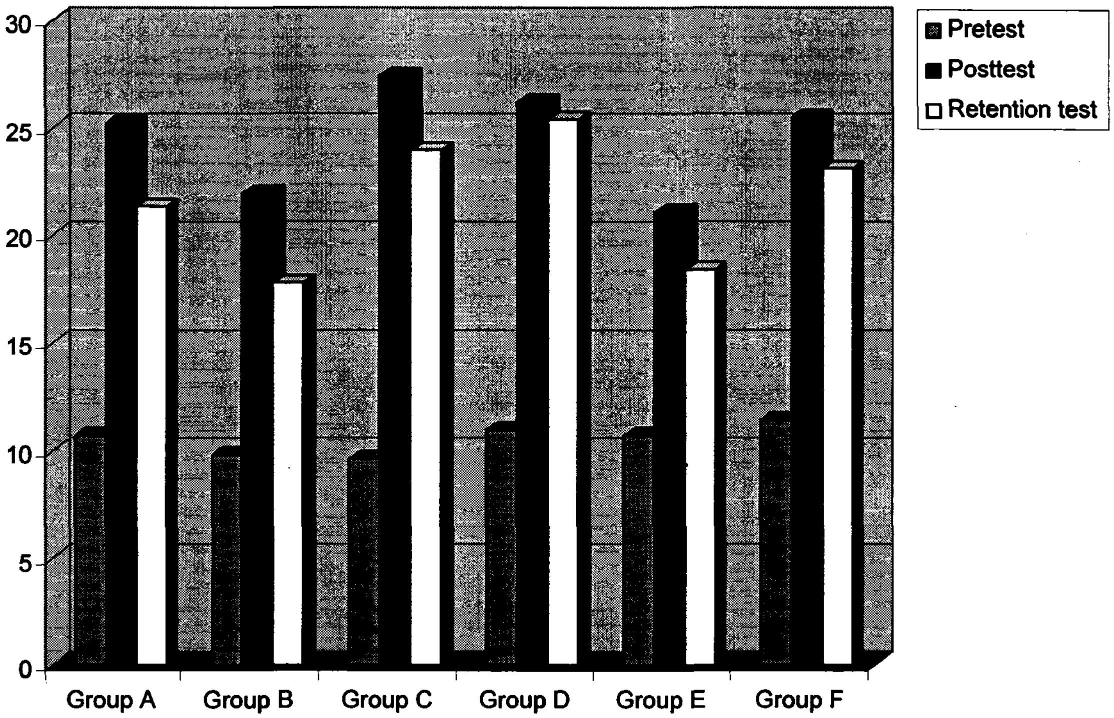


Figure 5.1. Group's means for student's raw scores: Group A (visual text), Group B (visual text and adding spoken text), Group C (visual text and adding graphics), Group D (visual text, adding graphics, and adding spoken text), Group E (reducing visual text and adding spoken text), and Group F (reducing visual text, adding graphics, and adding spoken text).

Student's Mean Degree of Certainty Estimates

The results discussed in the previous chapter indicated that the repeated factor, "test," had statistically significant main effects for the dependent variable. The interaction between factors "test" and "group" did not significant affects for the dependent variable on the pretest and the retention test.

The results of the ANOVA test were statistically significant on the posttest alone, $F_{(5, 166)} = 2.910, p = .015$, effect size = .081. The results of the follow-up Tukey' HSD indicate that there were significant differences in means between the groups on the posttest alone.

Figure 5.2 shows that there were significant differences in different tests as measured by student's mean degree of certainty estimates.

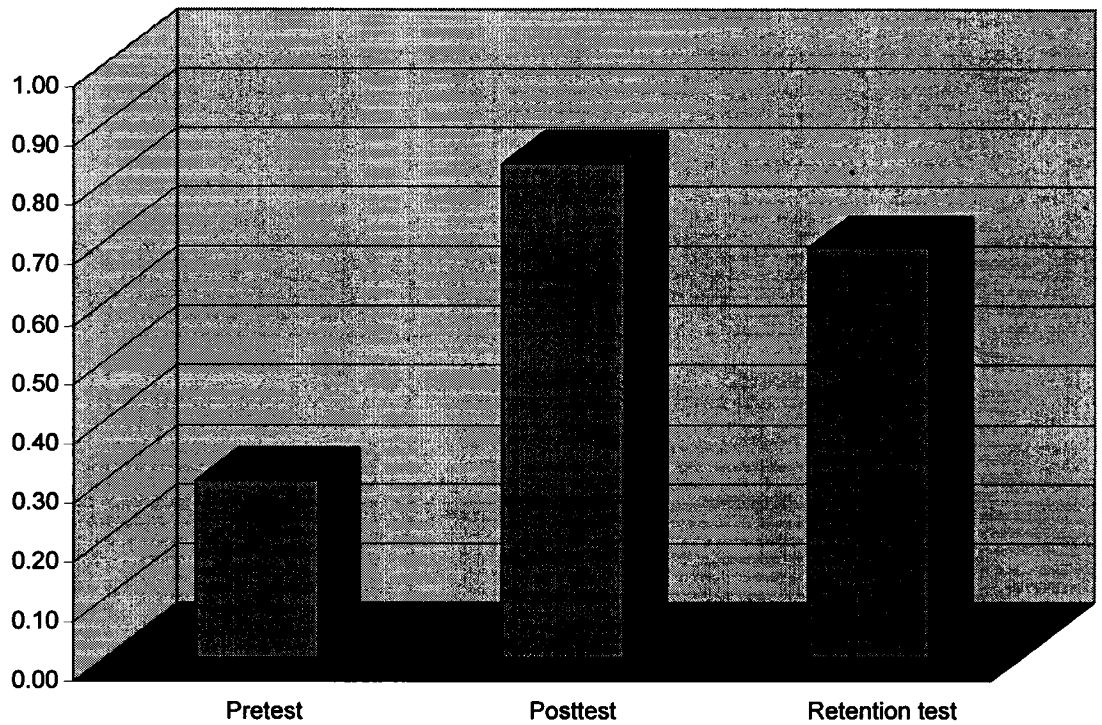


Figure 5.2. Test's means for student's mean degree of certainty estimates

This result shows that students, in general, earned a higher score which indicates that students increased their degrees of belief probabilities when they received multimedia instruction. The likely reason is that multimedia instruction helped students to increase their degrees of certainty estimates as well as to learn and retain English vocabulary.

Admissible Probability Scores

The study adopted Shuford's Admissible Probability Measurement (APM) to reduce guessing scores on the multiple choice testing. As discussed in the previous chapter, the repeated factor, "test," and the interactions between factors "test" and "group" were statistically significant effects on the dependent variable.

The results of the ANOVA tests were statistically significant on the posttest, $F_{(5, 166)} = 4.789$, $p = .000$, effect size = .126, as well as on the retention test, $F_{(5, 166)} = 3.378$, $p = .006$, effect size = .092. The results of the follow-up test, Tukey' HSD indicate that there were significant differences in means between the groups on the posttest and the retention test. These results lead to the conclusion that there was a significant difference in means of student's admissible probability scores between the groups when students received multimedia instruction.

As shown in Figure 5.3, students in Group C (visual text and adding graphics) and Group D (visual text, adding graphics, and adding spoken text) learned and retained English vocabulary more effectively than students who received the other types of instruction: Group A (visual text), Group B (visual text and adding spoken text), Group E (reducing visual text and adding spoken text), and Group F (reducing visual text, adding graphics, and adding spoken text).

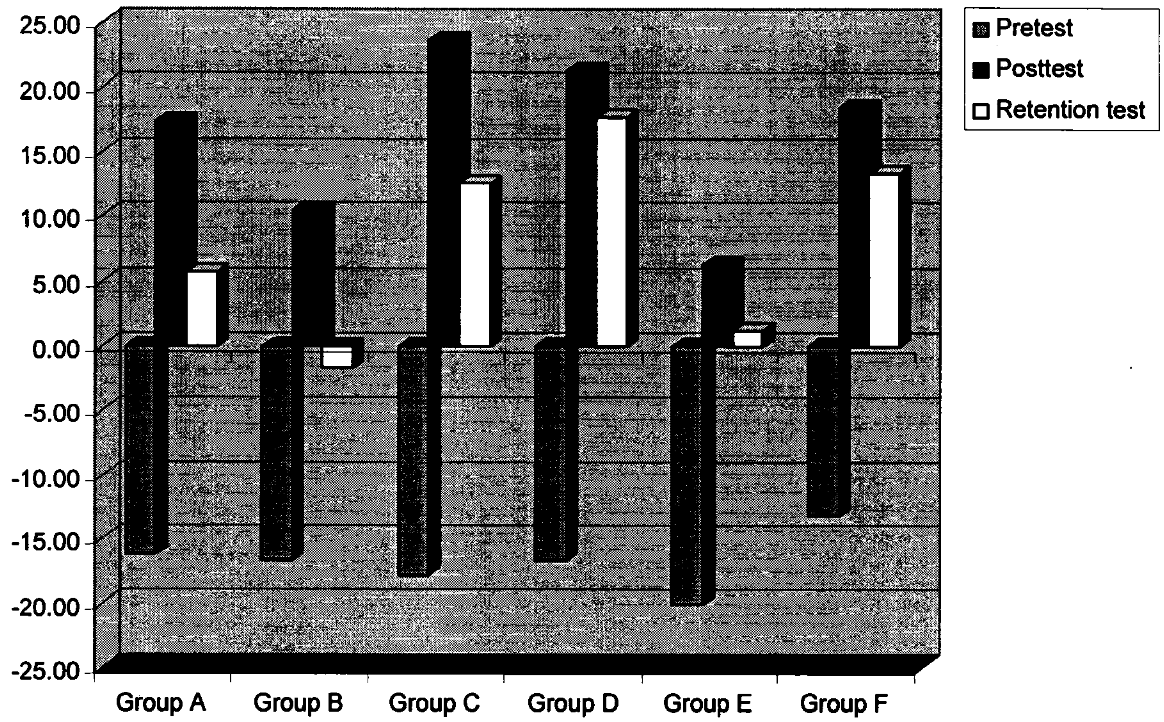


Figure 5.3. Group's means for student's Shuford Admissible Probability Scores: Group A (visual text), Group B (visual text and adding spoken text), Group C (visual text and adding graphics), Group D (visual text, adding graphics, and adding spoken text), Group E (reducing visual text and adding spoken text), and Group F (reducing visual text, adding graphics, and adding spoken text).

Conclusion

The mixed factorial design (the split-plot analysis of variance) on data obtained from the scores of students who were taught under the six methods of multimedia instruction conditions as measured by the student's raw scores and the Shuford Admissible Probability Scores on the posttest and the retention test showed differences between the six methods of multimedia instruction at the .05 level of significance.

No significant differences were found among treatment groups on data of the student's mean degree of certainty estimates on the pretest and the retention test. Thus, it is reasonable to conclude that there were no significant differences among the treatment groups with respect to the degree of certainty of knowledge on the pretest and the retention test. However, the results show that students, in general, earned a higher score, indicating that their degrees of belief probabilities increased when they received multimedia instruction.

The results likely indicate that students, in general, earned a higher score which indicates that they learned better when they received "visual text and adding graphics" or "visual text, adding graphics, and adding spoken text" in their multimedia instruction than did students who received other types of instructions ("visual text", "visual text and adding spoken text", "reduced text and adding spoken text", or "reduced text, adding graphics, and adding spoken text"). In other words, when visual text is presented with graphics, students may be motivated to success and achievement in L2 vocabulary learning on the current vocabulary test.

Discussion

Based on visual text. The instruction based on visual text (Group A), in general, helped students to learn and retain English vocabulary more effectively than students who received the instruction based on visual text and adding spoken text (Group B) and the instruction based on reducing visual text and adding spoken text (Group E).

From Mayer and Moreno's research (2002), the results should have indicated that proving words as narration (spoken text) helped students' performance rather than on-screen text (visual text). However, the results show that words alone may help students to learn and retain English vocabulary. A possible reason for this is that English as a Foreign Language (EFL) learners often adopt various strategies to memorize vocabulary words. For instance, learning a second language (L2) vocabulary learning is often used with strategies, such as word lists or paired associates, in which new words are presented with their translations. These strategies often require learners to memorize pair associations directly (Sun & Dong, 2004). L2 vocabulary learning studies in Korea, often, have focused on learning based on visual text alone in printed materials.

Adding spoken text. The instruction based on visual text and adding spoken text (Group B) and based on reducing visual text and adding graphics (Group E) reduced students' ability to learn and retain English vocabulary. From cognitive load theory (Mayer, 2001; Sweller et al., 1998; Tabbers et al., 2004), the results should have indicated that students could reduce memory load by reduced text with adding spoken text (Group E). However, in fact, this aid did not help students to learn and retain English vocabulary. This result indicated that replacing visual text with spoken text and adding graphics to the visual text both do not easily generalize to all educational settings (Tabbers et al.).

The limited score for Group B (visual text and adding spoken text) and E (reducing visual text and adding spoken text) may indicate problems in phonic learning. Students may have difficulty in knowing exactly how the words are pronounced. Because many EFL learners in Korea are accustomed to memorizing new words without knowing exactly how the word is pronounced, spoken text of multimedia instruction created an unnecessary distraction.

Another possible reason for this is that the test was designed to measure only students' understanding of a word's meaning and did not measure student's knowledge of the word's pronunciation. The spoken text seemed to be a distraction to students who are accustomed to learning foreign language mainly in the current written test. Thus, this result leads one to conclude that an effective way to improve learning of new English vocabulary is to avoid the addition of spoken text when explaining what the vocabulary means in Korean.

Adding graphics. The instruction based on visual text and adding graphics (Group C), based on visual text, adding graphics, and adding spoken text (Group D), and based on reducing text, adding spoken text, and adding graphics (Group F) helped students to learn and retain English vocabulary more effectively than students who received the other types of instruction on pretest and retention test: Group A (visual text), Group B (visual text and adding spoken text), and Group E (reducing visual text and adding spoken text). The results show that students, in general, earned a higher score which indicates that they learned better when they received "graphics" or "graphics & spoken text" in their multimedia instruction than did students who received other types of instructions (Group A, B, and E). In other words, when visual text was presented with graphics, students may be motivated to success and achievement in L2 vocabulary learning on the current vocabulary test. The likely reason is that text often doesn't translate in a manner that is meaningful to the student, while a graphic allows the student to visualize the definition in a more meaningful way. A possible reason for this is that some words can not be translated directly and retain meaning for middle school students. When students received the instruction based on visual text only, for example, showing "taut" means "pulled or stretched tight." Learners may not be able to explain what that definition means in ways that make sense to them. These results supported the study (Kost et al., 1999) that L2 students performed better on vocabulary tests when they were allowed to use a combination of visual text and graphics.

From dual coding theory (Mayer & Moreno, 2002; Paivio, 1986; Sadoski & Paivio, 2001), the results support that students are likely to build connections between verbal (visual text) and nonverbal (graphics) representations. As Mayer (2001) concluded, we assume that processing of visual text takes place initially in the nonverbal channel and then moves to the verbal channel. The results appeared to indicate that providing both visual text and graphics helped students to select relevant information, organize it into coherent representations, and integrate it with other knowledge as meaningful learning (Mayer and Moreno).

The results appears to indicate that replacing visual text with spoken text and adding graphics to the visual text both do not easily generalize to all educational settings (Tabbers et al., 2004). A possible reason for this is that reduced text was not sufficient to explain what the vocabulary means in Korean.

In addition, learning new vocabulary in a second language (L2) within the context of the instruction based on visual text and adding graphics may indicate that

> students have to make informed guesses as to the meaning of a new word in light of available linguistic cues in the context as well as the relevant knowledge in the learner's mind, including general knowledge of the world, awareness of the situation, and relevant linguistic knowledge. (Sun & Dong, 2004, p. 132)

Thus, the results lead to the conclusion that an effective way to improve learning of English vocabulary is to offer graphics to explain what the vocabulary means in Korean. Providing graphics in Web-based multimedia instruction may help students to select relevant information, organize it into coherent representations, and integrate it with other knowledge as meaningful learning for English vocabulary learning.

Hypothesis 2

Ho: There are no differences in time to complete instruction among students who are taught under the six methods of multimedia instruction.

Time Required to Complete Instruction

Data presented in the previous chapter indicated that the ANOVA was not significant. The *p* value is higher than .05; the study failed to reject the null hypothesis that there are no differences in the amount of time required to complete instruction among students who are taught under the six methods of multimedia instruction conditions as shown in Figure 5.4.

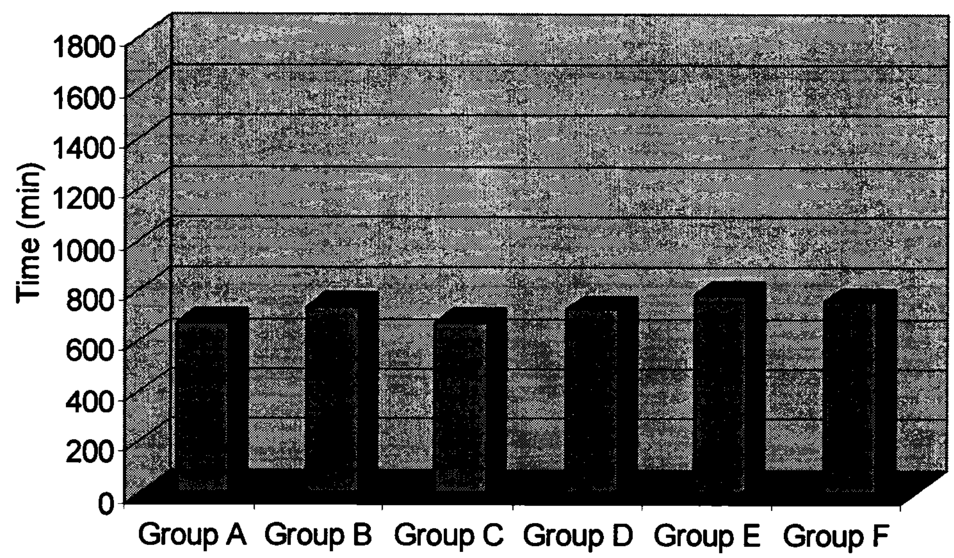


Figure 5.4. Group's means time to complete instruction

Conclusion

Results of analyses of variance (ANOVA) on data obtained from the students who were taught under the six methods of multimedia instruction conditions as measured by the time required to complete instruction showed no differences between six methods of multimedia instruction at the .05 level of significance. Thus, this result leads to the conclusion that there were no significant differences among the six methods of multimedia instruction with respect to time to complete instruction.

Discussion

Providing spoken text (Group B, D, E, and F), in general, required students to spend more time to complete the instruction, but it wasn't significant. Thus, the result leads to the conclusion that providing graphics or spoken text does not significantly affect the time required to complete instruction.

Hypothesis 3

Ho: There are no differences in students' attitude toward instruction among students who are taught under the six methods of multimedia instruction conditions as measured by their scores on student attitude inventory.

Student Attitude Inventory

Data presented in the previous chapter indicated that the ANOVA was not significant. The *p* value was higher than .05; the study failed to reject the null hypothesis that there are no differences in students' attitude toward instruction among students who are taught under the six methods of multimedia instruction conditions as shown in Figure 5.5.

Conclusion

Results of analyses of variance (ANOVA) on data obtained from the students who were taught under the six methods of multimedia instruction conditions as measured by score on student attitude inventory showed no differences in students' attitude toward instruction among students who were taught under the six methods of multimedia instruction conditions.

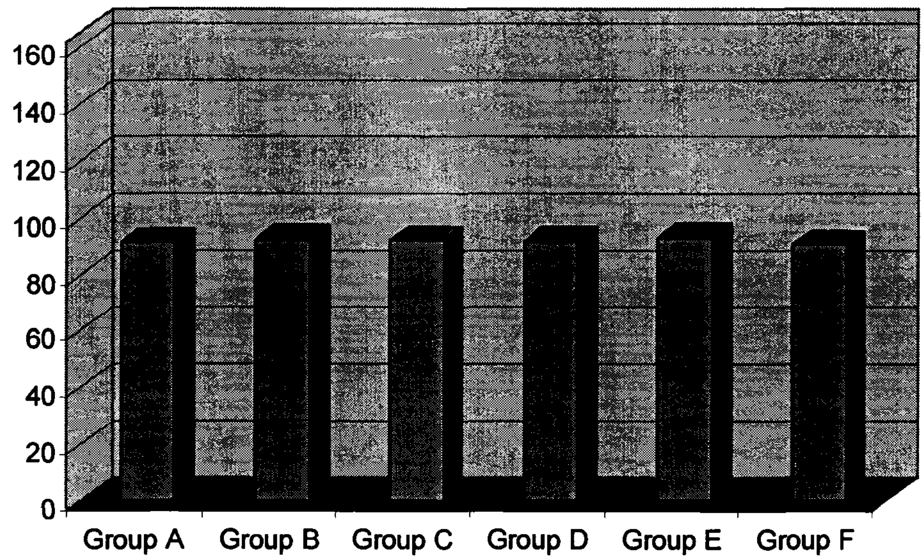


Figure 5.5. Group's means for student's attitude inventory scores: Group A (visual text), Group B (visual text and adding spoken text), Group C(visual text, and adding graphics), Group D (visual text, adding graphics, and adding spoken text), Group E (reducing visual text and adding spoken text), and Group F (reducing visual text, adding graphics, and adding spoken text).

Discussion

No significant differences were found among treatment groups on data of the student attitude inventory. Thus, these results lead to conclusion that there were no significant differences among the treatment groups with respect to student attitude.

Summary

The mixed factorial design (the split-plot analysis of variance) on data obtained from the scores of students who were taught under the six methods of multimedia instruction conditions as measured by student's raw scores and Shuford Admissible Probability Scores on the pretest, posttest and retention test showed differences between six methods of multimedia instruction at the .05 level of significance.

The results indicate that students, in general, earned a higher score when they received "visual text and adding graphics" or "visual text, adding spoken text, and adding graphics" in their multimedia instruction than did students who received other types of instructions ("visual text", "visual text and adding spoken text", "reduced text and adding spoken text", or "reduced text, adding spoken text, and adding graphics"). In other words, when visual text was presented with graphics, students may be motivated to success and achievement in L2 vocabulary learning on the current vocabulary test.

In addition, the data from student's degree of certainty estimates shows that students, in general, earned a higher score indicating that their degrees of belief probabilities increased when they received multimedia instruction.

Results of analyses of variance (ANOVA) on data obtained from the students who were taught under the six methods of multimedia instruction conditions as measured by time required to complete instruction and the student's attitude inventory showed that there were no differences between six methods of multimedia instruction at the .05 level of significance. Thus, this result demonstrates that there were no significant differences among the six methods of multimedia instruction with respect to time to complete instruction and student attitude to multimedia instruction.

Recommendation

Future research could focus on measuring students' knowledge of a word's pronunciation as well as measuring students' understanding of the word's meaning. The test in this study was designed to measure only students' understanding of a word's meaning. In a test that measures students' knowledge of the word's pronunciation, the spoken text may not be a distraction to student's English vocabulary learning.

In the current study, each student was required to complete the pretest, posttest, and retention test within a one-week period. More delayed retention tests may be needed for measuring students' learning in English vocabulary.

All multimedia instruction is not equally effective for all students. For example, Schnotz et al. (2002) reported situations in which some learners reduced the amount of attention they paid to text when pictures were added. Thus, further study should consider different factors such as learning styles, age, and gender in students' English vocabulary learning.

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APPENDIXES

APPENDIX A

Vocabulary Test Form (Translation in English)

APPENDIX A

Vocabulary Test Form (Translation in English)

VOCABULARY TEST

Date Month - Day

Class

Remain Time min sec

Directions: The questions below are designed to measure what you learned during the multimedia instruction. With each multiple-choice question below, there are two forms. The first form is for your response to each question (a, b, c, or d). Please read each question carefully and select the correct answer. In the second form, write a number from 0 to 100 which indicate how sure you are that your response is correct. If you are 100% sure that your response is correct, the second space should contain 100. If you are not completely sure, the second space should contain a smaller number. If you state your degree of certainly accurately, you will be able to maximize your score.

1. What does 'tether' mean?

- to tie or restrain
- to fade or make them fade, dry up and die
- to take, force or keep apart from others
- to fall or collapse suddenly

1. Percent

%

2. What does 'waylay' mean?

- to fall or collapse suddenly
- to travel
- to lie in wait for and ambush someone
- to tie or restrain

2. Percent

%

3. What does 'wither' mean?

- to take, force or keep apart from others
- to fade or make them fade, dry up and die
- a chain or shackle fastened to a prisoner's ankle
- a narrow channel dug in the ground

3. Percent

%

4. What does 'wizen' mean?

- to tie or restrain
- a lighthouse
- a chain or shackle fastened to a prisoner's ankle
- to make or become old and shriveled

4. Percent

%

5. What does 'tumble' mean?

- to extinguish (a fire or light, etc)
- a pointed tool used for boring small holes
- to fall or collapse suddenly
- to eat or swallow greedily

5. Percent

%

6. What does 'quench' mean?

- pulled or stretched tight
- to extinguish (a fire or light, etc)
- to lie in wait for and ambush someone
- a narrow channel dug in the ground

6. Percent

%

7. What does 'separate' mean?

- to take, force or keep apart from others
- a lighthouse
- said of plants: to fade or make them fade, dry up and die
- to tempt or persuade

7. Percent

%

8. What does ‘taut’ mean?

- to tie or restrain
- to make or become old and shriveled
- the topmost ridge of a mountain
- pulled or stretched tight

8. Percent

%

9. What does ‘gorge’ mean?

- to fall or collapse suddenly
- to travel
- a chain or shackle fastened to a prisoner's ankle
- to eat or swallow greedily

9. Percent

%

10. What does ‘entice’ mean?

- to travel
- to tempt or persuade
- to take, force or keep apart from others
- a lighthouse

10.Percent

%

11. What does ‘fetter’ mean?

- a chain or shackle fastened to a prisoner's ankle
- pulled or stretched tight
- to tempt or persuade
- to lie in wait for and ambush someone

11.Percent

%

12. What does ‘ditch’ mean?

- a lighthouse
- a narrow channel dug in the ground
- to take, force or keep apart from others
- to fall or collapse suddenly

12.Percent

%

13. What does 'beacon' mean?

13.Percent

- said of plants: to fade or make them fade, dry up and die
- to make or become old and shriveled
- a lighthouse
- a chain or shackle fastened to a prisoner's ankle

%

14. What does 'awl' mean?

14.Percent

- to tie or restrain
- to eat or swallow greedily
- a pointed tool used for boring small holes
- pulled or stretched tight

%

15. What does 'crest' mean?

15.Percent

- the topmost ridge of a mountain
- to travel
- a lighthouse
- a chain or shackle fastened to a prisoner's ankle

%

16. The boy is (   )ed to the tree.

소년이 나무에 (   ) 있다.

16.Percent

- tumble
- taunt
- waylay
- tether

%

17. The tiger (   )s lambs behind the rock.

호랑이는 바위 뒤에서 양을 (   ).

17.Percent

- gorge
- fetter
- waylay

%

- beacon

18. The flowers (   )ed and died.

꽃이 (   ).

18.Percent

- tether
- wither
- gorge
- waylay

%

19. He has finally (   )ed.

그는 마침내 (   ).

19.Percent

- wizen
- fetter
- taut
- latten

%

20. The cans have begun to (   ).

캔들이 (   ) 시작했다.

20.Percent

- crest
- waylay
- tumble
- wizen

%

21. He (   )ed a fire with the bucket of water.

그는 물통을 가져와서 불을 (   ).

21.Percent

- quench
- ditch
- awl
- crest

%

22. She (　　　　)d the apples from the apples and pears in the basket.

그녀는 과일 바구니에서 사과를 (　　　　).

22.Percent

- quench
- beacon
- taunt
- separate

%

23. The rope is stretched (　　　　) by the two men.

두 남자가 밧줄을 (　　　　) 당기고 있다.

23.Percent

- wither
- taut
- entice
- waylay

%

24. Michael (　　　　)d himself on dinner.

마이클은 저녁을 (　　　　).

24.Percent

- gorge
- tumble
- tether
- crest

%

25. Eve (　　　　)d Adam to eat the fruit.

이브는 아담을 (　　　　) 선악과를 먹게 했다.

25.Percent

- wizen
- entice
- separate
- awl

%

26. One leg was tied to a (   ).

그는 (   ) 가 채워져 있었다.

26.Percent

- tether
- ditch
- beacon
- fetter

%

27. The wild flowers are in bloom along the (   ).

야생화들이 (   ) 에 피어있다.

27.Percent

- awl
- taut
- ditch
- entice

%

28. The light is radiated from the (   ).

(   ) 에서 빛이 비춘다.

28.Percent

- beacon
- wither
- waylay
- gorge

%

29. She pierced her leather belt with an (   ).

그녀는 (   ) 으로 허리띠를 뚫었다.

29.Percent

- crest
- awl
- tether
- beacon

%

30. He climbed to the ( ) of the mountain.

그는 산 ( )에 도착했다.

- awl
- tether
- waylay
- crest

30.Percent

%

Submit

APPENDIX B

Student Attitude Inventory (Translation in English)

APPENDIX B

Student Attitude Inventory (Translation in English)

STUDENT ATTITUDE TOWARD MULTIMEDIA VOCABULARY INSTRUCTION

This is not a test of information; therefore, there is no one "right" answer to a question. We are interested in your opinion on each of the statements below. Your opinions will be strictly confidential. Do not hesitate to put down exactly how you feel about each item. We are seeking information, not compliments; please be frank.

Date ______ Month - Day

Class ______

Instruction Mode ______

1. While taking Web-based multimedia instruction I felt challenged to do my best work.

   ○ Disagree strongly ○ Disagree ○ Neutral ○ Agree ○ Agree strongly

2. The material presented to me by Web-based multimedia instruction caused me to feel that no one really cared whether I learned or not

   ○ Disagree strongly ○ Disagree ○ Neutral ○ Agree ○ Agree strongly

3. While taking Web-based multimedia instruction I felt boring.

   ○ Disagree strongly ○ Disagree ○ Neutral ○ Agree ○ Agree strongly

4. I was concerned that I might not be understanding the material.

   ○ Disagree strongly ○ Disagree ○ Neutral ○ Agree ○ Agree strongly

5. I was not concerned when I missed a question because no one was watching me anyway.

Disagree strongly   Disagree   Neutral   Agree   Agree strongly

6. While taking Web-based multimedia instruction I felt isolated and alone.

Disagree strongly   Disagree   Neutral   Agree   Agree strongly

7. While taking Web-based multimedia instruction I felt as if someone were engaged in conversation with me.

Disagree strongly   Disagree   Neutral   Agree   Agree strongly

8. The responses to my answers seemed appropriate.

Disagree strongly   Disagree   Neutral   Agree   Agree strongly

9. I felt uncertain as to my performance in the programmed course relative to the performance of others.

Disagree strongly   Disagree   Neutral   Agree   Agree strongly

10. I found myself trying to get through the material rather than trying to learn.

Disagree strongly   Disagree   Neutral   Agree   Agree strongly

11. I knew whether my answer was correct or not before I was told.

Disagree strongly   Disagree   Neutral   Agree   Agree strongly

12. I guessed at the answers to questions.

Disagree strongly   Disagree   Neutral   Agree   Agree strongly

13. In a situation where I am trying to learn something, it is important to me to know where I stand relative to others.

Disagree strongly   Disagree   Neutral   Agree   Agree strongly

14. As a result of having studied some material by Web-based multimedia instruction, I am interested in trying to find out more about the subject matter.

Disagree strongly Disagree Neutral Agree Agree strongly

15. In view of the time allowed for learning, I felt too much material was presented.

Disagree strongly Disagree Neutral Agree Agree strongly

16. I was more involved in running the machine than in understanding the material.

Disagree strongly Disagree Neutral Agree Agree strongly

17. I felt I could work at my own pace with Web-based multimedia instruction.

Disagree strongly Disagree Neutral Agree Agree strongly

18. Web-based multimedia instruction makes the learning too mechanical.

Disagree strongly Disagree Neutral Agree Agree strongly

19. I felt as if I had a private tutor while on Web-based multimedia instruction.

Disagree strongly Disagree Neutral Agree Agree strongly

20. I was aware of efforts to suit the material specifically to me.

Disagree strongly Disagree Neutral Agree Agree strongly

21. I found it difficult to concentrate on the course material because of the hardware.

Disagree strongly Disagree Neutral Agree Agree strongly

22. The Web-based multimedia instruction situation made me feel quite tense.

Disagree strongly Disagree Neutral Agree Agree strongly

23. Web-based multimedia instruction is an inefficient use of the student's time.

Disagree strongly Disagree Neutral Agree Agree strongly

24. While on Web-based multimedia instruction I encountered mechanical malfunctions.

Disagree strongly Disagree Neutral Agree Agree strongly

25. Web-based multimedia instruction made it possible for me to learn quickly.

Disagree strongly Disagree Neutral Agree Agree strongly

26. I feel frustrated by the Web-based multimedia instruction situation.

Disagree strongly Disagree Neutral Agree Agree strongly

27. The Web-based multimedia instruction approach is inflexible.

Disagree strongly Disagree Neutral Agree Agree strongly

28. In view of the effort I put into it, I was satisfied with what I learned while taking Web-based multimedia instruction.

Disagree strongly Disagree Neutral Agree Agree strongly

29. In view of the amount I learned, I was say Web-based multimedia instruction is superior to traditional instruction.

Disagree strongly Disagree Neutral Agree Agree strongly

30. With a course such as I took by Web-based multimedia instruction, I would prefer Web-based multimedia instruction to traditional instruction.

Disagree strongly Disagree Neutral Agree Agree strongly

Submit Form | Reset Form

APPENDIX C

Web-based Multimedia Self-Instruction Program (Translation in English)

APPENDIX C

Web-based Multimedia Self-Instruction Program (Translation in English)

Method 1: Visual text (Group A)

min sec

Word:
Tether
Definition:
to tie or restrain

Example sentence:
The boy is (tether)ed to the tree.

Frame #1

min sec

Word:
Wither
Definition:
to fade or make them fade, dry up and die.

Example sentence:
The flowers (wither)ed and died.

Frame #2

min sec

Word:
Tumble
Definition:
to fall or collapse suddenly

Example sentence:
The cans have begun to (tumble).

Frame #3

min sec

Word:
Separate
Definition:
to take, force or keep apart from others

Example sentence:
She (separate)d apples from the fruit basket.

Frame #4

min sec

Word:
Gorge
Definition:
to eat or swallow greedily

Example sentence:
Michael (gorge)d himself on dinner.

Frame #5

min sec

Word:
Fetter
Definition:
a chain or shackle fastened to a prisoner's ankle

Example sentence:
One leg was tied to a (fetter).

Frame #6

min sec

Word:
Beacon
Definition:
a lighthouse

Example sentence:
The light is radiated from the (beacon).

Frame #7

min sec

Word:
Crest
Definition:
the topmost ridge of a mountain

Example sentence:
He climbed to the (crest) of the mountain.

Frame #8

min sec

Word:
Awl
Definition:
a pointed tool used for boring small holes

Example sentence:
She pierced her leather belt with an (awl).

Frame #9

min sec

Word:
Ditch
Definition:
a narrow channel dug in the ground

Example sentence:
The wild flowers are in bloom along the (ditch).

Frame #10

min sec

Word:
Entice
Definition:
to tempt or persuade

Example sentence:
Eve (entice)d Adam to eat the fruit.

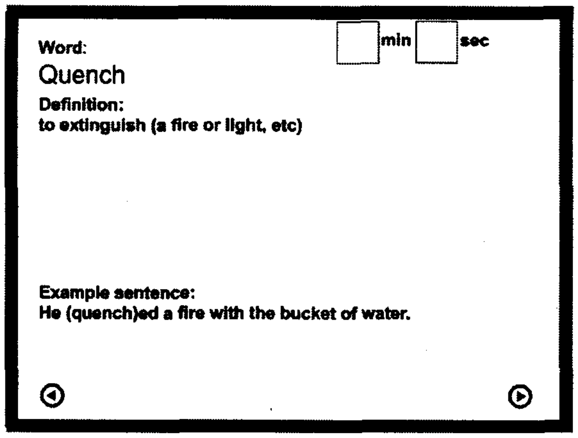
Frame #11

min sec

Word:
Taut
Definition:
pulled or stretched tight

Example sentence:
The rope is stretched (taut) by the two men.

Frame #12



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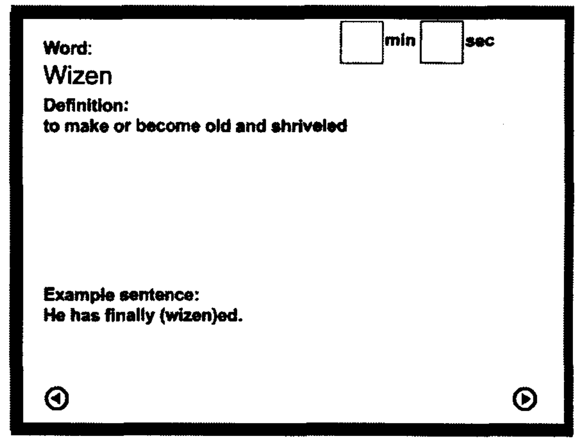

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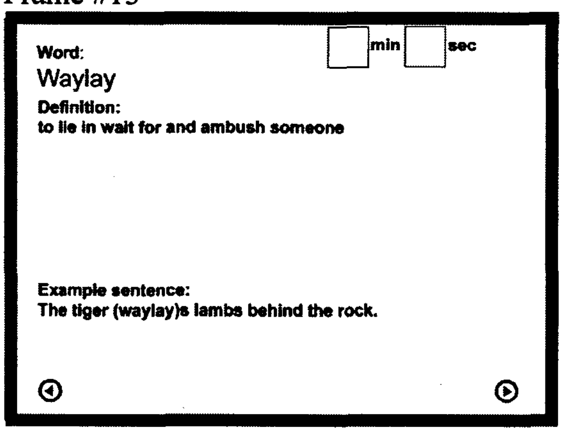


Frame #15

Method 2: Visual text + spoken text (Group B)

min sec

Word:
Tether
Definition:
to tie or restrain

Example sentence:
The boy is (tether)ed to the tree.

Audio Player

Frame #1

min sec

Word:
Wither
Definition:
to fade or make them fade, dry up and die.

Example sentence:
The flowers (wither)ed and died.

Audio Player

Frame #2

min sec

Word:
Tumble
Definition:
to fall or collapse suddenly

Example sentence:
The cans have begun to (tumble).

Audio Player

Frame #3

min sec

Word:
Separate
Definition:
to take, force or keep apart from others

Example sentence:
She (separate)d apples from the fruit basket.

Audio Player

Frame #4

min sec

Word:
Gorge
Definition:
to eat or swallow greedily

Example sentence:
Michael (gorge)d himself on dinner.

Audio Player

Frame #5

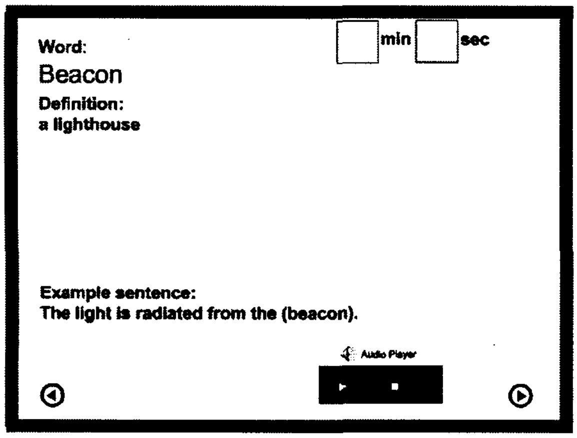
min sec

Word:
Fetter
Definition:
a chain or shackle fastened to a prisoner's ankle

Example sentence:
One leg was tied to a (fetter).

Audio Player

Frame #6



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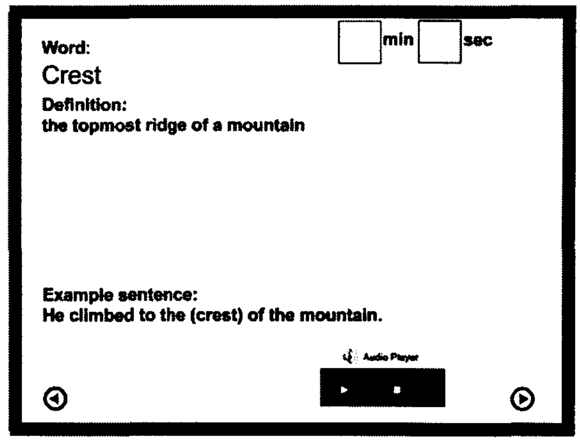

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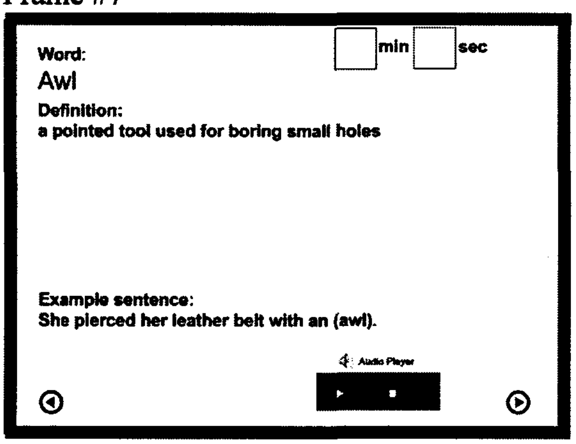

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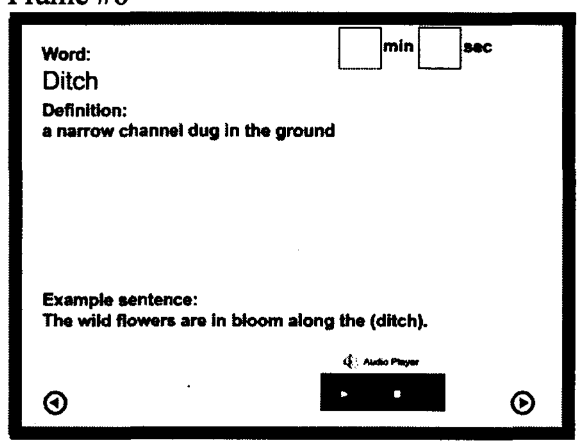

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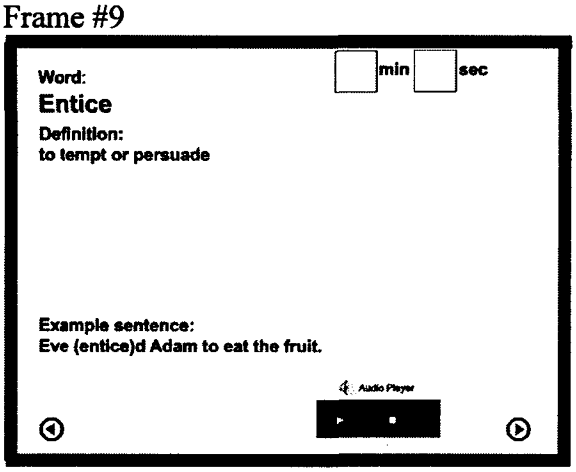

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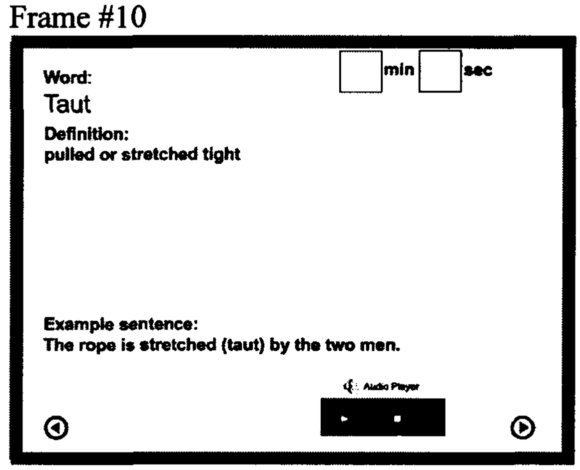

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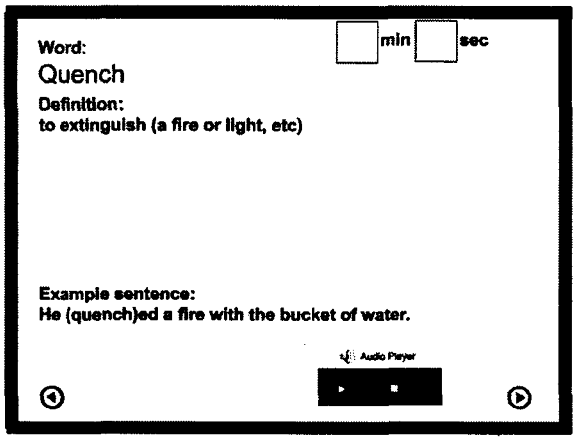

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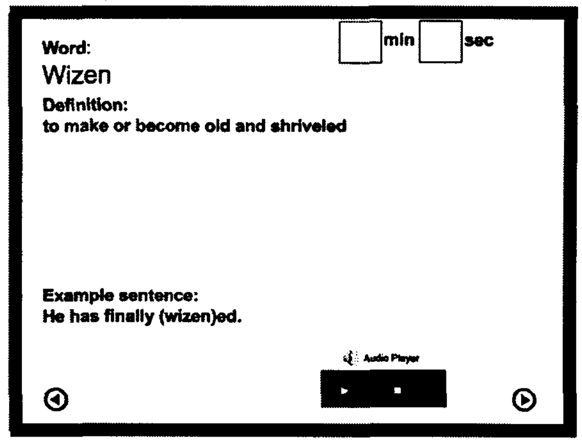

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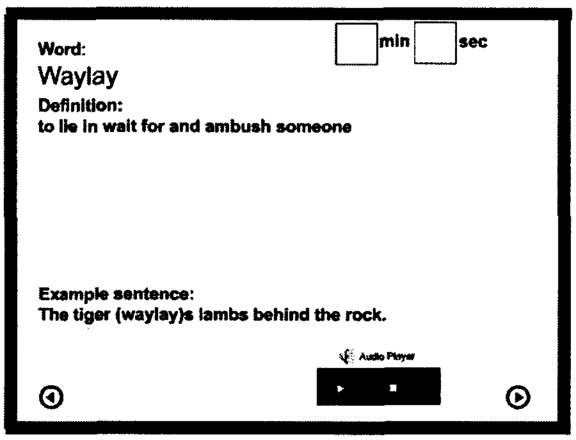


Frame #15

Method 3: Visual text + graphics (Group C)

min sec

Word:
Tether
Definition:
to tie or restrain

Example sentence:
The boy is (tether)ed to the tree.

Frame #1

min sec

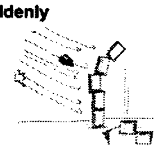
Word:
Wither
Definition:
to fade or make them fade, dry up and die.

Example sentence:
The flowers (wither)ed and died.

Frame #2

min sec

Word:
Tumble
Definition:
to fall or collapse suddenly



Example sentence:
The cans have begun to (tumble).

Frame #3

min sec

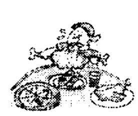
Word:
Separate
Definition:
to take, force or keep apart from others

Example sentence:
She (separate)d apples from the fruit basket.

Frame #4

min sec

Word:
Gorge
Definition:
to eat or swallow greedily



Example sentence:
Michael (gorge)d himself on dinner.

Frame #5

min sec

Word:
Fetter
Definition:
a chain or shackle fastened to a prisoner's ankle

Example sentence:
One leg was tied to a (fetter).

Frame #6

Word:
Beacon
Definition:
a lighthouse

Example sentence:
The light is radiated from the (beacon).

min sec

Frame #7

Word:
Crest
Definition:
the topmost ridge of a mountain

Example sentence:
He climbed to the (crest) of the mountain.

min sec

Frame #8

Word:
Awl
Definition:
a pointed tool used for boring small holes

Example sentence:
She pierced her leather belt with an (awl).

min sec

Frame #9

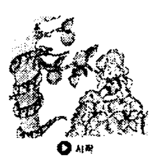
Word:
Ditch
Definition:
a narrow channel dug in the ground

Example sentence:
The wild flowers are in bloom along the (ditch).

min sec

Frame #10

Word:
Entice
Definition:
to tempt or persuade

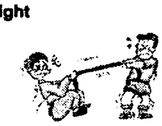


Example sentence:
Eve (entice)d Adam to eat the fruit.

min sec

Frame #11

Word:
Taut
Definition:
pulled or stretched tight



Example sentence:
The rope is stretched (taut) by the two men.

min sec

Frame #12

Word: Quench [ ] min [ ] sec

Definition:
to extinguish (a fire or light, etc)

Example sentence:
He (quench)ed a fire with the bucket of water.

Frame #13

Word: Wizen [ ] min [ ] sec

Definition:
to make or become old and shriveled

Example sentence:
He has finally (wizen)ed.

Frame #14

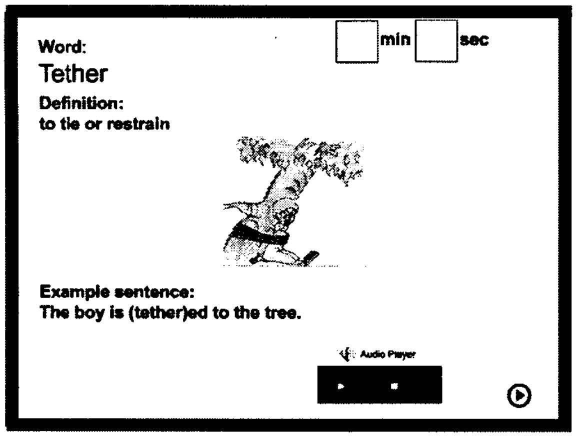
Word: Waylay [ ] min [ ] sec

Definition:
to lie in wait for and ambush someone

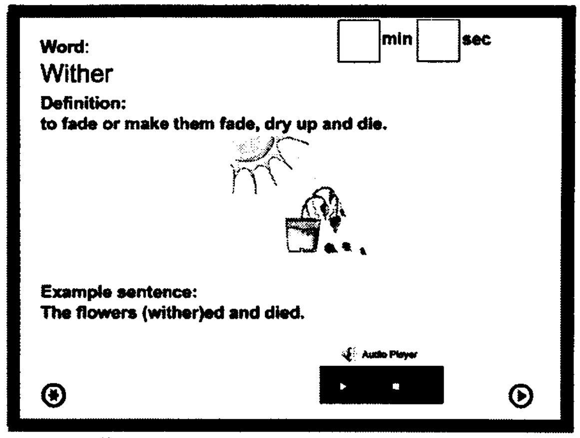
Example sentence:
The tiger (waylay)s lambs behind the rock.

Frame #15

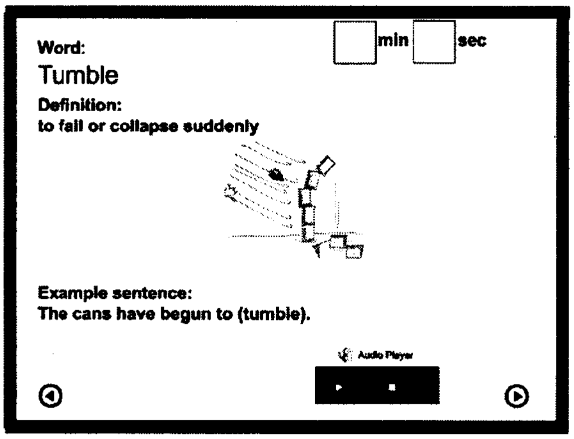
Method 4: Visual text + graphics + spoken text (Group D)



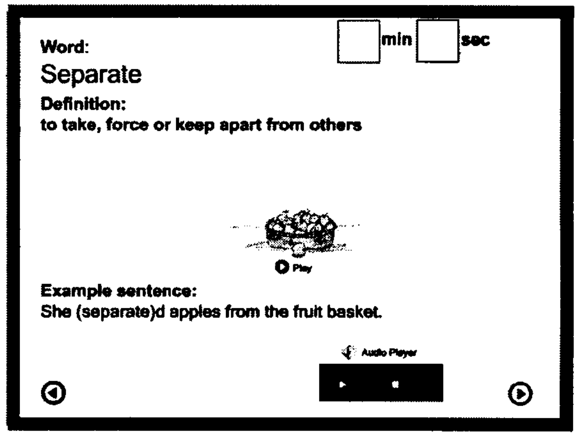
Frame #1



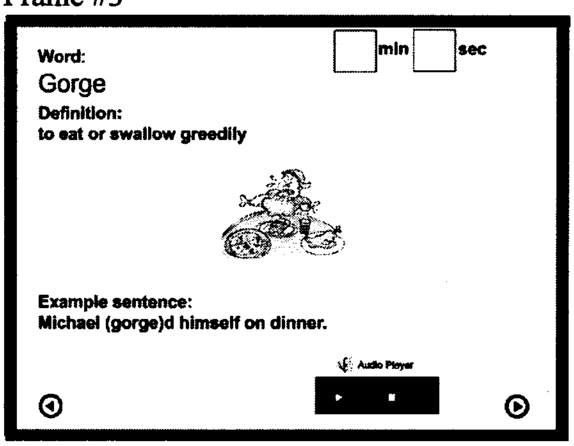
Frame #2



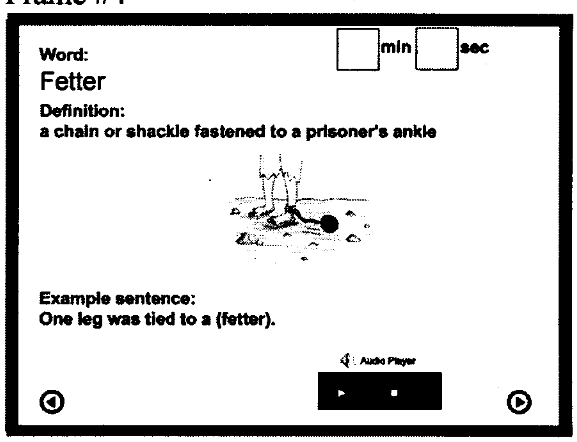
Frame #3



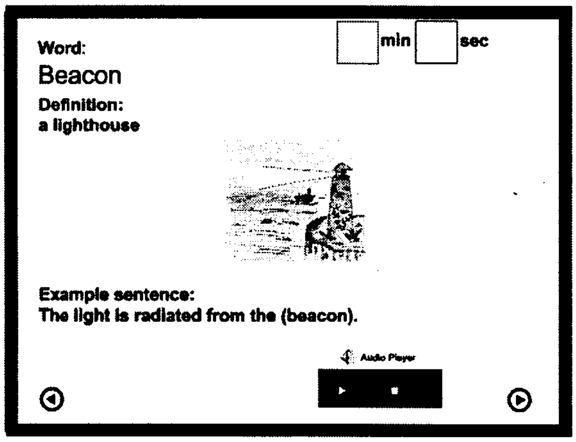
Frame #4



Frame #5



Frame #6



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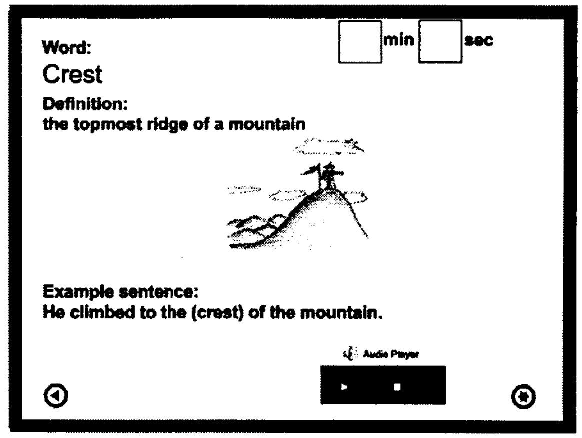

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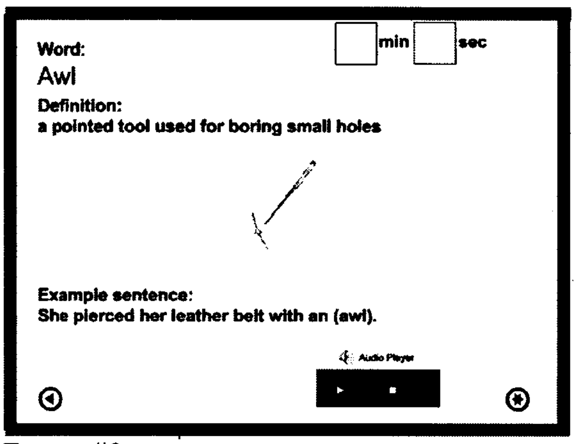

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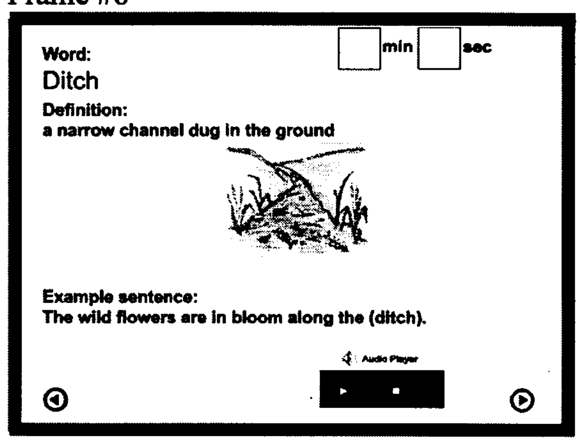

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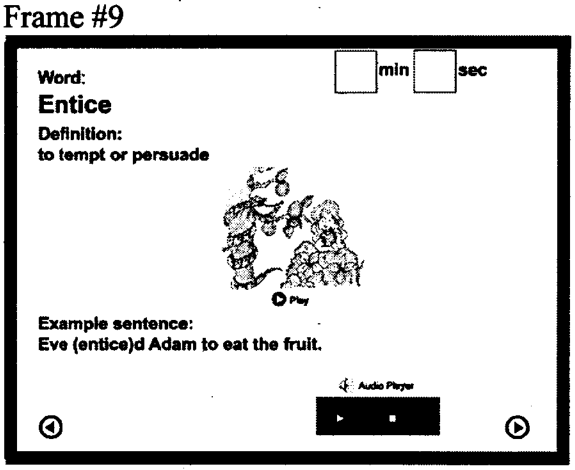

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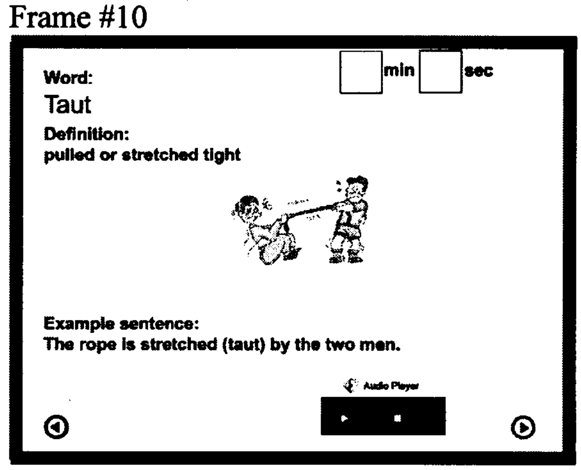

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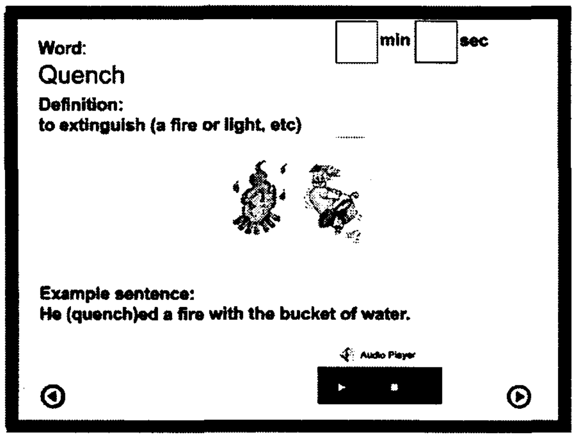

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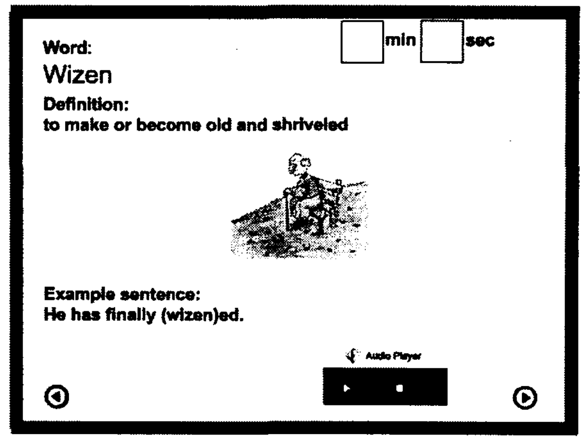

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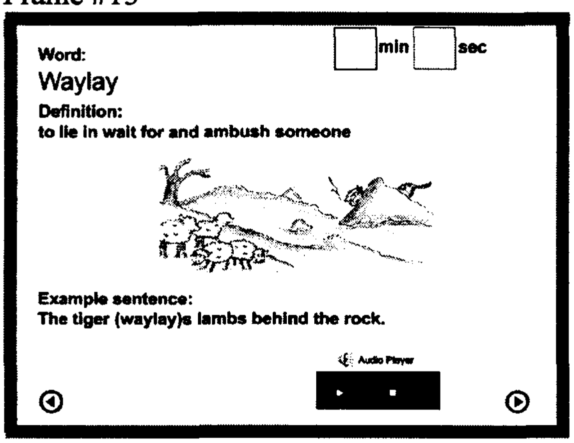
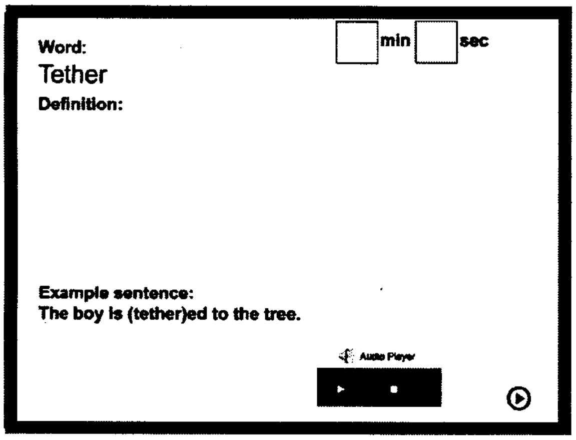
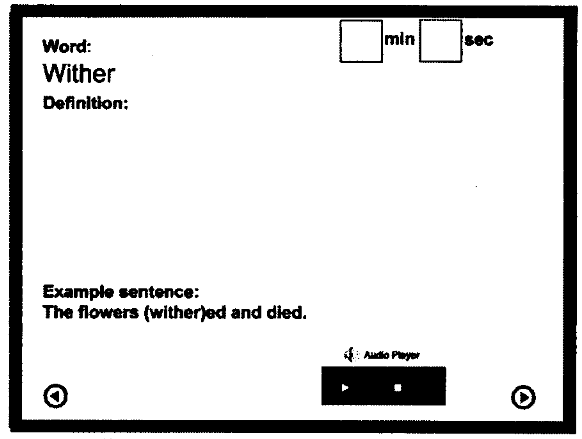


Frame #15

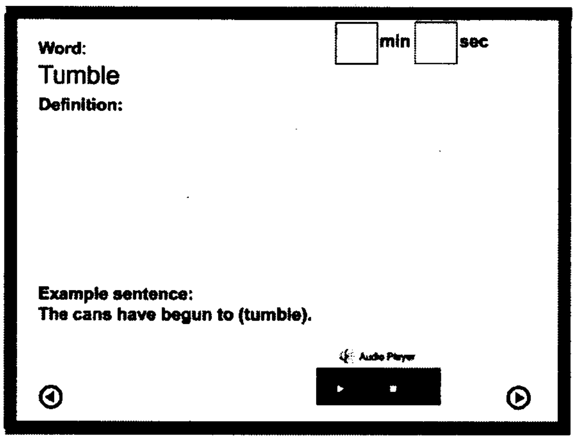
Method 5: Reduced visual text + spoken text (Group E)



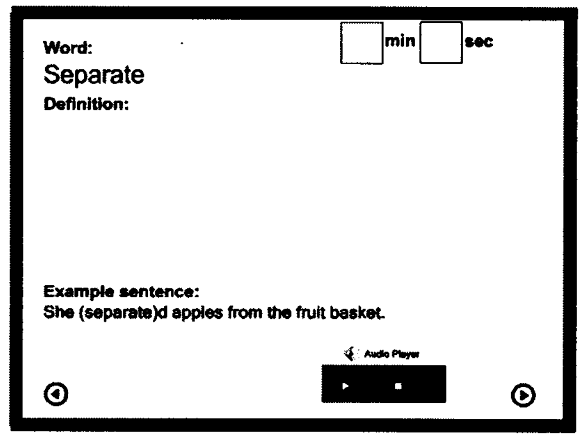
Frame #1



Frame #2



Frame #3



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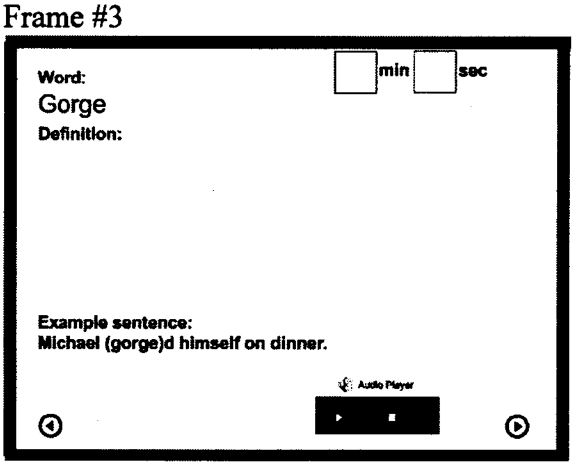

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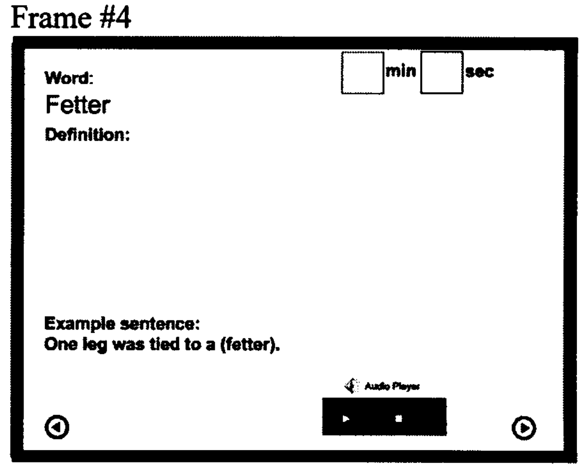

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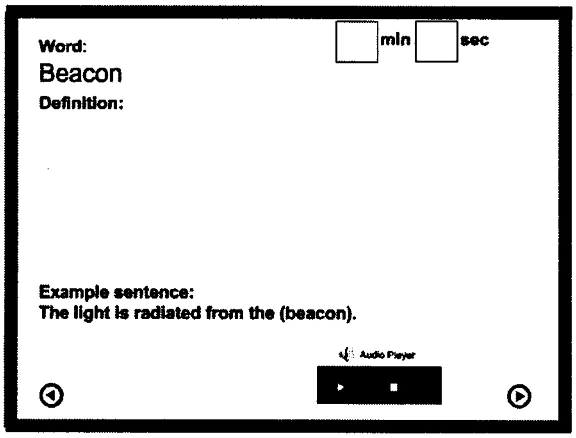

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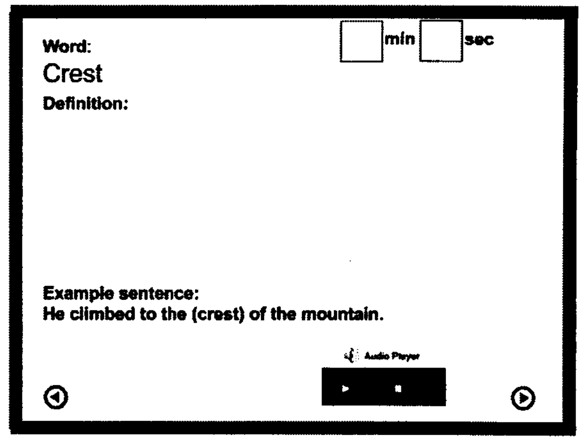

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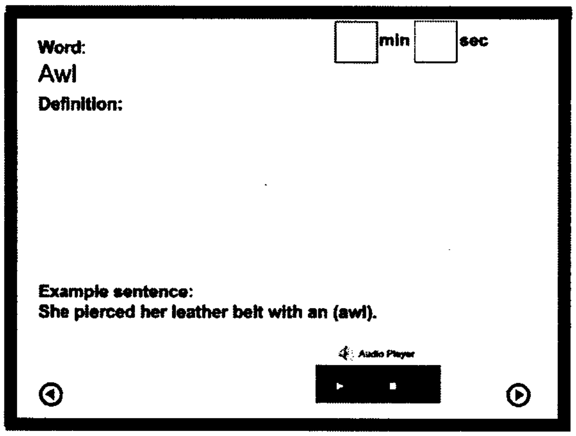
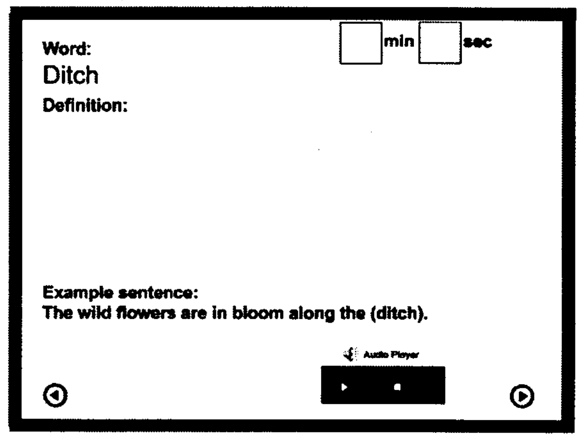


Frame #9



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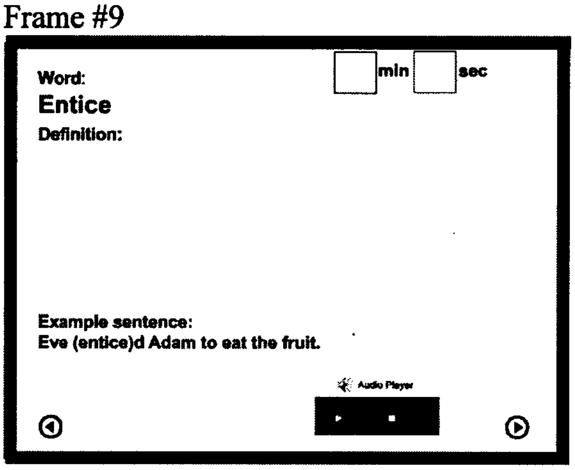

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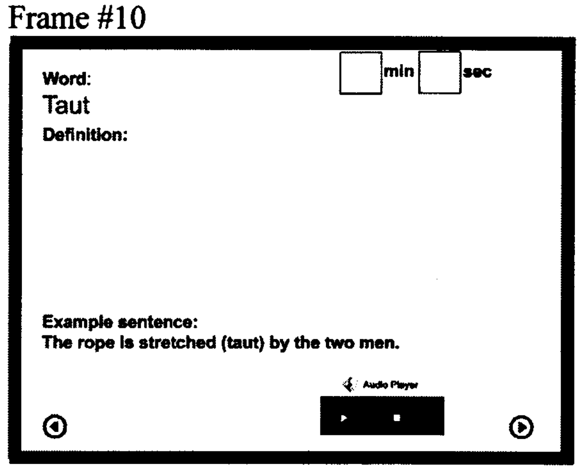

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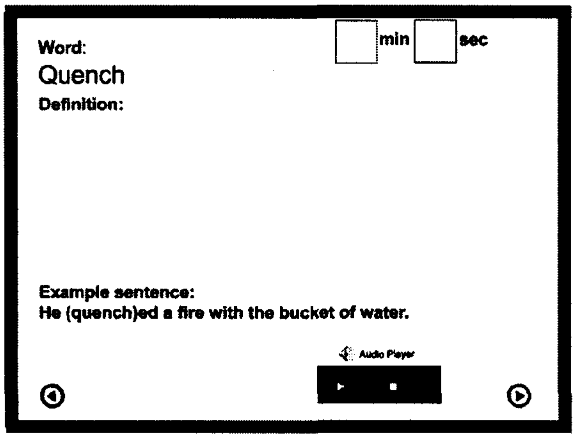

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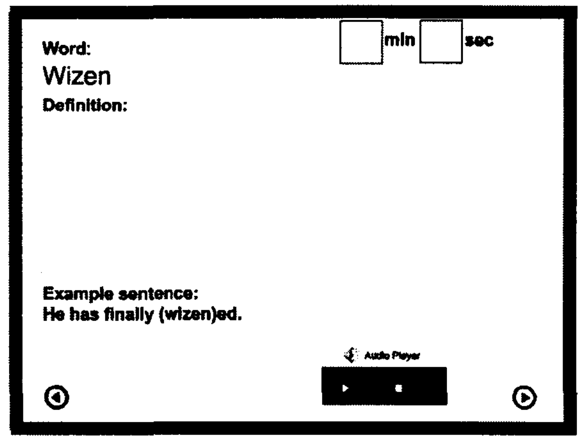

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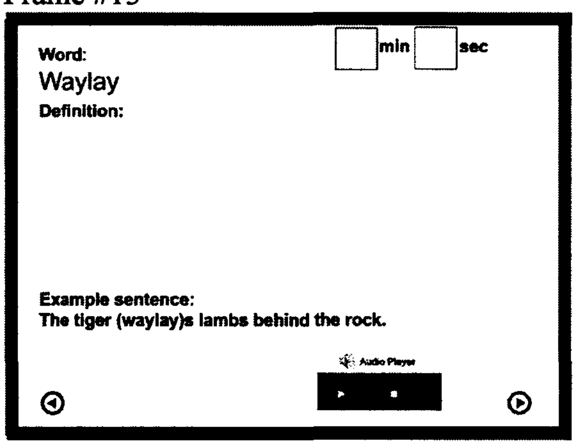
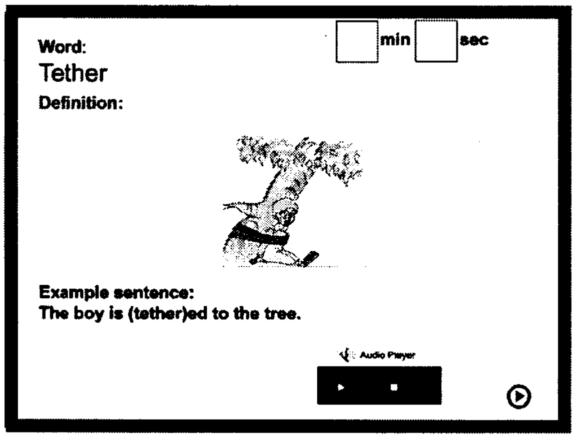
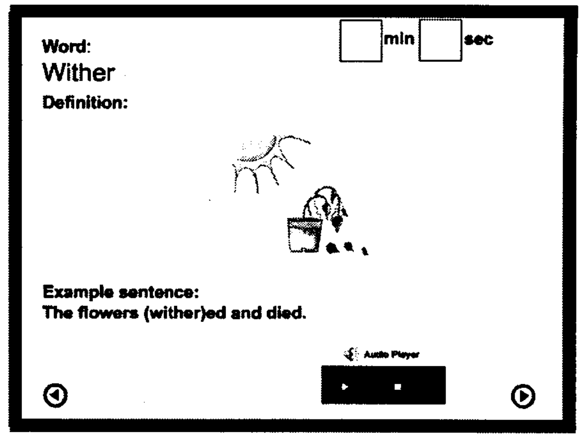


Frame #15

Method 6: Reduced visual text + graphics + spoken text (Group F)



Frame #1



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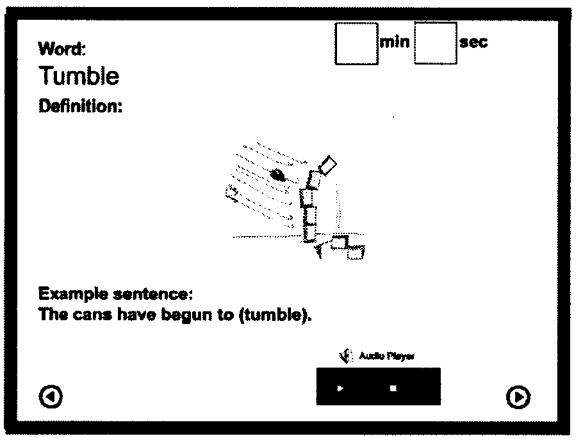

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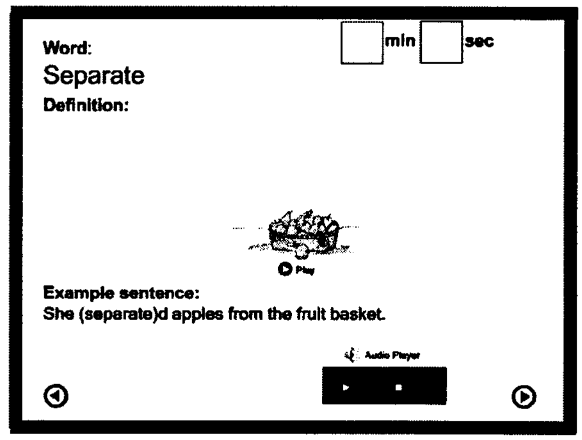

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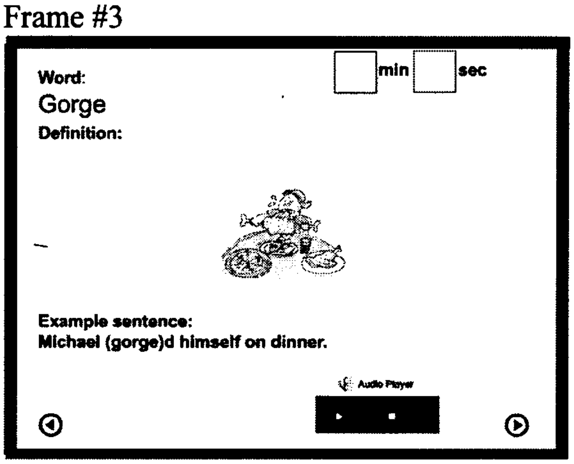

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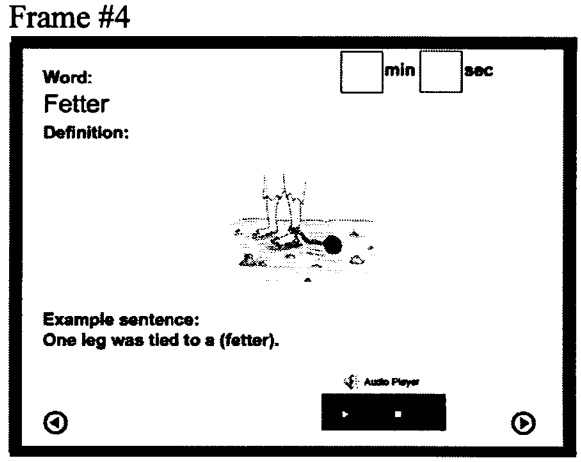

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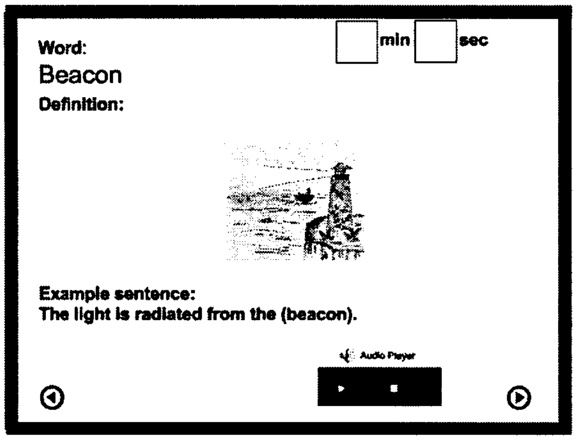

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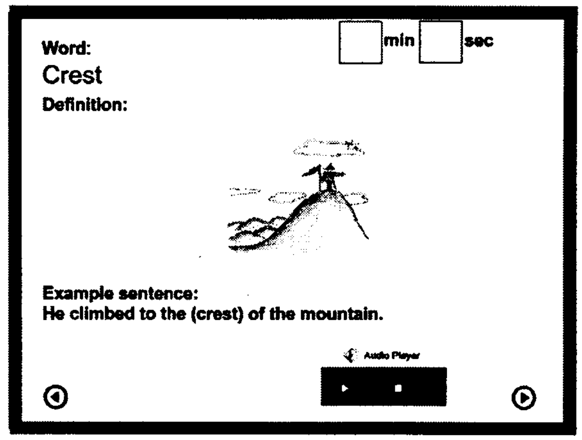

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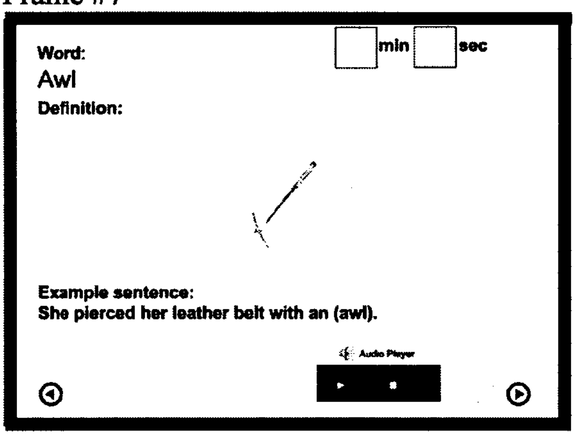

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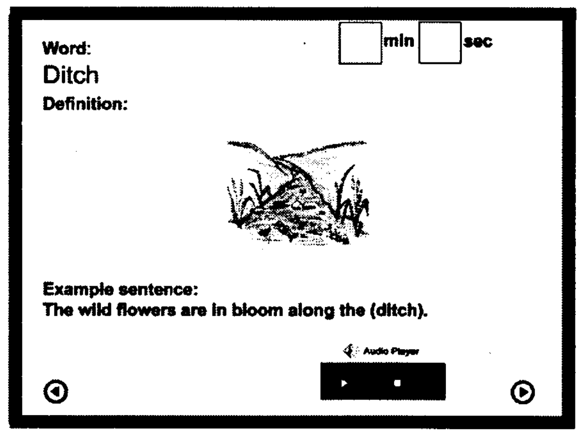

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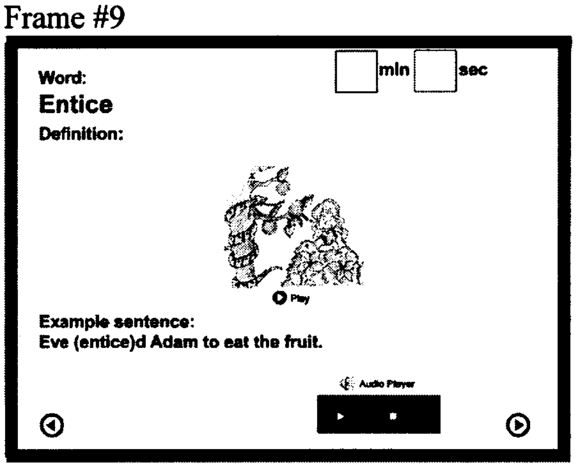

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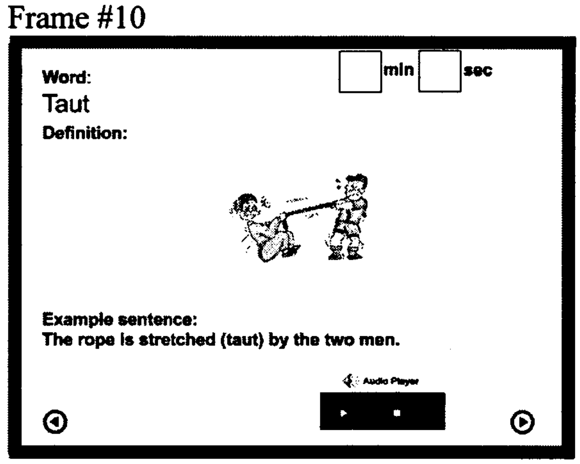

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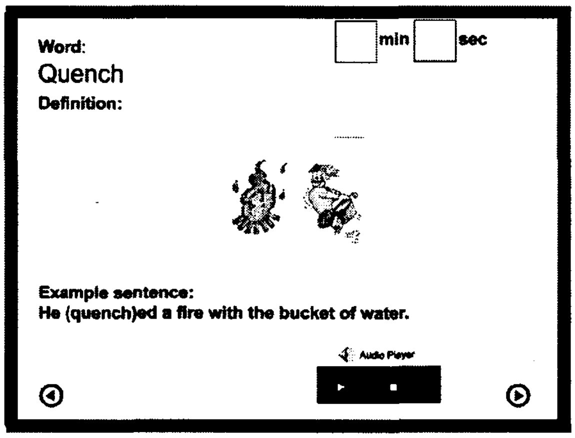

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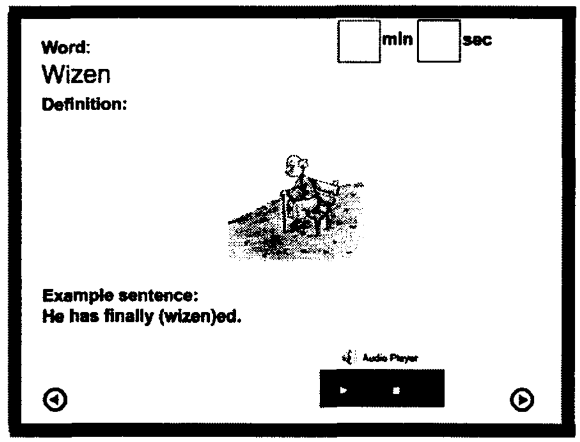

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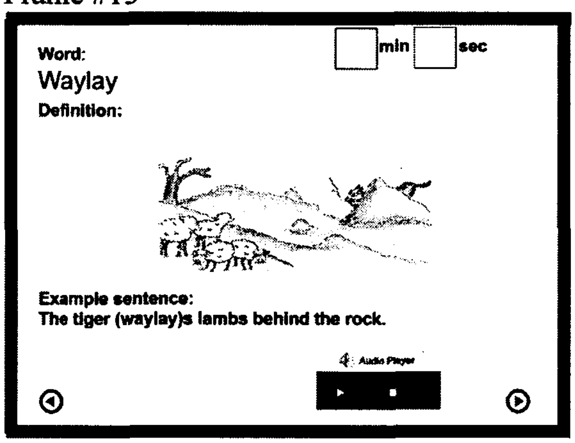

Frame #15

APPENDIX D

Institutional Review Board Materials

APPENDIX D

Indiana State University
More. From day one.

Institutional Review Board

Terre Haute, Indiana 47809
812-237-3088
Fax 812-237-3092
Federal Wide Assurance Number:
FWA00001884

4 December 2005

Daesang Kim
Dr. David A Gilman
CIMT
College of Education
Indiana State University

RE: Effects of Text, Audio, and Graphic Aids in Multimedia Instruction on the Achievement of Students in Vocabulary Learning (IRB# 6075)

Dear Daesang Kim,

I have reviewed your proposed study listed above, pursuant to Indiana State University's *Policies and Procedures for the Review of Research Involving Human Subjects* and 45 CFR 46. This proposed study falls within an exempt category and is therefore considered exempt from Institutional Review Board Review. You do not need to submit continuation requests or a completion report. Should you need to make modifications to your protocol or informed consent forms that do not fall within the exemption categories, the IRB must approve the modifications prior to implementation.

Informed Consent: A stamped approved copy of your informed consent document (assent document in this case) is attached. Please type the IRB number, approval date, and expiration information at the bottom of the consent document you send to subjects or post on the web. The IRB has granted a waiver of the requirement to obtain signed informed consent because "the research presents no more than minimal risk of harm to subjects and involves no procedures for which written consent is normally required outside of the research context" (45 CFR 46.117c). And because of the specific legal conditions in South Korea related to obtaining parental permission.

Reporting of Problems: Any problems involving risk to subjects or others, injury or other adverse effects experienced by subjects, and incidents of noncompliance must be reported to the IRB Chairperson or Vice Chairperson via phone or e-mail immediately. Additionally, you must submit Form F to the Office of Sponsored Programs within five working days after the first awareness of the problem.

If you have any questions, please contact the Office of Sponsored Programs at 812-237-3088 or irb@indstate.edu, and your question will be directed to the appropriate person. I wish you well in completing your study.

Sincerely,

Thomas L. Steiger

(Chair or Vice-Chair), Institutional Review Board

cc: Dawn Underwood, IRB Administrator

ASSENT TO PARTICIPATE IN RESEARCH

Study of the English vocabulary learning using multimedia instruction

1. My name is Daesang Kim. I am a Ph. D student at Indiana State University.

2. My professor, Dr. David Gilman, and I are asking you to take part in a research study because we are trying to learn more about how multimedia instruction helps you learn English vocabulary learning.

3. If you agree to be in this study, I will ask you to do three things below for about two hours.

   1) I will ask you to participate in a multimedia instruction,

   2) I will ask you to take a vocabulary test,

   3) I will ask you to answer a student attitude inventory.

4. You will not be hurt or upset by being in this study. If you take part in the study and believe that you have been hurt or upset in any way, you may stop being in the study. This study is anonymous. No one will be able to identify you or your answers, and no one will know whether or not you participated in the study.

5. This study will probably help you learn some English vocabulary with multimedia instruction. This study will teach me important ways to help other students like you in the future.

6. Your teachers have given their permission for you to take part in this study. Even though your teachers said "yes," you can still decide not to do this.

7. If you don't want to be in this study, you don't have to participate. Remember, being in this study is up to you, and no one will be upset if you don't want to participate or even if you change your mind later and want to stop.

8. You can ask any questions that you have about the study. If you have a question later that you didn't think of now, you can call me at 1-812-237-7317 or Dr. Gilman at 1-812-237-2925. You may call me or Dr. Gilman at any time to ask questions about the study.

9. Clicking the Start button below means that you agree to be in this study.

▷ Start

Indiana State University
Institutional Review Board
APPROVED
IRB Number: 6075
Approval: 12/4/05
Expiration Date: EXEMPT