Strategies for Defining and Understanding Critical Technology Integration Terms

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ABSTRACT

Educational technology scholars believe that teachers should understand how to effectively integrate technology in their teaching. This study identified key terms related to integrating technology in education and investigated the effectiveness of three online instructional strategies (Text-only, Text plus Video, and Text plus Video plus Question) in conveying meaning to native and non-native English speakers. During the term identification phase, educational technology experts reviewed 79 terms and after a second analysis, reduced the list to 21 key technology integration terms such as collaborative eLearning, ePortfolios, WebQuests, synchronous learning, and digital storytelling.

The second phase of the study engaged 42 native and 53 non-native English speakers (95 total) in learning terms from three instructional strategies. In a within-subject repeated measures design, participants studied 21 terms (7 for each strategy), and completed a comprehension test. Results revealed that instruction using Text plus Video ($M = 4.70$, $SD = 1.55$) and Text plus Video plus Question ($M = 4.72$, $SD = 1.63$) were both significantly more effective at the $p < .01$ level than Text-only ($M = 4.04$, $SD = 1.93$) for non-native English speakers. There was a significant correlation ($r\ (53) = .31$, $p < 0.05$) between the Text-only comprehension scores and the self-rated level of English proficiency for non-native English speakers. Differences between the instructional strategies on comprehension scores were not significant for native English speakers.

Non-native speakers learned more when terms were presented using both tangible (images) and arbitrary (language) symbol systems. Non-native English speakers may have benefited more from images because tangible symbol systems are more universally understood than arbitrary language symbols. Thus, native speakers easily understood these terms from

written descriptions in their native language, whereas non-native speakers had more difficulty in drawing meaning solely from descriptions in their second language. Results indicate that when key concepts are presented using both tangible and arbitrary symbol systems, a wider range of learners will understand them. Learners with higher levels of English proficiency also understood terms better.

Native speakers easily understood these terms from the written descriptions. This ceiling effect may have concealed benefits of the video and question strategies. Future studies might use more difficult terms and more challenging questions. Other studies might consider relative benefits of these instructional strategies under incidental as opposed to intentional learning conditions.

DEDICATION

This work is dedicated to my father, mother and siblings. It is especially dedicated to my wife Ngood and my children Nada, Lubna, Abdullah and Randa whose sacrifice of our time together has not gone unnoticed. Without them, I could not have weathered the challenges of completing this work.

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CHAPTER ONE

Introduction

Technology has a long history of serving education, but the relationship between the two has been given additional attention in the last decades as technology has become an integral part of people's lives. The development of information and communication technology has opened the door to new ways of communication, collaboration, working, and learning. This has resulted in a significant impact on the ways in which people think, live, work, and construct knowledge (Klopfer, Osterweil, Groff, & Haas, 2009).

In education, demands have increased to integrate technology into schools, and teachers are asked to use new technology in their daily instructional practices. It has been argued that integrating technology into educational practices will improve teaching and learning, increase the productivity of schools, and help students acquire the knowledge and skills required by a workforce (Vrasidas & Glass, 2005). Although effective lesson plans can be created without incorporating new technologies, research suggests that embracing and utilizing technology in educational practices will help create more engaging lessons that improve students' performance and learning and mitigate the gap between how students are taught and how they approach life outside school (Klopfer et al., 2009).

Today's students have grown up with different types of digital technologies as an important aspect of their lives. Therefore, they expect technology to be as fully integrated into their education as it is into their lives (Klopfer et al., 2009). Dewey (2001) stated that,

> From the standpoint of the child, the great waste in the school comes from his inability to utilize the experiences he gets outside the school in any complete and free way within the

school itself; while, on the other hand, he is unable to apply in daily life what he is learning at school. That is the isolation of the school -- its isolation from life (p. 46).

Teachers need to understand that teaching in the 21st century with its multiple uses of technology requires them to think about teaching with technology in a more extensive manner than just using presentation tools and electronic whiteboards. They need to expand the use of technology to include time in and out of class in order to enhance students' learning and help them prepare to compete in the job market, where technology skills and teamwork are essential. Technology in the classroom is a fact of life; it is here to stay. According to the North Central Regional Educational Laboratory (NCREL), "Whether technology should be used in schools is no longer the issue in education. Instead, the current emphasis is on ensuring that technology is used effectively to create new opportunities for learning and to promote student achievement" (Rodriguez & Knuth, 2000, para. 1).

Many schools are now equipped with new technology and offer access to the Internet, and teachers are expected to take advantage of what technology and the Internet afford (Vrasidas & Glass, 2005). Although the access to powerful technologies in school has recently improved, they are not integrated effectively, and their use has been reduced to simple applications, such as word processing, drill and practice, educational games, and tutorials (Barton, 2001; Maddux & Johnson, 2006). Research suggests that for effective technology integration, technology should not be used in isolation, but instead it should be used to solve real-life problems and complete meaningful projects (Frei, Gammill, & Irons, 2007). Harris (1998) pointed out that taking advantage of the educational potential of emerging technologies requires teachers to learn how to apply them to facilitate teaching and learning instead of focusing on how to operate them. She believes that technologies are important, but using them without clear purposes would not be

beneficial. According to Dias (1999), “Technology is integrated when it is used in a seamless manner to support and extend curriculum objectives and to engage students in a meaningful learning” (p. 2). There are many creative instructional uses of new technologies in the classroom, but they require that teachers understand how to utilize them in appropriate ways (Morrell, 2002). Morrell (2002) also points out that "the key in using educational technology is to utilize meaningful activities that may promote students’ thinking in new and different ways, not available before educational technology was in place" (p. 5).

However, the challenge that teachers encounter with integrating new technologies is finding meaningful ways to seamlessly incorporate these technologies to promote students’ learning (Harris, 1998; Klopfer et al., 2009). Klopfer et al. (2009) stated that, “While many new technologies have emerged throughout history, so has the cry for educators to find meaningful ways to incorporate these technologies in the classroom” (p. 3). Typically, the responsibility lies with the schools of education to provide future teachers with the knowledge and skills that allow them to integrate technology effectively into teaching and learning (Vrasidas & Glass, 2005). Thus, technology integration courses have become an integral part of teachers’ preparation programs. Most teacher education programs currently offer only one course that focuses on preparing future teachers to teach with technology. However, professionals in the field of educational technology have different perceptions regarding what future teachers need to know in order to integrate technology into their daily teaching (Simsek, 2005). Therefore, the content of technology integration classes might vary between programs.

Parker (1996) stated that in teacher preparation programs, the technology course taken by future teachers is reduced to learning about technology, including operation, names, and technological terms, but the practical application of technology in education is missing in many

programs. It is important that teachers gain basic knowledge about technology, but one of the difficulties that teachers encounter is utilizing technology meaningfully in the learning activities (Klopfer et al., 2009). Some teachers may have the technological skills that enable them to operate many different technologies, but they do not know how these technologies can be used effectively with the content that they are teaching. They need to find ways that can utilize the technology so that they can incorporate technology resources into their knowledge of content area in ways that enhance students' learning (Dexter, Doering, & Riedel, 2006). Harris (1998) claimed there is a misconception that knowing how to operate hardware and software can result in successful integration of technology in the classroom. In fact, this knowledge is just a pre-requisite for creating innovative lessons that integrate technology (Harris, 1998).

With the advent of information and communication technology and its increasing affordability, many terms have emerged that reflect possible ways of integrating technology in educational practices. Terms such as "digital storytelling," "WebQuests," "ePortfolio," and "global classroom" emphasize the presence of technology in educational practices. These terms imply new ways of teaching and learning and describe relatively complex concepts that require educators to understand the critical capacity of the technologies and effective ways to integrate them into teaching and learning. According to Anohina (2005), many technologies have recently been used in education to create learning materials, deliver content, manage the learning process and support it entirely or partially, and enhance collaboration; people use different terms to describe these technology-based activities. Understanding the meaning of these terms would pave the way for teachers to find meaningful ways to take advantage of what the new technologies offer and link them with the content area they are teaching. Targeting these terms

that reflect possible ways of teaching and learning with technology and clarifying their meaning is essential to all educators looking for methods to integrate technology into their daily teaching.

In any field, specialized terms are an important component that people need to understand in order to be able to comprehend that field's content. Lessard-Clouston (2005) pointed out that no matter what field students major in, each professional field has its own special language, especially in defining the major elements and processes of that field. All who work in that field must understand its specialized terminology and be able to put this knowledge into practice if they want to be productive and successful (Rusanganwa, 2013). Educational technology, as a field of specialization that focuses on preparing future teachers to use technology in their daily teaching, is not an exception. This field develops its own terms, and students need to comprehend them.

When learning the specialized language used in their chosen field, students might have trouble mastering the terminology at first. However, if the student is from a country where English is not the native language, that student will probably have more trouble acquiring the terminology than native speakers. This is because the problem lies not only with the use of a second language but also with the cultural background differences between the native speaker and the non-native speaker (Lessard-Clouston, 2005).

In order to assist all students, including those from different cultural backgrounds, researchers believe that technology, specifically multimedia technology, can facilitate learning in general and vocabulary acquisition in particular since it has the potential to combine different modes of instruction, such as text, pictures, audio, and video (Clark & Mayer, 2011). Before the advent of computer graphics and multimedia technology, spoken words and printed text were the common format of instruction. Today, however, it has become easier to access high quality

images that can be used to supplement instruction (Mayer, 2005a), and advanced multimedia software that can create and edit multimedia instruction has become readily available (Wetzel, Radtke, & Stern, 1994).

Mayer (2005a) defined a multimedia instructional message as one that presents materials in verbal forms, such as printed text or spoken words, and in pictorial forms, such as static images, illustrations, diagrams, maps, dynamic video, and animation, for the purpose of fostering learning (p. 32). Mayer claims that people learn from the combination of visuals and words better than from verbal instruction alone. He developed a theory, called the cognitive theory of multimedia learning that works as a guideline for designing effective multimedia instruction. The theory has three assumptions: (a) dual-channel assumption, (b) limited capacity, and (c) active processing (Mayer, 2005a).

In regards to the first assumption, Mayer (2005a) states that the human mind possesses two systems for processing information: one processes visual information, and the other processes verbal information. When information is presented in the form of an image, video, or illustration, it is processed in the visual channel. When information is presented in the form of audio, such as narration, it is processed in the auditory channel. The second assumption is that each of the two channels has a limited capacity so they do not copy the whole multimedia message but instead process only part of the information. The third assumption is that the learner is an active processor who engages in selecting information, organizing, and integrating it with the previous knowledge (Mayer, 2005a, p. 36). According to Mayer (2005a), designing effective multimedia instruction should take into consideration the two channels (visual/pictorial and auditory/verbal) that the human mind possesses, as well as the limited capacity of these channels. The design should also promote active engagement of learners in the learning process.

The effectiveness of multimedia instruction has been a subject of investigation for many researchers who have studied whether multimedia instruction has a greater effect on learning outcome than a text-only format, and what multimedia formats would be most effective in learning different types of content. Mayer (2001) found that using multimedia instruction resulted in better learning than using a text-only format. Al-Seghayer (2001) compared the effect of different modes of multimedia on learning unknown words. The results revealed that video clips and pictures were more effective in enhancing learning than text only, and video clips were more effective than still pictures. Chun and Plass (1996) found that the text/picture mode was a more effective mode in learning vocabulary than either text-alone mode or the text/video mode. Akbulut (2007) also found that the use of visuals in learning vocabulary is more effective than using text only, but no difference was found between static pictures and video. Yoshii and Flaitz (2002) found that using text and an image together was more effective in aiding second language learners in understanding vocabulary than using text only or picture only.

At the same time, many other studies show that adding visuals to instruction would not result in better learning. Kahn (n.d) reviewed numerous research studies that compared the text-alone format with other multimedia format, and none of these studies revealed a significant difference. Kahn concluded that, "With all of the delivery modes available, the most important component in producing an effective learning experience continues to be in the quality of the instructional design and content, not the media itself" (pp. 4-5). Other studies investigated how the previous knowledge of the learners impacts the effectiveness of multimedia instruction. Mayer and Anderson (1992) and ChanLin (2001) compared the effect of using the text-only format and the combination of text and visuals on learning outcomes. The researchers found that the combination of text and visuals worked best with novice learners. These results are consistent

with Mayer and Gallini's (1990), who conducted three experiments involving learning three science lessons using two multimedia instructional modes (text alone and text and illustration). The results also showed that adding visuals was more beneficial for learners with limited knowledge of the three lessons.

These previous studies showed inconsistent results, and thus they have left the door open for more studies to investigate the effectiveness of multiple modes of multimedia with various types of content and different groups of learners. Vocabulary acquisition using multimedia is an area that has received attention recently, but most of the studies focused on concrete words that can be depicted easily by pictures (Mohsen, 2011). Many researchers suggested that future studies should examine how abstract terms can be learned through the use of different multimedia, especially with non-textual format (Al Ghafli, 2011; Chun & Plass, 1996; Mohsen, 2011). This indicates a dearth of studies for measuring the effectiveness of learning non-concrete vocabulary with different multimedia modes.

It is argued that using visuals, such as still images or videos, for learning abstract words would not be beneficial, as it is difficult for non-textual instruction to precisely give accurate meaning. One concern that researchers have raised about using visuals with non-concrete terms is that the visuals can be subjective and might mislead learners (O'Bryan, 2005). Visuals with abstract words are a matter of interpretation, which means that learners might understand the visuals differently and therefore infer an incorrect meaning. Al-Seghayer (2001) pointed out that pictures or video segments should precisely depict the meaning of the words, and they should be simple in order to help learners understand the meaning of the words. However, Chapelle (2003) found that when defining an abstract word using a picture, even if the connection between the picture and the word is weak, the picture can still be helpful in representing the meaning. In other

words, even if an image does not represent a concept precisely, it can still give learners a clue about the concept and in turn enhance the retention and comprehension of the instructional message (Clark & Lyons, 2010).

One important component of designing multimedia instruction for learning vocabulary in a multimedia environment that has received little attention is the idea of engaging learners with the content they are learning through embedded questions. The design of multimedia instruction for vocabulary acquisition has focused on promoting the visual aspect of instruction, but learners still passively interact with the instruction. Having a prompting or practice question with instruction can be more engaging for students and help them pay attention and acquire vocabulary. Nagata (1999) conducted a study to investigate what format of translation is more effective in helping second language learners recall unknown words. Participants in this study were 26 American students taking a Japanese course. The students were split into two groups. The first group was provided with a single textual definition for each of the 20 target words, and the second group was provided with two possible definitions for each word in a multiple-choice format; participants needed to choose the correct definition. The results showed that the translation in multiple-choice format was more effective in helping participants recall words. Nagata stated that the multiple-choice format helped students better recall the words since they had to pay attention and make more effort to understand the correct meaning. However, Nagata's results were contradicted by those of Watanabe (1997), who found that learners who had access to a single textual definition outperformed those who had access to definitions in a multiple-choice format. While Nagata and Watanabe may have contradictory findings, both research projects indicate that giving learners any format of engagement can improve learning.

The idea that any form of engagement can improve learning is also emphasized by Clark and Mayer (2011), who stated that giving learners any practice format, such as embedded questions with the instructional content, would foster learners' interaction with the content and enhance learning, since practice helps the learner pay attention to the content and "fosters the selection, organization, integration, and retrieval of new knowledge" (p. 253). Additionally, receiving feedback reinforces the benefit of practice questions in multimedia instruction. According to Clark and Mayer (2011), "A missed question is a teachable moment. The learner is open to a brief instructional explanation that will help build the right mental model" (p. 263). Previous research has shown that feedback that focuses the attention of learners on the task could enhance learning (Azevedo & Bernard, 1995; Butler, Karpicke, & Roediger, 2008; Pashler, Cepeda, Wixted, & Rohrer, 2005). Therefore, having an engaging question in the multimedia instruction for vocabulary learning is an important area that needs to be investigated.

The Purpose of the Study

The main objectives of this research were to identify critical terms related to technology integration in education and to investigate and compare the effectiveness of three online instructional interventions/strategies: (a) textual definition alone (T); (b) the combination of textual definition and instructional/explanatory video (V); and (c) the combination of textual definition, instructional/explanatory video and prompting question (Q) in aiding target participants to learn critical terms of technology integration in education.

In addition, this study aimed to explore if (a) the participants' English language proficiency (b) and prior experiences of technology were correlated to their performance on the test of critical technology integration terms comprehension.

Research Questions

RQ1: What are the key technology integration terms that imply new ways of teaching and learning with technology that education students should understand?

RQ2: What instructional strategy (Text alone, Text plus Video, Text plus Video plus Question) is the most effective for learning specialized terms in education related to technology integration by native English speakers and non-native English speakers?

RQ3: Is there a relationship between participants' English language proficiency and their comprehension of technology integration terms?

RQ4: Is there a relationship between participants' technology expertise and their comprehension of technology integration terms?

Hypotheses of the Study

H1: Participants will score differently on a comprehension test of technology integration terms based on the instructional strategy they experience (Text only, Text plus Video, Text plus Video plus Question).

H2: There is a relationship between participants' English language proficiency and their performance on a comprehension test of technology integration terms.

H3: There is a relationship between participants' technology expertise and their comprehension of technology integration terms.

Significance of the Study

The findings of this study could be useful for teachers' preparation programs. These programs are concerned about what teachers need to know in order to be able to use technology effectively to enhance student learning. The study gathered key terms of technology integration that imply new ways of teaching and learning that can increase teachers' understanding of how

different technologies can be integrated in different domains. Understanding the meaning of technology integration terms in turn leads to understanding the critical capacity of different kinds of technologies and finding significant ways to incorporate these technologies into educational practices.

In addition, a need exists for more studies that look at the effectiveness of learning abstract words with non-textual instruction. According to Mohsen (2011), most of the studies that have investigated the impact of multimedia instruction on vocabulary learning focused on concrete words. This indicated the need for research that investigates the effectiveness of learning abstract words with multimedia instruction. One goal of this study was to investigate which multimedia instructional strategy is more effective in learning terms related to technology integration in education. Those terms are considered abstract since they have no physical images that represent them. Therefore, this study would be an addition to the body of knowledge in vocabulary acquisition, and especially abstract vocabulary, using multimedia instruction.

This study also investigated if having a practice question embedded with the multimedia instruction would enhance the learning outcome of the technology integration terms. Adding the component for learning specialized terms to the multimedia instruction is an area that needed to be investigated. Most of the studies related to learning words from multimedia focused on the mode and modality of multimedia, but checking learners' understanding of the words that were being studied during the learning process has received little attention.

Definition of Terms

"Terms," "words," and "vocabulary" are used interchangeably in this study to describe the same idea.

Comprehension Test: A multiple-choice test that presents a scenario for each of the terms studied and gives four options from which the participants have to choose the appropriate term for that scenario.

Explanatory Video: A series of images along with caption and narration.

Multimedia: "Presenting words (such as printed text or spoken text) and pictures (such as illustrations, photos, animation, or video" (Mayer, 2005b, p. 2).

Native English Speaker (NES): Refers to people for whom English is the first language learned in childhood (Davis, 2003),

Non-native English Speaker (NNES): Refers to those who are currently learning or have learned English as a second or foreign language (Davis, 2003).

Technology Integration: Using technology seamlessly to support and extend curriculum objectives and to increase students' engagement in the learning process (Dias, 1999).

Technology Integration Terms: Terms imply new ways of teaching and learning with technology (e.g., webquest, digital storytelling, and ePortfolio).

Visuals: A non-textual element (picture, video, illustration, and animation).

CHAPTER TWO

Literature Review

This chapter provides an extensive review of the previous literature and research related to this study. This chapter is divided into sections that include (a) the framework of this study (the cognitive theory of multimedia learning), (b) the value of using visuals as aids to learning, (c) designing effective multimedia instruction, (d) multimedia instruction and language learning, (e) instructional video versus text, and (f) benefits of practice tests on learning.

The Theoretical Framework

The theoretical framework of this study is the cognitive theory of multimedia learning. This theory is based on three assumptions: dual channels, limited capacity of those channels, and learning as an active process. It draws attention to the importance of presenting information in visual and verbal formats that can be represented and processed by the two information-processing systems that humans possess. It also addresses the limitation of the capacity of human memory, how inappropriate instructional design overloads the working memory and impedes learning, and the role that previous knowledge of the presented material plays in minimizing the cognitive load of learners. Additionally, this theory draws attention to the value of active engagement of learners in the learning process whereas they pay attention, select essential information from the presented materials, and connect that information to their previous knowledge. That active engagement can be empowered by incorporating questions in the multimedia instruction to guide learners to attend to important elements in the presented materials and to help them think about what they are learning in the light of previous knowledge. The cognitive theory of multimedia learning holds many implications for multimedia learning and for designing effective multimedia instruction capable of promoting learning.

In discussing multimedia learning, Mayer (2005a) asserted, "the design of multimedia instructional messages should be compatible with how people learn" (p. 32). Mayer postulated that there are three assumptions in the cognitive theory of multimedia learning. First, Mayer suggests that there are separate channels for processing auditory and visual information. Second, he states that each channel has a limited capacity for information that can be processed at one time. And third, he says that the learner is an active processor who engages in selecting information, organizing it, and integrating it with previous knowledge (pp. 34-37). According to Mayer (2005a), designing effective multimedia instruction should take into consideration all three assumptions listed in the cognitive theory of multimedia learning.

The first assumption of the cognitive theory of multimedia learning, dual channel assumption, is that the human mind possesses two systems, or channels, for processing information. One channel processes verbal or auditory information, such as narration. The other channel processes visual information, such as an image, video, or illustration. Mayer (2005a) stated that "there are two ways of conceptualizing the difference between the two channels – one based on presentation modes and the other based on sensory modalities" (p.34). In the presentation mode approach, the verbal channel processes materials in the form of spoken words or written text and the visual channel processes information in the form of an image, video, animation, or illustration. On the other hand, the sensory-modality approach considers whether the information is presented to the eye or to the ear. If the information is presented visually, whether in the form of on-screen text, image, video or animation, then the channel that is responsible for processing that information is the visual channel. In contrast, if information is presented aurally, such as narration, then the channel responsible for processing that information is the verbal channel (Mayer, 2005a).

The dual channel assumption of cognitive theory of multimedia learning is grounded in the dual coding theory (Paivio, 1990). Paivio pointed out that there are two systems for representing and processing information. The first system focuses on representing and processing linguistic information such as text or spoken words. The second system focuses on representing and processing pictorial information such as static or dynamic images (Paivio, 1990). Paivio claims that the visual system is limited to processing concrete stimuli, while the verbal system is able to process abstract, as well as concrete, stimuli. Therefore, concrete sentences or passages are easier learned than abstract sentences or passages as they can be processed in the verbal and visual systems. The two systems can work independently; also, the two systems can both be active at the same time. In addition, the two systems can activate each other by processing information in one channel and converting it to the other. According to Mayer (2005a), these two channels are separate, but they are functionally interconnected, which means that information can be processed in one channel and then converted to the other channel in a different format. For example, a learner might process a word heard in the verbal channel and then convert it to a picture in the visual channel. It is believed that when individuals use both systems, they are able to learn the information better than when using only one system.

Paivio (1990, 1991) identified three types of information processing that happen within and between the verbal and visual systems: (a) representational, (b) referential, and (c) associative. The representational type refers to the activation process of the two systems based on the type of stimulus. If the stimulus is an image, the corresponding system that would be activated is the visual system. On the other hand, if the stimulus is a word, it activates the verbal system. Referential, the second type of information processing, refers to the process in which each system activates the other. For example, a learner might listen to a word and process it

through the verbal system and then make a pictorial representation of that word in the visual system, or the individual might see an image and process it through the visual system and find a corresponding word for that image by activating the verbal system. The third type of information processing is called associative. In this process, when a stimulus activates one of the two systems, additional information becomes activated too. For example, a stimulus such as a picture of a cat can be activated in the visual system, which could also activate a picture of a dog (Richards & Rolati, 1997).

The instructional design implication of the dual channel assumption is that designing instruction that takes into consideration the verbal and visual systems that humans possess could promote learning. Mayer (2005b) notes that people tend to learn better from a combination of words and pictures than from words alone. Mayer (2005b) believes that presenting materials verbally and visually takes advantage of the two information processors that humans possess, and thus more information can be understood through both channels. Also, Mayer (2005b) further notes that "words and pictures […] can complement one another and that human understanding is enhanced when learners are able to mentally integrate visual and verbal representations" (p. 5).

The second assumption of the cognitive theory of multimedia learning is that each of the two channels (visual and verbal) can only process a limited amount of information at one time (Mayer, 2005a). This limited capacity assumption is related to other cognitive theories such as the cognitive load theory (Chandler & Sweller, 1991) and the working memory theory (Baddeley, 1992). These theories share the idea that humans possess a working memory that consists of two separate processors (verbal and visual) that are limited in the information they hold and process at one time (Mayer & Moreno, 2003; Sweller, Van Merrienboer, & Paas, 1998),

and this limitation increases when dealing with new information or making cognitive processes with that information (Artino, 2008). According to Mayer (2005a), "When an illustration or animation is presented, the learner is able to hold only a few images in working memory at any one time, reflecting portions of the presented material rather than an exact copy of the presented material" (p. 35).

Miller (1956) points out that working memory has a limited capacity of seven items or elements of information, and the capacity of working memory is reduced when people need to make cognitive processes such as comparing or contrasting the information held in the working memory. The capacity of working memory can be expanded by having multiple modes of information that can be processed by the visual and verbal processing systems which humans possess (Sweller et al., 1998). Another means of increasing the capacity of working memory is related to the strategy that designers or learners use to present or process the information. According to Schunk (2004), "One can increase the amount of information by chunking, or combining items in a meaningful fashion" (p.157). For example, when trying to memorize ten digits, a person can divide the digits into three chunks and relate parts of it to something familiar such as a birthdate number stored in long-term memory.

In addition to its capacity, working memory is also limited regarding the amount of time that the information is held (Sweller, 2005). For example, when a learner reads a text, he or she is able to hold information from that text in his or her working memory for only a few seconds. To keep the information in the working memory for a longer time or to store it in the long-term memory, the learner needs to engage cognitive processes with that information, such as repeating the information or elaborating it (Lohr, 2003). These processes occupy part of the capacity of the working memory, but at the same time, they can keep the information in the working memory for

an extended time before transferring it to the long-term memory; that is critical in order for learning to occur.

Being aware of the limitation of working memory also requires understanding the factors that contribute to its overload. The cognitive load theory identified three sources of cognitive loads that can overburden humans' working memory and consequently affect learning: intrinsic, extraneous, and germane (Sweller et al., 1998). The first source is called the intrinsic cognitive load, which results from the degree of complexity of the materials to be learned. Sweller et al. (1998) state that there is an interaction between the level of difficulty of the material and the learners' prior knowledge of the material. If the content to be learned is difficult and requires learners to deal and interact with many new facts in the working memory, then the cognitive load is high. In other words, the more elements that learners need to process, the higher the cognitive load would be (Artino, 2008). As a result, prior experience with the material or parts of it can reduce the cognitive load because learners would need to process fewer elements.

Another source of cognitive load that can affect working memory is called extraneous cognitive load, which is related to the cognitive load that results from inappropriate design of the learning material and the way it is presented to the learners. As opposed to the intrinsic cognitive load, this type of cognitive load can be controlled by the instructional designers (Sweller et al., 1998). Chandler and Sweller (1991) stated that poor instructional design requires learners to invest an amount of cognitive resources in activities unrelated to learning. Instruction that requires learners to split their attention between two sources of information or to look for information not displayed in a clear manner would require learners to use more cognitive resources than what the learning material requires, and if the learning material is difficult, the cognitive loads that learners are required to deal with would exceed the working capacity and

therefore interfere with learning. This means that the instructional material should be designed to reduce the extraneous cognitive load in order for learners to have enough space for intrinsic cognitive load (Sweller et al., 1998).

The third source of cognitive load is germane, which happens when there is room for learners to make additional cognitive processes in the instruction such as elaboration, addition, subtraction, or imagination (Artino, 2008). The idea of germane cognitive load is that when the intrinsic cognitive load is low (the learning material has fewer elements to be processed so it is not considered complex) and the extraneous cognitive load is reduced (the designers follow appropriate instructional design procedures), the working memory will have enough space for additional cognitive processes. These processes can increase the cognitive load but also improve learning (Artino, 2008). According to Sweller et al. (1998), germane cognitive load allows learners to "invest extra effort in processes that are directly relevant to learning, such as schema construction. These processes also increase the cognitive load, but it is the germane cognitive load that attributes to, rather than interferes with, learning" (p. 264).

The instructional implication of the limitation of human memory is that learning can be impeded if the materials to be learned exceed the available cognitive capacity of the learners (Artino, 2008; Mayer & Moreno, 2003). Therefore, instructional designers should be aware of the limited capacity of human memory and not overload it with unnecessary extraneous elements. Mayer (2005c) identified five methods for designing multimedia instruction that can minimize the cognitive load due to instructional design: coherence, signaling, redundancy, spatial contiguity, and temporal contiguity. The coherence principle suggests that words and images that are not relevant to the objectives of the instruction should be removed. Adding decorative images, background music, interesting videos or additional text that are not relevant

to the learning materials but are employed only for excitement purposes can impose a high cognitive load on learners, which could hinder learning. The signaling principle suggests that adding cues that direct learners' attention to important information in presented materials decreases the extraneous cognitive load. Instructional designers can use cues such as underlining, highlighting, bolding, or outlining to redirect learners attention to critical information in the learning materials so that the learners can invest extra time processing this information instead of processing unrelated information (Sweller et al., 1988). The redundancy principle states that learning is better without redundant information rather than with redundancy. For example, adding redundant information such as onscreen text to narration and animation requires more space for processing than having only narration and animation. The spatial contiguity principle suggests that related words and pictures should be integrated together in the same place instead of placing them into separate places. For instance, when placing an instructional text on a page and the related image on another page, learners consume cognitive spaces as they navigate between pages. The temporal contiguity principle suggests that words and pictures should be presented simultaneously. If learners are presented with images or animation but then need to wait for the corresponding narration, holding the information in working memory results in an increase in the cognitive load and a loss of important information (Mayer, 2005c).

The third assumption of the cognitive theory of multimedia learning is that "humans actively engage in cognitive processing in order to construct a coherent mental representation of their experience. These active cognitive processes include paying attention, organizing incoming information, and integrating incoming information with other knowledge" (Mayer, 2005a, p. 36). This assumption is contradicted by the view that learners passively code information presented to them (Mayer, 2005a). Mayer (2005a) asserts that there are three important cognitive processes

for active learning: selecting important information from the presented materials, organizing the selected materials into a coherent mental representation, and relating the newly formed knowledge to previous knowledge. Based on the active learning assumption, when a learner is in charge of learning an instructional message consisting of words and pictures, he or she first needs to pay attention to that message in order to select essential verbal and pictorial information. Next, the learner transfers the selected information to working memory and makes connections between the parts of that information (the verbal and the visuals) and builds an appropriate mental model. Finally, the learner needs to connect the information in the working memory with relevant information previously learned (Lohr, 2003).

The assumption that learning is an active process is based on the generative learning theory (Wittrock, 1989). One essential assumption of the generative learning theory is that learners are not passive receivers of information but that they actively work to process information and make meaning of it (Lee, Lim, & Grabowski, 2007). According to Bannan-Ritland, Dabbagh, and Murphy (2000), generative learning requires active involvement and interaction with the learning environment by learners who seek to connect and organize elements of that environment into a coherent structure and integrate it with previous knowledge in order to construct new knowledge.

The active learning assumption implies that in the development of multimedia instruction, the designers of multimedia messages should not only concentrate on presenting information to learners in multiple formats (verbal and visuals) where learners passively view the presented information but also that effective design encourages active interaction with the presented materials and creates an opportunity for learners to manipulate information to construct meaning (Bannan-Ritland et al., 2000; Clark & Mayer, 2011). Active engagement in

multimedia learning can take many forms, such as controlling the pace of instruction, navigating between the different parts of the instruction, and having practice questions.

Clark and Mayer (2011) state that giving learners any practice format with the learning content fosters learners' interaction with the content and consequently engages them in various cognitive processes, such as paying attention to the learning material, organizing, integrating with the previous knowledge, and retrieving it when needed. Martin and Klein (2008) point out that practice in multimedia instruction needs to be provided by the instructors after the learners have studied the new content in order to check their understanding of it and thus help them be aware of what they learned or missed. Kelly (2005) states that,

> By asking students about what they have learned in the very early stages, they have the opportunity to reflect upon their understanding of the new thing they have just learned. It's possible that misunderstandings can occur or there might be some confusion in the minds of the learners because what they have just learned does not 'fit' with their prior experience (Para, 12).

Giving learners the opportunity to test their understanding would not only help them actively interact with the presented material but also would help them construct the best mental model. As learners answer questions or perform activities with the presented materials, they will mentally connect ideas together and organize them into a mental representation that they relate to previous knowledge in order to construct meaning; that is what constructs active learning.

In summary, the cognitive theory of multimedia learning discusses many aspects for learning from instruction that includes both words and visuals. According to this theory, humans possess two information-processing systems (verbal and visual), and when presented materials in both visual and verbal formats, the learning outcome increases because of the dual processing of

the information. Also, human memory is limited in the information it can hold at one time, and learners cannot copy the entirety of the presented material and transfer it to memory. Instead, they have to select part of the presented material to process. Therefore, any poorly designed multimedia message that lacks coherence or includes irrelevant details would impose a high cognitive load and undermine optimal learning. Finally, the cognitive theory of multimedia learning emphasizes the role of learners in constructing knowledge from words and visuals. Consequently, effective multimedia instruction facilitates that role by guiding learners to important information in the multimedia message and providing them with the opportunity to process and manipulate that information.

Visuals as Aids to Learning

Most people are familiar with the proverb that "a picture is worth a thousand words" as pictures can have many details and can convey messages without limiting people to having knowledge of a specific language in order to understand the conveyed message. Visuals are used in various places (e.g., airports, hospitals, or train stations) around the world to instruct people who might encounter difficulties understanding the verbal instruction (Oatesa & Rederb, n.d). In education, teachers prefer using verbal instruction in place of visual instruction in their daily teaching. Likewise, many students find the verbal format more convenient in expressing themselves, communicating their ideas, and reflecting upon their acquired knowledge (Clark & Lyons, 2010). According to Clark and Lyons, teacher and student preference for verbal instruction would be attributed to the emphasis on reading and writing as important skills in education. Teachers also think that the integration of visuals in instruction requires a special skill of designing and manipulating graphics. Therefore, visual instruction is not widely used in

teaching and learning, which means that the instructional capability of visuals is not taken advantage of (Clark & Lyons, 2010).

Wright (1989) pointed out that students learn not only from spoken words they hear or the printed text they read but also from what they see. Therefore, visuals as an instructional resource should not be overlooked. Clark and Lyons (2010) defined instructional graphics as "pictorial expressions of information designed to promote learning and improve performance" (p.3). Beers (2003) believes that when learners read a text, their abilities to visualize the text is important for their understanding of the text. Therefore, visualizing the text for learners would enhance the comprehension of the text.

Six instructional functions of visuals exist: decorative, representational, organizational, interpretive, transformational, and relational (Clark & Mayer, 2011; Lohr, 2003). Decorative pictures are used to enhance the aesthetic of the learning materials and make them attractive or interesting to students, but they have no direct value for learning. Clark & Lyon (2010) contend that although decorative images can gain learners' attention, the extensive use of decorative pictures might hinder learning as those images overload working memory. The second function of graphics is representational, which are considered another form of information identical to the verbal form. According to Lohr (2003), "Representational visuals carry the same information as the text, making the information more concrete. They help a learner visualize information" (p.29). For example, a picture of a triangle helps learners to visualize this concept, and it is also considered a pictorial representation of the shape's word.

The third function of visuals in instruction is for organizational purposes. Organizational visuals assist learners in their ability to comprehend the structure and the hierarchy of the learning materials and to help them see the relationship between elements. For example, a

concept map is an organizational visual because it visually shows the structure of the information and helps learners understand the relationship between elements. The fourth function of graphics is interpretive, which helps "learners build understanding of events or process that are invisible, abstract or both" (Clark & Lyons, 2010, p. 19). Animation that shows the flow of blood in a heart is an example of interpretive visuals. The fifth function of visual is transformational, and it helps learners understand the change that occurs over time or space. An example of functional graphics would be animation that shows the Monarch butterfly's life cycle. The sixth function of pictures is relational, which shows the relationships between numerical values. This kind of graphic includes bar and statistical graphs.

In addition to these six functions of images, it is believed that images have a superior effect on memory over words. According to the dual coding theory (Paivio, 1990), people recall visuals better than words since visuals are processed by two systems (verbal and visual), whereas words are only processed with one system. The dual processing of the picture makes recognizing it more probable than recognizing a word that is processed with only one system. It is also easier for people to label a picture than to form a pictorial representation of a text (Carpenter & Olson, 2012). Names of pictures are generated automatically, while creating a pictorial representation of a word might require additional mental effort or instruction (Oatesa & Rederb, n.d).

Bagget (1979) found that it is easier for people to recall a story shown in visual format than in verbal format. Baggett (1979) provided college students with two identical versions of a story: auditory and visual. Students were asked to write a summary of the story immediately after being exposed to the two versions and again a week later. Students performed similarly on the immediate test, but those who were exposed to the visual version recalled more information in the delayed test than those who were exposed to the audio version. The superiority of visual

messages over verbal messages was also indicated by Madigan's (1983) research. Madigan examined the effect of pictures on memory by showing a group of learners a series of pictures while hearing the labels of those pictures at the same time. Another group viewed the pictures but heard different labels. The third group was not shown the pictures but only heard the labels. The results revealed that those who viewed the pictures scored higher on the recognition test than those who only heard the labels.

However, with all the potential benefits of visuals as an instructional aid, their value is dependent on the appropriate use of them. Visuals per se do not improve learning unless they are purposefully employed in instruction (Mayer, 2001). The following section illuminates several principles for designing effective multimedia instruction consisting of words and visuals.

Designing Effective Multimedia Instruction

The previous sections illustrated that visuals have a memorable effect on humans' memory and consequently hold promise for promoting learning. Furthermore, it is believed that the value of visuals could be expanded if they are combined with words. Mayer (2005b) described the combination of words (printed or spoken) and pictures (illustrations, static images, animation, and videos) as multimedia. He defined multimedia learning as the construction of mental representation from words and pictures, and multimedia instruction as the use of words (printed or spoken) and pictures (illustrations, static images, animation, and videos) to improve learning (Mayer, 2005b). Multimedia instruction is concerned with providing learners with multiple representations of information, which create extra mediums for conveying the learning messages in order to help those who encounter difficulties processing information from one medium to benefit from the other (Siribodhi, 1995). Multimedia learning has recently been linked with the use of computers as the main controller of multimedia instruction. Multimedia

applications make it easier to combine text, audio, and images (static or dynamic) and give learners control over the instruction (Siribodhi, 1995). The common assumption of multimedia learning is that instruction consisting of words and visuals is more effective than words alone. However, adding visuals to an instructional message does not guarantee the effectiveness of the instruction, and in some cases could impede learning.

Mayer (2001) identified several basic principles for designing an effective instructional message containing words and pictures and capable of improving learning:

1. Multimedia Principle: The combination of words and pictures is better for learning than words alone.
2. Spatial Contiguity Principle: Words and pictures in close proximity make learning better than words and pictures widely apart.
3. Temporal Contiguity Principle: Presenting words and pictures at the same time is better for learning than it is when one is presented before the other.
4. Coherence Principle: Excluding unnecessary words, pictures, and sounds is better for learning than including them.
5. Modality Principle: A combination of animation and narration is better for learning than a combination of animation and onscreen text.
6. Redundancy Principle: The addition of onscreen text to narration and animation is less beneficial than a combination of animation and narration.
7. Individual Differences Principle: The combination of words and pictures is more beneficial for low knowledge learners than it is for high knowledge learners, and it is also more beneficial for high-spatial learners than for low-spatial learners (Mayer, 2001, p.184).

These principles are based on previous research about learning from multimedia instruction conducted by Mayer and his colleagues. The goal of these principles is to guide instructional designers to effectively combine different formats of instruction in an appropriate manner. Five of these principles appear as the most relevant to the design of this study: multimedia principle, temporal contiguity principle, coherence principle, redundancy principle, and individual differences principle.

Multimedia Principle

The first principle of designing multimedia instruction is that combining words and pictures results in a better learning outcome than using words alone. The multimedia principle is based on the idea that humans have two separate channels (visual and verbal) for representing information. When receiving information, they make a verbal representation of that information in the verbal channel and a visual representation in the visual channel. These two channels can complement each other, and thus learning is enhanced as people build connections between these two channels (Mayer, 2001).

Nugent (1982) conducted two studies to compare the effects of various multimedia presentations on learning outcomes and found that dual presentations were better for learning than single mode of presentation. In study 1, Nugent compared the effect of using pictures, audio, print, and any combination of these elements on learning factual information. To make these comparisons, the researcher created seven versions of instructions:

1. Visuals alone: A series of pictures
2. Audio alone: A narration of the print version
3. Print alone: A transcript of the visuals
4. Visuals plus audio: A series of pictures and corresponding audio

5. Visuals plus print: Pictures and captions
6. Print plus audio: Text over black with audio
7. Visual plus audio plus print: A series of captioned pictured with synchronized audio. The captioned pictures appear first on the screen, and then the corresponding audio begins

Participants were randomly assigned to eight groups, with seven groups representing the experimental conditions and the eighth group acting as the control. Data was collected using a multiple-choice comprehension test based on the presented materials. The results revealed that the experimental groups outperformed the control group. The study also showed that no significant difference was found between the visuals alone group (M = 17.88), audio alone group (M = 18.38), and print alone group (M = 18.70). However, significant differences were found when comparing dual-presentation versions to single-presentation versions. The results revealed that visuals plus audio (M = 22.00) was significantly better than visuals alone or audio alone, and visuals plus print (M = 20.70) was better than either visuals or audio alone. In comparing dual-media (the combination of more than one mode of instruction), no significant difference was found, with an exception that visuals plus audio was significantly better than print plus audio. The results of this study support the presentation of information through two coding systems as opposed to only one. The results show that the combination of visuals and audio or print was better for learning than using a single-system presentation.

In study 2, Nugent (1982) created three versions of instruction: visuals alone, audio alone, and visuals with audio. The difference between this study and study 1 was that the audio was not redundant with the information in the visuals as it was in case study 1, but the audio had additional information. The visual version of instruction consisted of a series of pictures with no

narration. The audio alone instruction was solely audio segments. The audio-visual version consisted of narration that was not redundant with the visuals but had additional information, and the visuals were related to the audio but could not alone convey the information in the audio. One hundred and seventeen fourth and fifth graders were assigned to the three versions of instruction. After being exposed to the three versions of instruction, they took a comprehension test that included 41 questions: 21 represented the information in the audio and 20 covered the information in the visuals. Participants who view the visuals should not be able to answer the questions that covered the audio since the audio covered information did not exist in the visuals. Likewise, participants who only viewed the audio should not be able to answer the questions covered by the visual version.

When comparing information that appeared in the visuals, the results showed that the visual and audio-visual groups outperformed the audio group that served as a control group, and no significant difference was found between the visual and the audio-visual groups. In comparing the performance of the three groups regarding the information that was carried by the audio, the group that viewed the visuals served as a control group. The results revealed that the audio group and the audio-visual group outperformed the groups who viewed the visual version of instruction, but no significant difference was found between the audio and the audio-visual groups. The researcher concluded that when comparing the group that received audio instruction with the group that received audio-visual instruction, the presence of visuals did not interfere with learning; also, the audio did not hinder learning when comparing the visuals group with the audio-visuals. In study 1, the researcher found that the combination of two modes of instruction was better than using the single mode of instruction; however, the information in study 1 was redundant. In study 2, the researcher used additional information that might not be relevant to

learning and that could distract learners from focusing on the most important elements in the learning material.

The superiority of the combination of words and visuals were found in nine studies reviewed by Mayer (2001), in which the learning outcomes of students who received instruction in words alone and in a combination of words and pictures were compared. Students' learning was measured using retention and transfer measures. In the retention measurement, students were asked to write down what they could remember form the presented materials; the more main ideas they provided, the higher the retention would be. The transfer measurement was the ability to use the facts learned from the presented materials in order to solve problems. Six studies out of nine revealed that retention of information was better with the combination of words and pictures. Also, all nine studies revealed that transfer of knowledge was better when pictures were added to words (Fletcher & Tobias, 2005).

Temporal Contiguity Principle

Another important principle when designing multimedia instruction is temporal contiguity. This principle suggests that there should not be a long time interval between the presence of pictorial information and the corresponding narration. Presenting narration and visuals at the same time can help learners make a verbal and visual representation of the presented material and build a connection between them. If the time that separates the presence of visual and verbal instruction is short, there is still a probability that learners could make the connection, but if the time interval is long, learners are less able to make that connection and consequently learning would suffer (Mayer, 2001).

Baggett (1984) conducted a study to investigate the effect of the contiguity of verbal and visual information on the learning outcomes. Various versions of an instructional video

containing visuals and narration were created. The order of the presentation of the visuals and narration was alternated in seven versions: visuals presented 21, 14 and 7 seconds before narration; visuals presented 21, 14, and 7 seconds after narration; and visuals and narration presented together. An immediate and a delayed test were used to measure the learning outcome. The results showed that there is a significant effect of contiguity on learning outcomes. The versions that presented visuals and narration together and the version that had a visual presented 7 seconds before narration were found to be more effective in both the immediate and delayed test. Learners who were exposed to those versions scored significantly higher than those who were exposed to the other versions of the video.

Coherence Principle

Another principle of designing effective multimedia instruction is the coherence principle. The basic assumption of this principle is that the multimedia instructional message should not include irrelevant media or details that might distract learners or overload working memory. Having irrelevant words or pictures in the presented materials distracts learners from paying attention to the most relevant information and also consumes cognitive resources that should be devoted to processing relevant information (Mayer, 2001). It is common that instructional designers use some irrelevant audio, images, or text to excite learners or to enhance the look of the instruction, but that had no instructional value and might have a negative effect on the learning outcome. Moreno and Mayer (2000) tested the impact of adding background music or sounds to improve the quality of multimedia instruction on the learning outcome. The findings showed that when sounds and background music were added to the multimedia instruction, the performance of the learners deteriorated.

Mayer, Bove, Bryman, and Tapangco (1996) conducted three experiments to investigate the effect of adding additional instructional details on the recall and transfer of knowledge among college students. In the first experiment, 56 college students were instructed in a lesson about lightning using the following versions of instruction: a brief overview consisting of captioned illustrations that illustrate the main steps of forming lightning (summary), a full text consisting of 600 words explained the formation of lighting with a summary (passage with summary), a full text without summary (passage alone), and a control group with no instruction. The researchers expected that learners who received a summary instruction or a full text and summary would learn better than those who received a full text only, because the summary that listed the main ideas of how lightning develops verbally and visually would help learners focus on the main idea and build a mental representation from the verbal and visual instruction. On the other hand, students who received a full text without summary would be distracted by extraneous details. After being exposed to the three instructional interventions, learning was measured by a retention and a transfer test in which learners were asked to list the main idea of how lightning develops (retention text), or to solve a problem related to the instruction such as why clouds might occur without having lightning develop (transfer test). The results revealed that participants who received captioned illustrations performed significantly better than the other groups on the recall test. On the transfer text, those who received a summary or a full passage with summary outperformed those who received no instruction or full passage without summary.

In experiment 2, the researcher investigated if the addition or the absence of visuals played a major effect on the comprehension of the lesson. As in experiment 1, several groups were established: a group of students who were instructed with the full text and summary, a group with a summary (captioned illustrations), a group with summary consisting of words only,

and a summary consisting of illustrations only. The results showed that as in experiment 1, the students in the captioned illustrations summary outperformed those who received the full passage and summary in the recall text. However, in contrast to experiment 1, the summary group performed significantly better than the full passage and summary group in the transfer test. A major finding in this study was that the captioned illustrations summary was significantly more effective than the summary with words only or the summary with illustrations only.

In experiment 3, the researchers explored whether adding extra words to the summary would have an effect on the learning outcomes. Three versions of the summary were created: the first version consisted of a brief summary as was the case in experiment 1 and 2; the second version included a summary with 50 words; and the third version included a summary with 550 words. The hypothesis was that adding extraneous words would minimize the effectiveness of the instruction. The researchers found that the brief summary was more effective than the other versions of the summary. Also, the summary that had 50 words was more effective than the 550-word summary. The researchers concluded that adding extraneous words or pictures to the instructional message distracts learners and deteriorates learning.

Redundancy Principle

Another principle that is related to the design of multimedia learning is the redundancy principle. Redundant information is carried out when adding on-screen text to a narrated multimedia instruction such as a narrated animation or video. The rationale behind this is based on the idea that to transfer information through many paths will accommodate individual preferences so that learners can choose the format that works best for them. Learners who might have difficulties learning from a format such as narration would be able to use another format such as visuals or printed text (Mayer, 2001). Mayer (2001) stated that adding a redundant on-

screen text to a narrated explanation hurts learning since it would overwhelm the working memory of learners. Mayer, Heiser and Lonn (2001) conducted two experiments to prove the negative impact of redundancy. Learners received two kinds of multimedia explanation on how lightning storms develop: a narrated animation and a narrated animation with on-screen text. A recall test in which students write down important steps they remember from the presentation and a transfer test in which they respond to essay questions were used to measure the learning outcomes. The results showed that adding a redundant text resulted in poorer learning.

However, in contrast to those results, studies in second language learning have revealed that adding on-screen text to a multimedia explanation improves learning. Samur (2012) conducted a study to examine the effect of adding a redundant on-screen text to a narrated animation. Two versions of instruction about Turkish vocabulary were developed. The first version included animation, audio, and a synchronous on-screen text, while the second version was animation with audio only. Twenty-two undergraduate students learning Turkish as a second language at a public university in Turkey were randomly assigned to two groups: animation-audio-on-screen text and animation-audio. A multiple-choice text was used to measure learners' retention of the vocabulary. The results showed that the animation-audio-onscreen text group outperformed the animation-audio group. The researcher concluded that adding on-screen text to a multimedia presentation improves language learning.

Similar results were found by Toh et al. (2010), who compared the effectiveness of two types of multimedia instruction on English reading comprehension by non-native English speakers: one had a redundant on-screen text and the other did not. A total of 209 Yemeni learners were assigned to two groups: one received instruction in the form of static pictures and audio with redundant on-screen text and the other group received only static pictures and audio.

The results showed a significant difference in the performance of the two groups. Learners who were presented with information with a redundant on-screen text scored significantly higher than those who received instruction without a redundant text. The researchers stated that adding a redundant on-screen text is important for second language learners, as it is difficult for them to fully understand the narration. Chun and Plass (1996) also suggest that a redundant on-screen text should be added to multimedia instruction when presenting information to second language learners.

Individual Differences Principle

Prior knowledge is an important learner characteristic that can influence how they process and interact with different instructional formats. The discrepancy of knowledge background among learners regarding the material plays a significant role in the effectiveness of instruction that has words and visuals (Clark & Mayer, 2011; Kalyuga, 2005). Experienced learners and novice learners can be distinguished by the amount of knowledge they have about the presented material (ChanLin, 2001). Clark and Mayer (2011) contend that learners with disparate levels of prior knowledge would not equally benefit from adding visuals to textual information. Learners with low prior knowledge benefit from multimedia instruction that consists of words and visuals more than learners with high prior knowledge, because experienced learners are able to infer meaning from reading text alone. On the other hand, supplementing text with visuals could help low-knowledge learners connect what they read to the visuals in order to make the right mental representation (Clark & Mayer, 2011, p. 83).

The theoretical rationale of the effect of prior knowledge on multimedia learning was explained by Mayer (2001):

> High-knowledge learners are able to use their prior knowledge to compensate for lack of guidance in the presentation -- such as by forming appropriate mental images from words – whereas low-knowledge learners are less able to engage in useful cognitive processing when the presentation lacks guidance (p.161).

Many experiments have been conducted across different disciplines to examine if the instructional message that includes words and visuals work equally for all learners. These studies suggest a pattern that multimedia instruction increases the learning outcomes of novice learners better than it does with experienced learners, with some exceptions in which novice learners did not benefit from visual instruction or experienced learners learn better with visual instruction (Wetzel et al., 1994).

Mayer and Anderson (1992) found that presenting video animation and narration simultaneously assisted learners with low prior knowledge learn scientific facts on how pumps and brakes work. Mayer and Gallini (1990) also compared the effectiveness of adding illustration to passages on low and high prior knowledge learners. Leaners were divided into two groups based on their knowledge background, either low or high, and studied lessons on brakes, pumps, and generators using text with illustration or without. The researchers found that learners with low knowledge benefitted more than high knowledge learners from adding illustration to text.

ChanLin (2001) investigated the effect of three formats of computer-based instruction (text, graphic, or animation) and learners' prior knowledge on learning descriptive and procedural knowledge of concepts related to physics. The participants of the study included a total of 357 students: 183 eighth graders and 174 ninth graders. The ninth grade students were classified as the experienced group and the eighth grade students as the novice group. The learners were instructed on the scientific concepts using three computer-based instructional formats. The text

version of the instruction explained the concepts in text only. The graphic version added static pictures to the textual information, and the animation version of the instruction included both text and animation. The three versions of instruction had the same textual information, and the graphic and animation versions only added graphic and animation to the text. The two areas of knowledge covered in the study were descriptive and procedural knowledge. Descriptive knowledge included facts about the concepts, such as definitions or description. Procedural knowledge covered procedures in physics concepts and problem-solving steps. The results revealed that there was a significant interaction effect between the instructional formats and prior knowledge. Among the novice learners, the picture format of instruction was found to be more effective than the text in descriptive knowledge and better than text and animation in procedural knowledge. However, experienced learners performed similarly under the three instructional formats.

In language learning, research conducted on the effect of previous knowledge on multimedia-learning outcomes revealed inconsistent results. Markham (1989) found that adding text as a caption to instructional video enhanced the performance for all learners with different English abilities. Seventy-six students studying English as a second language were grouped by their English knowledge into three groups: 21 beginners, 24 intermediate, and 31 advanced. Each group watched two videos, one with a caption and the other without. They then took a multiple-choice comprehension test to examine the effect of the availability of the caption with the video. The results showed that beginning, intermediate, and advanced students benefitted from having a caption along with the video and demonstrated better comprehension. The researcher's initial assumption was that advanced learners would not benefit from having a caption with the video because the advanced learners had a higher English proficiency, but the results showed that the

availability of the caption was beneficial for them. The researcher also anticipated that beginning learners would not comprehend the captioned and non-captioned video, but the results showed that they performed higher with the captioned video.

Chang et al. (2011) also examined the effect of the level of English proficiency and the materials presentation mode (single vs. dual) on English comprehension. Participants in the study were assigned to two groups based on their level of English proficiency: 59 participants were classified as high English proficiency and 58 as low English proficiency. Participants of each group were randomly assigned to two different presentation modes of materials, audio only or text and audio. The results showed that participants with high English proficiency scored higher in the comprehension test in both presentation modes. Also, the results showed that participants with high and low English proficiency using dual channels (text and audio) performed better on the comprehension test than using single channel (audio only). However, there was no significant interaction between the presentation mode and the level of language proficiency. This study also did not include visuals such as images or videos.

Taylor (2005) investigated the effect of the length of time studying Spanish using captioned video. Seventy-one participants were divided into two groups: participants with one year of study (called the one-year group) and participants with three to four years of study (called the three-year group). Of the 71 participants, 17 from the one-year group and 18 from the three-year group watched a video with a caption, and 24 from the one-year and 12 from the three-year group watched a video without a caption. The results showed that the three-year group outperformed the one-year group on a recall test with the captioned video. However, there was no significant difference between the two groups when they watched a video without a caption. Taylor (2005) concluded that beginning second language learners did not appear to benefit from

instruction that included text, pictures, and audio together as they encountered difficulties adjusting to the three channels. Taylor's finding is contradictory to Markham's (1989), who found that adding a caption to an instructional video enhanced learning for novice learners of the a second language.

Multimedia Instruction and Language Learning

One area directly tied to the effect of multimedia instruction on learning outcomes is second language learning, and more specifically, word acquisition through multimedia annotations, or definitions provided for understanding unknown words. The design of multimedia instruction that has words and visuals for the purpose of enhancing word acquisition has gone through many phases. Early research compared the use of online textual annotation to traditional dictionary and found that online annotation was better for learning words (Aust, Kelley, & Roby, 1993). Researchers next investigated the effectiveness of adding other media components, and they found that visual components (static pictures or dynamic video) in annotations can advance vocabulary learning. According to Chappelle (2003), "One form of modification that gives learners access to the meaning of some vocabulary or other textual meaning is an image or video depiction of what is expressed in the language" (p. 47). With the advancement of multimedia applications, it is possible to enhance the instructional inputs and provide learners with multiple representations of information such as adding images to texts or using dynamic video or animated images.

Several studies have shown that the combination of images and words enhance vocabulary acquisition. Kost, Foss and Lenzini (1999) conducted a study to examine the effect of three types of annotations (text, picture, and a combination of text and picture) on second language vocabulary learning. Fifty-six native English speaking students in their second semester

studying German were assigned to three groups representing each of the three types of annotations: text, picture, and a combination of text and picture. The participants were asked to read a passage consisting of 272 words in which 20 words were defined either in text, picture, or a combination of text and picture. Readers were able to access the definitions by clicking on each hyperlinked word in the reading passage. Immediate and delayed recognition (multiple-choice questions) and production test (providing an equivalent English word) were used for data collection. The researchers found that the combination group scored significantly higher than the other two groups in both the immediate and delayed recognition tests.

Similarly, Yoshii and Flaitz (2002) examined the effect of three different types of annotations (text-only, picture-only, and a combination of text and picture) on vocabulary retention. One hundred and fifty one students studying English as a second language were assigned to these three different conditions: text-only, picture-only, and a combination of text and picture. Students were asked to read an online story with 14 annotated words. The study found that the combination group's scores on the immediate and delayed vocabulary tests were higher than the scores of the other two groups.

Likewise, Yanguas (2009) investigated the effect of different types of multimedia annotations on vocabulary recognition and reading comprehension. Ninety-four learners were randomly assigned to four conditions, namely textual, pictorial, textual and pictorial, and a control group was established as well. Participants were asked to read a computerized passage with 21 annotated words. Yanguas used reading comprehension, recognition, and production tests to measure the effects of multimedia annotations. The results showed that all the annotations groups outperformed the control group in the recognition measure, while there was no significant difference between the groups in the production measure. However, the group that

was provided with the definitions in the form of both text and picture outperformed all other groups on the comprehension test of the passage.

As sound was added to annotations by pronouncing the terms, investigators considered the benefits of spoken form of instruction. In particular, they studied if sound in multimedia annotation, which has been used as an additive component, can improve learning. Yeh and Wang (2003) examined the effectiveness of three kinds of multimedia annotation (text alone, text plus picture, and text plus picture plus audio) for Chinese students learning English. The audio was used to pronounce the words, spell them, and read the sentences that included the target words. The performance of the group that was exposed to the annotation with audio was less than the other two groups.

In contrast to Yeh and Wang's study, Ben Salem (2007) found that audio had a positive effect when added to text in vocabulary learning. In order to find this effect, a sample of 93 English speakers learning Spanish as a second language read an online text with 25 annotated words under the following conditions: no definition (None), text (T), text plus audio (TA), text plus audio plus picture (TAP), and text plus audio plus picture plus writing (TAPW). The results showed that the use of audio was beneficial for vocabulary acquisition.

Following these results, investigators started to explore more advanced uses of visuals for vocabulary acquisition in order to discover the most effective type of visual instruction. Chun and Plass (1996) conducted three studies to investigate the effect of three types of media (text only, text plus picture, and text plus video) on vocabulary acquisition among 160 second-year German students at three California universities. A within-subject design was used in the three studies where all participants were exposed to the three media types. The number of participants was different in the three studies: 36 in study 1; 103 in study 2; and 21 in study 3. The

participants in the three studies read an online story in German that consisted of 762 words with 82 words defined in the three types of media: text only, text plus picture, and text plus video. The story was created by a multimedia application called CyberBuch, and it was placed on the right side of the screen. Students were able to recognize the annotated words because these words were marked with a symbol (°). When a learner selected a word, icons appeared to indicate the available types of annotation, and students were able to choose the desired annotation type by dragging it to the representative icon; the definition then appeared on the left side of the screen.

The first goal of Chun and Plass's (1996) three studies was to investigate the incidental acquisition of the annotated words as students were reading the story. In study 1, thirty-six students took a vocabulary test immediately when they finished reading the story and two weeks later. They were required to provide the equivalent English word for 15 German words included in the test. In the second study, the number of words included in the test was 36 with 12 words representing each annotation type (text, text plus picture, and text plus video). The same number of words was used in the third study test, but instead of providing the equivalent English word for each German word, participants were provided with pictures, videos, and textual definition and were asked to select the corresponding German word. Compared to the probability of learning a word from the first exposure suggested by Coady (1993) and Knight (1994), which were 5% to 15%, and 5% to 21% respectively, the results of the three studies showed a high vocabulary acquisition rate. In this first study, the results of the immediate test showed a high vocabulary learning rate with a mean of 3.89 (of 15 words) or 25.9%. The delayed test also indicated high incidental vocabulary learning with a mean of 3.97 or 25.5%. In the second study, the mean of the correct answer was 8.65 (of 36 words) equal to 24.1%. In the third study where participants were required to recognize the words instead of providing the equivalent English

word, the mean score of the correct answers in the immediate and delayed test were higher than the mean scores on the first and second study (immediate test $M = 27.71$, or 77%; delayed test $M = 27.76$, or 77.1%). The results revealed a positive effect of multimedia on learning words incidentally.

The second goal of the study was to investigate what kind of multimedia type (text only, text plus picture, and text plus video) was more effective in helping learners acquire vocabulary. In study 2, the researcher found a significant difference on the immediate retention test between the three media types. The results revealed that words with visual annotation (picture or video) were better recalled than words with text only. The means and percentages for the correct answers based on the media types were as follows: text only was 2.15 or 17.9%; text plus video was 2.76 or 23%; and text plus picture was 3.75 or 31.2%. This study also showed that text-picture annotation was more effective than text-video annotation in recalling vocabulary. The superiority of visual annotations (text plus picture and text plus video) was explained by saying that the words were coded using both the verbal and visual channels and that use of both channels led to better coding and recall of the words. In terms of the superiority of picture annotation over video, the researchers stated that could be due to the low resolution of the video and the short length that ranged from 2.05 to 11.22 seconds, which could not help learners construct an appropriate mental representation of the information. Also, static pictures allowed longer viewing time for learners and that helped them code information properly (Chun & Plass, 1996).

In study 3, no significant difference was found between the three media types. The immediate test revealed that 75.1% correct words for text annotations, 76.2% correct words for text plus picture annotations, and 81.4% correct words for text plus video annotations. The

delayed test exhibited 75% correct words for text annotations, 81% correct words for text plus picture annotations, and 77.2% correct words for text plus video annotations. The researchers attributed the lack of differences to the small size of the sample, which had only 21 participants. The difference between the two visual annotations (video and picture) was not also observed in study 1.

Al-Seghayer (2001) conducted a similar study to investigate which multimedia annotation (text only, text plus picture, or text plus dynamic video) could lead to better learning of vocabulary. Thirty English as second language learners participated in this study. A within-subject design was used with 30 subjects exposed to three formats of instruction: text definition alone, text definition and still pictures, and text definition and associated video clip. All the target words in this study reflected concrete concepts. Participants read an online text with 21 annotated words that included 10 words for each multimedia type. Following the reading portion, recognition and production tests were administered to participants. The recognition test included 21 words and asked students to choose the corresponding words to the annotated words from four options, while the production test required participants to provide the definition of six words, which included two words for each multimedia annotation type. A questionnaire and an interview were employed to find out which type of multimedia annotation was more helpful and best depicted the meaning of the annotated words.

The study found that a dynamic video was more effective than picture or text-only in helping participants learn unknown words. The mean of the correct answers for the text plus video annotation was 4.3 or 87%; 3.3 or 67% for text plus picture; and 2.7 or 53% for text only. The Friedman Test was also utilized to compare the means of the three multimedia annotations, and a significant difference was found. Pairwise comparisons revealed that text-video annotation

was better than text-picture and text alone. However, no significant difference was found between text-picture and text only.

The researcher also used a questionnaire to determine which type of annotation students found helpful, and its results confirmed the effectiveness of the text-video annotation. Participants rated the text-video annotation as the most helpful aid (86.6%), compared to 70% for the text-picture annotation, and 10% for the text-only annotations. A face-to-face interview with the participants was used to decide which annotation conveyed the meaning appropriately, and those results showed that 90% of the participants agreed that text-video annotation conveyed the meaning better than the other types of annotations.

Al-Seghayer's (2001) findings are contradictory to the results of Chun and Plass's (1996) study. Al-Seghayer (2001) attributed the differences in the results to the following factors. The first factor is related to the differences of the participants of the two studies as they represented different cultures and speaks different languages. The second factor is related to the type of visual used in the experiments. The third factor is related to the assessment and terms used in the studies. Al-Seghayer (2001) provided many explanations for the effectiveness of text-video annotation. The first explanation of the effectiveness of the video is its ability to get students' attention and help them concentrate on the information in the video. The second explanation was that redundant information (text coupled with video) gave learners a higher opportunity to process information because learners were exposed to the information twice, which could minimize the probability of losing part of the information to be learned. Finally, Al-Seghayer stated that dynamic videos are more likely to be remembered and could help learners construct a mental representation of the information.

Akbulut (2007) also compared the effects of three types of multimedia instruction on word acquisition and reading comprehension. The participants of this study were 69 advanced learners of English from a Turkish university. The participants were assigned to three types of annotations: text-only, text plus picture, and text plus video. A pre-test, vocabulary post-test, delayed test, and a reading comprehension test were used to collect data from participants. The results showed that the annotations that had visuals, whether picture or video, were more effective than the text-only annotations in vocabulary learning and retention. However, no significant differences were found between the annotation that had picture and the one that had video. Regarding reading comprehension, no significant differences were found between the three types of annotations.

The effectiveness of video was also found by Hanley, Herron, and Cole (1995), who conducted a study to compare the effectiveness of video clips and still pictures as advance organizers on the retention and comprehension of French passages. Sixty-two English-speaking students took part in the study. They were divided into two groups: the first group was shown a video clip presented the French narration, while the second group of students listened to the teacher presenting an identical narration by reading it aloud while showing them four still pictures related to the content. The results revealed that the video clip group outperformed the other group on the comprehension and retention tests.

However, Al Ghafli (2011) found that dynamic pictures were more effective than text-based annotations in vocabulary retention and reading comprehension. He compared the effectiveness of using text, text plus static images, and text plus animated images in learning technical terms related to petroleum engineering by second language learners. A total of 222 participants were assigned to three groups and read an online text with 50 annotated words. The

first group received the definition of the words in textual format, the second group in text and static picture, and the third group in text and animation. The groups took an immediate comprehension test. Next, they reviewed a list of 59 annotated terms and took immediate and delayed tests. The results revealed that learners who received instruction in the form of text and picture performed significantly better than those who received instruction in textual format.

From the previous research, it appears that there are inconsistent results in the effectiveness of visuals in word acquisition by second language learners. While Chun and Plass (1996) found that picture is more effective than video in vocabulary acquisition, Al-Seghayer's (2001) study revealed contradictory results. Akbulut (2007) also conducted a similar study and did not find a significant difference between picture and video. However, these studies found one common result, which is that a multiple format of annotation that consists of text and visuals is better than using text only. It should be noted that these studies concentrated on concrete words that can be represented easily with visuals, which leaves the question of how effective visual instruction would be when defining abstract words that do not have a concrete meaning.

Learning Abstract Words with Multimedia Instruction

Previous research on word acquisition has focused on defining concrete words with multimedia as these words can be adequately represented with visuals. Learning abstract terms with visuals did not receive enough attention as researchers assume that using visual aids for learning abstract words requires learners to infer the meaning from visuals that do not precisely represent the terms. Therefore, what learners infer might not be the correct meaning (O'Bryan, 2005). Matsumi (1994) compared the effectiveness of using visuals in learning abstract and concrete words and found that concrete words were retained better than abstract words. Paivio (1990) claims that concrete words that are represented easily by images can be learned and

recalled better than abstract words. Al-Seghayer (2001) pointed out that pictures should precisely depict the meaning of the words, and they should be simple in order to help learners understand the meaning of the words. However, Chapelle (2003) found that when defining an abstract word using a picture, even if the connection between the picture and the word is weak, the picture can still be helpful in representing the meaning. In other words, even if an image does not represent a concept precisely, it can still give people a clue about the concept and thus enhance the retention and comprehension of the instructional message (Clark & Lyons, 2010).

O'Bryan (2005) conducted a study to investigate the effectiveness of learning abstract words using graphics. Based on a scale of 1 to 7, experts evaluated the concrete nature of a list of words. A word that received a mean of 4 or less was considered abstract. The same list of words was evaluated on a scale of 1 to 7 for imagibility, with any word that received a mean of 3.5 identified as being imageble. Forty-eight words were chosen based on the concreteness and imagibility criteria for the study. A representative picture for each word was chosen that was then evaluated by a group of native and near-native English speakers to rate how well the picture depicted the target word meaning. A group of thirteen English as second language learners was placed into experimental and control groups; the experimental group viewed the definition of the words in pictorial format, and the control group had a textual definition in English words. Based on the data collected from the pre- and post-test, this study indicated that the two formats of definitions were effective in helping the participants learn abstract words. However, the control and experimental group demonstrated no statistically significant difference. O'Bryan concluded that statistical evidence did not exist proving that one format of definition was more effective than the other in facilitating learning unfamiliar abstract words; however, the research suggested

that it is possible that abstract words can be better defined using a textual definition format (O'Bryan, 2005).

Instructional Video versus Text

Video is considered to be a powerful instructional method that can convey any instructional message in various paths. According to Wetzel et al. (1994), more information can be conveyed using video, and students can learn through both visual and verbal channels, which increase the likelihood that the learners would process the content. Video has many features other than content that can attract viewers' attention and increase learners' engagement. Some of these features are the use of visuals and auditory media. Video can take many forms: a video can have dynamic pictures, such as videotaping some events or people, or it can consist of static pictures. The instructional video components complement each other and convey the instructional message more effectively than using a single format (Swarts, 2012).

Xin and Reith (2001) investigated the effect of using video as an instructional intervention to help elementary students with learning disabilities acquire words and comprehend text. Seventy-six students were assigned to two groups. One group received instructional video for 30 words and concepts, and the other group used a dictionary and the teachers' explanation of the words and concepts. Data was collected using pre-test, post-test, and a two-week follow-up test. The results revealed that learners in the video group outperformed learners in the non-video group.

Neuman and Koskinen (1992) investigated the effect of four instructional strategies on learning science vocabulary and concepts. A sample of 129 bilingual seventh and eighth grade students were assigned to four groups: captioned video, video without caption, reading a text and listing to an audio, and reading a text alone. Participants of each group viewed or read three units

of science segments adopted from a science book. The results showed that the captioned video group outperformed the other three groups on the word meaning post-test. The investigators concluded that "The visual representation of words in video form is an important contributor to students' increased word knowledge" (p. 102).

A study conducted by Pezdek, Lehrer, and Simon (1984) compared the comprehension and retention of materials presented in three forms of media: text with pictures, audio only, and video. Ninety-six third and sixth graders read one story in the textual format and were presented the other story in the form of either audio or video. A recall and a comprehension test were administered after the exposure to the media conditions. The results revealed that the video and text were more effective than the audio only format, but no significant differences were found between the text-picture and the video.

Swarts (2012) provided suggestions for what makes an effective instructional video. Some of these suggestions are drawn from the multimedia principles (Mayer, 2001), and the other suggestions from his research. According to Swarts, when designing an instructional video, designers should consider the following nine points:

- Effective educational videos resemble what is in printed text.
- Unnecessary visuals should not be included in order to keep learners focused on important information. Annotations such as words or arrows might be helpful in directing learners' attention to critical information in the instructional video
- Narration and visuals should appear at the same time.
- Instructional video needs to be well planned and edited. It can start from script or storyboards.

- Adding transitions, text, labels, and more advanced technical production features gives the impression that the video is professionally designed and credible, which in turn gives the viewers confidence in the content of the video.
- The audio narration needs to be clear, well intonated, and at an appropriate pace with no disruptive halting. That requires the narrator to be aware of the content. Rehearsals or reading from scripts can help a narrator produce a high quality audio soundtrack.
- Recorded video or still images need to be of high quality.
- Text is used to clarify the abstract nature of the video. Text added to the video needs to be readable.
- Different forms of instructional video are suitable for different kinds of messages. The designers of the instructional video can determine if they need to use either still pictures or dynamic images based on the content they are visualizing.

In addition to video, printed text or on-screen text is an instructional strategy used to deliver content to learners. Although text does not have as many features as video, it can still be meaningful and enhance learning. Well-written text that does not have irrelevant details could motivate learners and improve the comprehension of the text (Khan, Richards, & Wu, 2010). Providing definition in printed text (textual format) is a popular way to define concepts since it does not require additional preparation efforts, as is the case with visual aids.

Several studies have compared the effectiveness of instructional video for teaching concepts to textual instruction among native speakers. Luyben and Warden (2009) conducted a study to compare the effect of online text-based instruction and text-video-based instruction on learning concepts related to stimulus discrimination. The content to be learned was identical in both groups. The length of the clips used in the study ranged from 15 seconds to 1 minute and 31

seconds, and the text version had transcriptions of the clips and included the same content but in textual format. The number of words in the text versions ranged from 133 to 417. A total of 54 students from an introductory psychology course were assigned to one of the two experimental groups to study the concepts presented either in text or in text and video. Pre- and post-tests were used to collect the data. The results showed that there was an increase in learning from the pre-test to the post-test; however, the two groups demonstrated no statistically significant difference.

Breimer, Cotler, and Yoder (2012) compared the acquisition and retention of information system concepts using text-based and video-based instruction. The study also examined the participants' perceptions toward the two instructional formats. Participants of this study were instructed in a lab activity titled "Wagemart". This activity was presented either in the form of text or video. Then 51 students who were exposed to the text instruction and the 45 students who were exposed to the video instruction took a 50 multiple-choice test along with seven opinion questions. After six weeks, the participants took a final exam and completed an opinion survey regarding the two instructional types. The results showed that no significant differences were found between the text and the video groups in acquisition and retention. According to the impression survey, participants reported that the video instruction took longer time than text; it was found not significant that the video instruction was easier to follow and more helpful in comprehending the learning materials.

Benefits of Practice Test on Learning

One of the basic premises of learning from multimedia instruction is that adding more features of interactivity improves learning. Interactivity in multimedia instruction takes many forms, ranging from basic control over the pace of instruction to having practice questions and feedback (Hannafin, 1985). Many researchers have advocated adding practice questions as an

element of any instructional message over other forms of interactivity as they believe it has a superior effect (Hannafin, 1987; Hannafin, Phillips, Rieber, & Garhart, 1987; Martin & Klein, 2008; Phillips, Hannafin, & Tripp, 1988; Vural, 2013). Incorporating practice questions throughout the learning materials is believed to enhance the retention and the comprehension of information and increase performance on later related questions (Roediger III & Karpicke, 2006). Mayer (2001) suggested that when designing multimedia instruction, the focus should not only be on presenting material in different formats but also on providing learners with guidance on how to process the presented material, what part of the presented material to pay attention to, and how to connect it to prior knowledge. Hannafin (1985) contends that practice questions in multimedia instruction with appropriate feedback increase attention and retention since the questions usually direct learners' attention to critical features in the instructional content, enable learners to connect what they are learning with previous knowledge, and empower them to practice how to retrieve information from memory. Johnson and Mayer (2009) added that the practice question with content is used as a learning tool more than a knowledge assessment. It helps learners think about what they are studying and internalize new knowledge so that they can remember it (Martin & Klein, 2008).

Halamish and Bjork (2011) present two kinds of evidence that illustrate the effect of practice tests on learning outcomes: (a) evidence of comparing materials with a practice test versus materials without, and (b) evidence of comparing materials with a practice test versus restudying the materials. The first kind of evidence focuses on creating two versions of instruction identical in content, one with practice questions and the other without. Two groups of learners study the two versions of instruction and then take a test. The results of both groups are compared to see what version of instruction is the most effective. The other kind of evidence that

illustrates the effectiveness of having practice questions with instruction is to compare instruction with practice questions to studying the material twice without a practice test. This evidence is called the "testing effect." The testing effect claims that learners are able to recall information that was practiced better than information studied twice without being practiced.

Instruction with a Practice Test versus Instruction Without

Several studies have compared the effectiveness of instruction with a practice test to instruction without a practice test. Hannafin (1987) compared the performance of sixth grade students who were given computer-based instruction on space flight with and without practice questions. The practice questions were placed at the end of each of six sections of the instructional content. One group of students studied the practice version, and the other group studied the no-practice version; a posttest was then administered to the students. The results revealed that students who took the practice question version of instruction scored significantly higher than those who did not take the practice questions.

Martin, Klein, and Sullivan (2007) examined the effect of several elements of computer-based instruction (objectives, information, practice questions, examples, and review) on learning topics related to computer literacy. Six versions of the computer-based instruction were developed to instruct learners on several computer literacy topics. The first version was the full version and included all five elements: information, objectives, practice questions and feedback, examples, and review. The second version had no objectives. The third version had no examples. The fourth version had no practice. The fifth version had no review. The sixth version had only information. Data was collected from participants using a pre-test, post-test, and a survey measuring participants' attitudes toward the instruction and presence or absence of the instructional elements. The researchers found that among the instructional elements used in the

study, the practice test was the most effective and positively affected participant's attitudes and performance. Students who were instructed with the four versions of instruction that had a practice test performed significantly better than those who were instructed using the other two versions that did not include practice questions. The researcher noticed that when removing any element other than the practice test from the full version, students' performance was unaffected. However, when the practice test was removed, there was a significant decrease in students' performance.

Practice Test with an Instructional Video

Vural (2013) compared the effectiveness of two versions of instructional videos, one that had an embedded question at the end of each clip (QVE) and one without (IVE). A total of 318 education students were assigned to the two treatment groups. The QVE group consisted of 175 students who studied 83 short clips on computer literacy; at the end of each clip, they had to answer a multiple-choice question. The IVE group consisted of 143 students who also studied 83 short videos but without an embedded question. The videos in both treatment groups had the same content; the only difference between them was the embedded question. Data was collected from the participants through a computer literacy survey, a pre-test used as a covariate, a post-test used to measure the effectiveness of QVE and IVE, and recorded data from student interaction with the instructional videos. The results revealed participants in the QVE group outperformed the other group, and the participants in the QVE group spent more time interacting with the learning materials than those students in the IVE group. The researcher concluded that incorporating a question into instructional videos could increase students' motivation and interaction with the materials and likewise increase achievement.

Phillips et al. (1988) also compared the effect of three types of embedded practice in instructional video on students' learning. The participants of the study were 72 undergraduate students assigned to three groups: no practice, limited practice, and elaborate practice. The participants viewed eight short instructional videos on artists and art periods ranging from 3 to 5 minutes in length. Those videos were matched for content except for the level of practice in each video. The limited practice consisted of two multiple-choice questions, and when an answer was chosen, the participants received appropriate feedback. If an incorrect answer was chosen, the participants immediately received the correct answer. The elaborate practice also consisted of two questions, but when an incorrect answer was chosen for the first time, participants were directed to where they could find the right answer in the video. If an incorrect answer was chosen the second time, participants were shown the right answer. The no-practice group viewed the videos but without the embedded practice questions. Participants were given a post-test consisting of 32 questions; half of the questions were repeated from the practice questions, and the other half were new questions. The results showed that the limited and elaborate practice groups performed better than the no practice group. No significant difference was found between the limited group and the elaborate group. The researchers found that participants scored higher on the items they practiced before than on the new items. When comparing the performance of the three groups on the content not related to the practiced questions, the researchers found that there was only a marginal difference between the practice groups and the no practice group.

Instruction with a Practice Test versus Restudying (Testing Effect)

It is believed that a practice test given immediately after studying results in a better recall of information than restudying, which is called the testing effect. This claims that people can retrieve information after studying specific content and immediately taking a practice test better

than those studying the content twice without having a practice test (Johnson & Mayer, 2009). Roediger and Karpicke (2006) investigated the effectiveness of practice questions on learning outcome. One group of students studied a set of materials and then took an immediate practice test. Another group of students studied the same set of materials without a practice test. The third group studied the material twice also without a practice test. The three groups then took a final test to measure their understanding of the materials. The results revealed that the group that received a practice test outperformed the other two groups. Roediger and Karpicke (2006) concluded that a practice test is a powerful method that improves the retention of the material even better than studying the material twice. They added that testing students as they are studying could clear any misunderstanding of the materials and also increase their later performance on related tests.

Johnson and Mayer (2009) conducted a study to investigate the effectiveness of testing on learning from multimedia instruction. The study compared the performance of students who were instructed with a multimedia lesson on lighting formation and took a practice-retention test (practice-retention group) with those who studied the lesson twice (restudy group). The practice test was a simple question asking students what they learned from the multimedia lesson. Another comparison was conducted between students who viewed the same lesson and took a transfer practice test (practice-transfer group) with those who studied the lesson twice (restudy group). The transfer practice test included more advanced questions that asked students to solve problems. Next, the participants took retention and delayed tests. The results of the first comparison revealed that the restudy group scored better than the practice-retention group on the immediate retention test. However, the practice-retention group outperformed the restudy group

on the delayed test. The results of the other comparison showed that individuals in the practice-transfer group performed better in the delayed test than individuals in the restudy group.

Clark and Mayer (2011) state that practice in an online learning environment is not universally useful, but its usefulness depends on engaging learners in high-level information processing. Clark and Mayer identified two kinds of engagement that practice questions provide: behavioral and psychological. Behavioral engagement happens as learners produce actions when studying materials such as selecting an answer in a multiple-choice question or forwarding or rewinding a video. Answering a multiple-choice question about some facts mentioned in the lesson, such as a date or a number, is an example of behavioral engagement that required simple recalling of facts. Psychological engagement happens when learners engage in cognitive processes with the learning materials that result in formulating new knowledge. Some examples of psychological engagement include paying attention to the learning materials, elaborating, manipulating information, and integrating the new information with previous knowledge. Clark and Mayer (2011) emphasized that engagement activities should focus on psychological engagement more than behavioral engagement.

Clark and Mayer (2011) provided six principles for incorporating effective practices in online instruction:

1. Instructional designers should provide sufficient practice in order to achieve the learning objectives. The amount of practice can vary based on the complexity of the materials, but if the instructional designers are not certain about the amount of practice, they should include more practice.
2. The practice should be related to real life problems in order to facilitate the transfer of knowledge.

3. Instructional designers should provide effective feedback.
4. The practice should be distributed throughout the learning materials. Instead of giving learners a massive amount of practice at once, practice should be divided into small sessions and distributed through the learning materials or given at different times.
5. Practice questions, directions, and feedback need to be in text format so learners can refer to them as needed, and they also need to be visually aligned so learners can better access them.
6. Learners should start with examples so that students can gain experience with the learning materials and end with practice.

Giving learners any form of practice such as embedded questions with the instruction gives them the opportunity for feedback. Practice questions help students learn from the feedback they receive about their performance so that they will realize what they know about the material and what they do not know about it (Roediger III & Karpicke, 2006). Thorndike (1932) believes that learning happens as a result of practice and reinforcement. People construct knowledge as they respond to stimuli such as questions, with positive feedback reinforcing the correct answer and negative feedback working as punishment for the wrong answers (Delgado & Prieto, 2003). Feedback is defined as "knowledge of one's performance provided by an external agent" (Delgado & Prieto, 2003, p. 73). The general assumption is that providing feedback is more effective for the learning process than not providing feedback (Morrison, Ross, Kemp, & Kalman, 2011). Azevedo and Bernard (1995) conducted a meta analysis over 22 studies to investigate the effectiveness of using feedback on learning outcomes and found that feedback improves performance. Pashler et al. (2005) found that providing learners with the right answer after an incorrect response helps not only to improve the learning process but also to increase the

retention of the information by 494%. Butler, Karpicke, and Roediger (2008) found that feedback even after a correct response improves learning; the benefit was greatest when subjects reported low confidence with the correct response.

Technology-based instruction affords the use of feedback to judge whether an answer is right or wrong. There are three factors to be considered when designing a computer-based feedback: the type of feedback, the timing, and the presentation format. Morrison et al. (2011) identified five types of feedback that can be provided for evaluating answers. The first type of feedback is called "knowledge-of-result." The goal of this feedback is to simply tell the learner whether the answer is correct or incorrect without telling them what the correct answer is if the answer is incorrect. The second type is called "knowledge-of-correct-response." The goal of this type is "answer-until-correct." This feedback provides learners with the right answer when they respond to a question. The third type of feedback required learners to continue answering until they get the correct response; they will not be able to move to the next step until they respond correctly. The fourth type of feedback is elaborative feedback, which gives learners additional information regarding whether the response is correct or incorrect. It can be used to draw learners' attention to a section in the learning material or suggest a strategy that could help learners find the right response. The fifth type of feedback is "response-sensitive," which provides unique feedback to each response to assist learners as they understand why the response is correct or incorrect (Morrison et al., 2011, p. 249).

Clark and Mayer (2011) recommended that feedback should not focus on learners but instead on the material to be learned. Instead of praising learners when judging a response, feedback should tell the learner whether the response is right or wrong and provide an explanation to correct any misunderstanding that learners might have or to enhance correct

understanding by elaborating on the right answer. Brookhart (2008) mentioned two reasons for not focusing on learners when giving feedback. First, praising learners with words such as "intelligent" or "smart" does not add to learning since it does not provide information about the learning material. Second, praising learners might lead them to think that learning is a matter of natural, fixed intelligence instead of a result that comes from making an effort.

In addition to the type of feedback, the timing of it is another factor to be considered. Feedback can be provided immediately after a response, or it can be delayed until the end of the lesson, the unit, or test. In a meta-analysis of 53 studies on feedback timing and verbal learning, Kulik and Kulik (1988) found that using immediate feedback is more fruitful than delayed feedback. However, Morrison et al. (2011) state that immediate feedback can sometimes be distracting and might preoccupy learners regarding their performance. They suggest that when choosing the timing of feedback, the learning task should be taken into consideration. They point out, "If a task is difficult and making errors early in a lesson can result in a cumulative misunderstanding, it certainly makes sense to favor immediate feedback" (p.251).

The format of the feedback presentation is another factor that should be taken into account. There are many options for feedback presentation modes such as text, images, or audio. However, feedback must be in a format that can be understood by the learners. If the reading ability of the learners is not sufficient enough and there is a possibility that they cannot understand the feedback in text format, then pictures or audio would be preferable. In other words, the characteristics of the learners can determine the format of the feedback (Morrison et al., 2011).

Chapter Summary

Theories and studies discussed in this chapter are concerned with the effect of multimedia instruction on learning outcomes. The cognitive theory of multimedia learning used as a framework for this study supports the use of visual and verbal instruction in presenting instructional messages without overloading the working memory of learners. In addition, this theory supports the integration of practice questions in multimedia instruction as a technique of engaging students in active learning. In previous studies that targeted learning vocabulary using multimedia instruction, researchers focused on learning concrete words because they are easily depicted with visuals, while few studies have given importance to the effect of visual instruction on learning non-concrete words. Also, what makes this study unique is the use of a practice question embedded with the multimedia instruction. Relevant studies reviewed in this chapter support the use of a practice question in a multimedia environment; however, these studies used different content with various groups of students. Research also showed that previous knowledge interacts with different multimedia instruction, and not all learners can equally benefit from multimedia instruction.

CHAPTER THREE

Methods and Procedures

The main objectives of this research were to identify critical terms related to technology integration in education and to investigate and compare the effectiveness of three online instructional interventions/strategies in aiding target participants to learn critical terms of technology integration in education. These intervention/strategies include (a) textual definition alone (T); (b) the combination of textual definition and instructional/explanatory video (V); and (c) the combination of textual definition, instructional/explanatory video, and a practice question (Q). An example of each instructional intervention/strategy can be found in Figures 1-3.

Additionally, this study explored the relationship between the comprehension of critical technology integration terms, English language proficiency, and prior technology experiences. Convenience samples of native and non-native speakers of English were used in this study. Participants were oriented and then assigned to one of three presentation modes: A, B, and C. The three presentation modes in this study included a list of 21 terms represented using the three instructional strategies (T, V, Q), which were counterbalanced across the three presentation modes. At the conclusion of the intervention, data collection instruments were administered to all participants. Below are (a) the descriptions of the study design, (b) research questions, (c) variables, (d) hypotheses, (e) the composition of participants, (f) the design procedures of instructional materials used in this study, (g) measures and instruments, and (h) data analysis procedures.

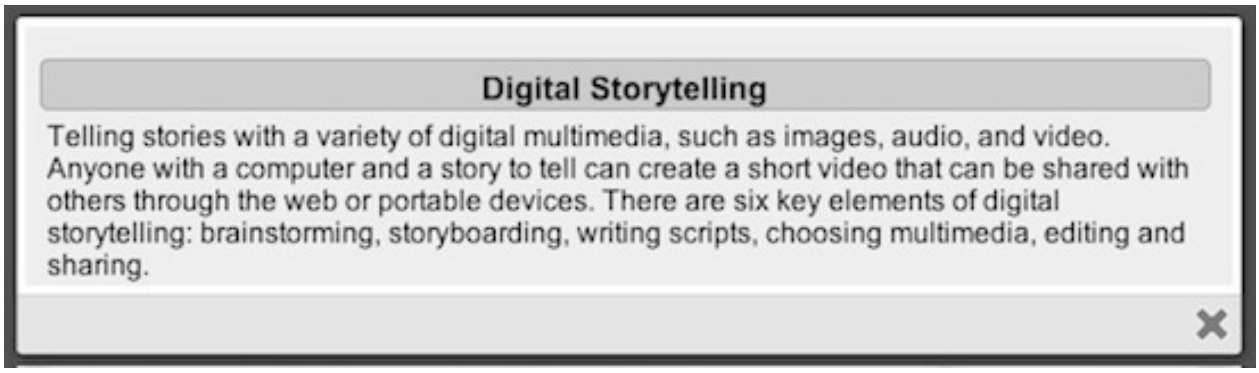


Figure 1. Textual definition (T)

Figure 2. Textual definition and explanatory video (V)

Figure 3. Textual definition, explanatory video and a practice question (Q)

Research Design

Within-subject design and statistical correlation were used to accomplish the goals of this study. The within-subject design was used to investigate the effect of three instructional strategies: (a) textual definition alone (T); (b) the combination of textual definition and instructional/explanatory video (V); and (c) the combination of textual definition, instructional/explanatory video, and a practice question (Q) on learning critical technology integration terms.

In within-subjects design, all subjects are exposed to all treatment conditions under investigation and then are assessed on the dependent variable (Warner, 2008). This requirement was met in that all participants of this study were exposed to the three instructional strategies (T, V, and Q) as they were learning 21 technology integration terms (Figure 4). After the participants were exposed to the instructional strategies, each took a comprehension test to measure his or her understanding of the 21 technology integration terms. Because each participant serves as his or her own control group, within-subject design is considered to be a powerful design that can reduce the error variance as compared to between-subjects design (Girden, 1992). Another advantage of this design is that it allows the researcher to reuse the same subjects several times (for different time probes or under different conditions) as compared to between-subjects design, thus allowing preservation of statistical power (Hall, 1998). Warner (2008) stated that,

> When a researcher uses the same participants in all treatment conditions, potential confounds between type of treatment and participant characteristics (such as age, anxiety level, and drug use) are avoided. The same participants are tested in each treatment condition. In addition, the use of repeated measures design make it possible, at least in

> theory, to identify and remove variance in scores that is due to stable individual differences in the outcome variable … and this may result in a smaller error term (and a larger t or F ratio) than a between-subject design (pp. 921-922).

Therefore, using this design to investigate the effect of different types of instructional interventions/strategies on learning terms would reduce the effect of group differences.

In this study, three instructional strategies were used to instruct participants in 21 technology integration terms: textual definition alone (T), the combination of textual definition and instructional/explanatory video (V), and the combination of textual definition, instructional/explanatory video, and a practice question (Q). Selection of the 21 critical terms related to technology integration in education was completed by the researcher from a list developed through consultation with experts in educational technology (Table 1). There were three presentation modes in this study, A, B, and C. Each mode consisted of the same 21 terms defined using the three instructional strategies (T, V, Q). In this group of 21 terms, seven terms were presented in the form of textual definition (T), seven terms were presented in the form of a combination of textual definition and instructional/explanatory video (V), and seven terms in the form of a combination of textual definition, instructional/explanatory video, and a practice question (Q). The instructional strategies were counterbalanced so each term was defined in the three different types of instruction (either T, V, or Q) in three different presentation modes (A, B, C) (see Table 1). Participants in the three presentation modes were exposed to the same list of terms; however, in each mode, participants were exposed to all three types of the instruction strategies (T, V, and Q). For example, the instructional intervention for the term "Asynchronous Learning" was shown in textual format (T) in the presentation mode A; in text and explanatory video (V) in the presentation mode B; and in text, explanatory video, and a practice question (Q),

in the presentation mode C. This design enabled each participant to experience the three types of instruction while also allowing each term to be presented in each of the three types of instruction across the three presentation modes.

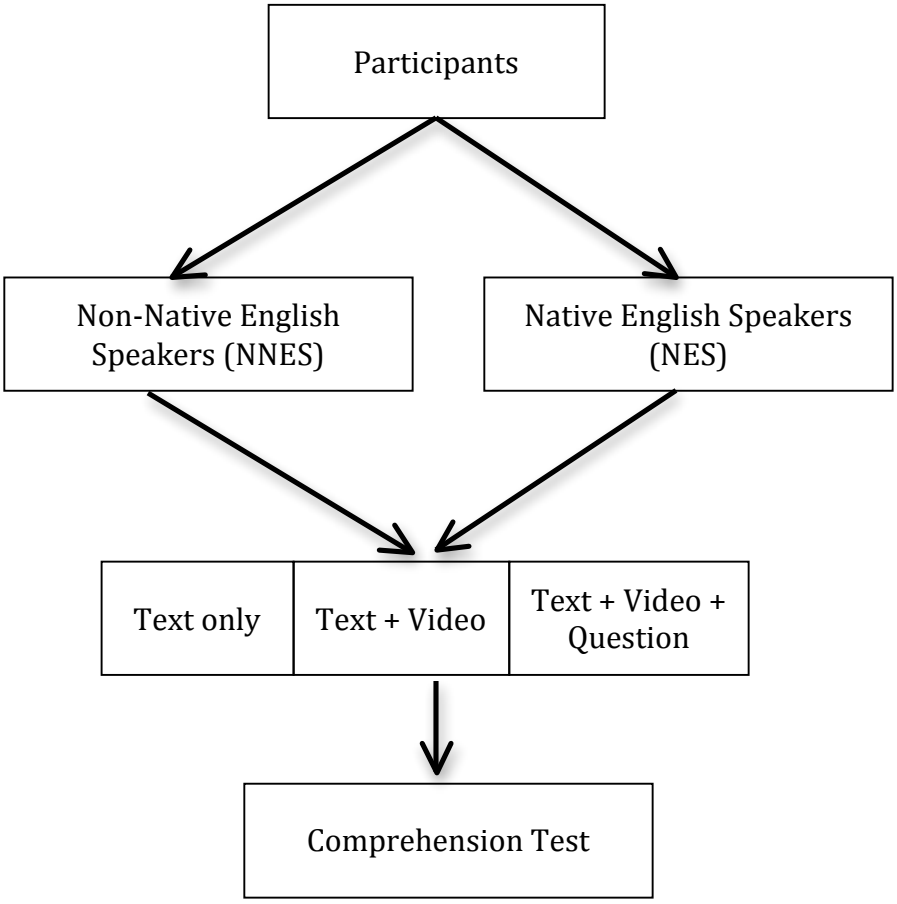


Figure 4. Within subject design

Table 1

Presentation Modes A, B, and C

A	B	C	Terms
T	V	Q	Asynchronous Learning
Q	T	V	Blended Learning
V	Q	T	Collaborative eLearning
T	V	Q	Concept Mapping
Q	T	V	Digital Citizenship
V	Q	T	Digital Storytelling
T	V	Q	Drill and Practice
Q	T	V	eAppearances
V	Q	T	ePortfolio
T	V	Q	ePublishing
Q	T	V	Global Classrooms
V	Q	T	Keypals
T	V	Q	Online role-play
Q	T	V	Scaffolding
V	Q	T	Simulation
T	V	Q	Social Media
Q	T	V	Synchronous Learning
V	Q	T	Technology Integration
T	V	Q	Teleconferencing
Q	T	V	Telementoring
V	Q	T	WebQuest

T= Text Only, V= Text + Video, Q = Text + Video + Question

Three webpages were created to represent the three presentation modes, each containing the 21 term list. The webpages looked the same for each of the three presentation modes (see Figure 5); however, when the participant clicked on a term, the instructional strategy he or she received (T; V; and Q) for each term was presented dependent on the presentation mode counterbalancing order.

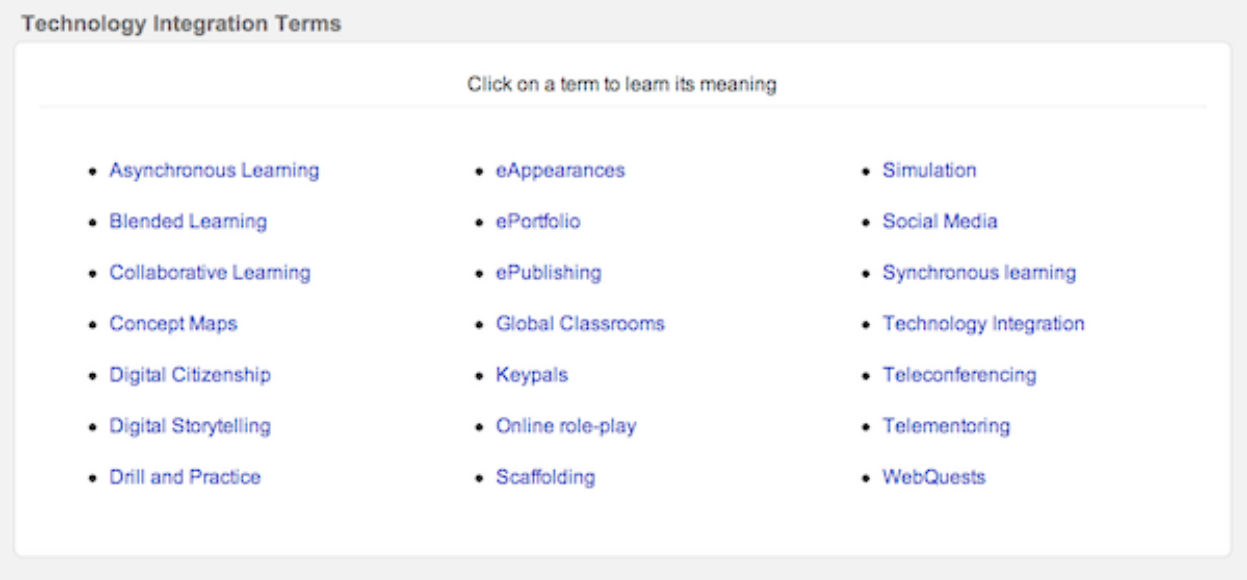


Figure 5. A webpage with 21 terms related to technology integration in education

Participants were allowed a twenty-minute study period and then given a comprehension test containing 21 questions, one for each term, intended to measure participants' understanding of the 21 technology integration terms (Appendix B). A dichotomous scoring strategy allowed for one point for each right answer and zero points for incorrect answers. The point(s) were then grouped by instructional strategy; in other words, grouped by the formations of text alone (T), text and video (V), and text, video, and a practice question (Q). The maximum score for each of the instructional strategy type was seven points: 7 points for the text alone strategy (T), 7 points for the text and explanatory video strategy (V), and 7 points for the strategy that had text, video,

and question (Q). The scores attained reflect not only the participant's comprehension of the meaning of terms but the effectiveness of the respective instructional strategy in aiding the learning of critical technology integration terms. Therefore, each subject had three scores representing his or her achievement on the comprehension test based on the instructional interventions being experienced.

A correlational study was used to evaluate the relationship between English language proficiency and the scores on the comprehension test of technology integration terms. The English proficiency of both Native English Speakers (NES) and Non-Native English Speakers (NNES) was measured by participants' self-evaluation on English reading and listening skills on the following Likert scale: 1 = poor, 2 = passing, 3 = average, 4 = good, 5 = excellent. The overall language proficiency was calculated as the mean of the self-reported values.

As the relationship between comprehension of technology terms and previous technology experience was an area of interest, an additional correlation study was conducted. Technology experience was another self-reported value, measured by a questionnaire in which subjects rated their knowledge of important educational technology tools (appendix D).

Research Questions

RQ1: What are the key technology integration terms that imply new ways of teaching and learning with technology that education students should understand?

RQ2: What instructional strategy (Text only, Text plus Video, Text plus Video plus Question) is the most effective for learning specialized terms related to technology integration in education by native English speakers and non-native English speakers?

RQ3: Is there a relationship between participants' English language proficiency and their comprehension of technology integration terms?

RQ4: Is there a relationship between participants' technology expertise and their comprehension of technology integration terms?

Variables

Independent Variables

1. The type of the instructional strategy was an independent variable. There were three levels of this independent variable, and each level represented an instructional strategy. The first instructional strategy was "T," which presented the definition of the term in words. The second instructional strategy was "V," which provided a textual definition of the term and a video that defined that term. The third instructional strategy was "Q," which provided a textual definition of the term, a video explanation of the term, and a multiple-choice question to check the participants' understanding of the term after viewing the definition.
2. The experience with important educational technology tools was an independent variable. The experience level was calculated by averaging the self-reported proficiency scores on a Likert scale questionnaire. It was the mean of self-evaluation of a list of 15 important technology tools and programs that were identified by previous research as important in educational technology. The list of technology tools and programs included web search engines, web design, graphic editing, word processing, presentation, animation, video editing, audio editing, collaboration, survey, teleconferencing, social networks, email programs, synchronous discussion, and community publishing (Appendix D).
3. The third independent variable was the level of English proficiency. The English proficiency of both native and non-native speakers was measured by participants' self-evaluation on the following Likert scale (1 = poor, 2 = passing, 3 = average, 4 = good, 5

= excellent). Also, the participants of this study were divided into three categories representing different level of English proficiency. The first category was the Native English Speakers (NES) for whom English is the first language (high English proficiency). The second category is the Non-Native English Speakers (NNES) who finished studying English as a second language at the Applied English Center and started taking academic classes (AL) (medium English proficiency). The third category was the Non-Native English Speakers who were still taking classes at the Applied English Center (AEC) (low English proficiency).

The Dependent Variable

The dependent variable in this study was the score on the comprehension test of technology integration terms. The comprehension test was a 21-item, multiple-choice format, and the items corresponded to the 21 terms related to technology integration being studied. Each item was a short scenario of a technology-based learning activity followed by four options, from which the participants had to choose the appropriate term for that scenario. The scores on the comprehension test were grouped by the instructional strategy into three categories (T, V, Q), where one category represents the scores of text alone strategy (T), the second category represents the scores of the text and explanatory video strategy (V), and the third category represents the score of the text, video, and a practice question strategy (Q). The maximum possible score for each category was seven points. Therefore, each participant had three scores representing performance under each of the three instructional strategies.

Hypotheses of the Study

H1: Participants will score differently on a comprehension test of technology integration terms based on the instructional strategy they experience (Text only, Text plus Video, Text plus Video plus Question).

H2: There is a relationship between participants' English language proficiency and their performance on a comprehension test on technology integration terms.

H3: There is a relationship between participants' technology expertise and their comprehension of technology integration terms.

Participants

Participants of this study were Native English Speakers (NES) and Non-Native English Speakers (NNES) who were current students at the University of Kansas and at the Applied English Center (AEC) that prepares non-native English speakers for study at American universities. The term "Native English Speaker" (NES) refers to people for whom English is the first language learned in childhood (Davies, 2003), while the term "Non-Native English Speaker" (NNES) refers to those who are currently learning or have learned English as a second or foreign language (Davies, 2003). Using the labels NES and NNES were adopted from research conducted by Lessard-Cloustin (2005) in which these two labels were used to distinguish between native English speakers and non-native English speakers.

Procedures for Recruiting Participants for this Study

Data collection from NNES took place in Fall 2012. Recruiting NNES subjects began four weeks before the start of the study, using different methods that included email, Facebook, and word of mouth. Because a high percentage of Arabic-speaking students enrolled in the University of Kansas were from Saudi Arabia, an email with an invitation to participate in the

study was distributed through the Saudi Students Association to all members. The same invitation was posted on the Saudi Students Associations' Facebook page. The invitation included a brief description of the study, what participants would be expected to do, the timing of the study, the computer labs that had been reserved for the study, and the researcher's contact information. The invitation also urged those who were interested in participating but had a conflict with the allotted time to contact the researcher if they wanted to participate in the study at a more convenient time. The invitation also emphasized that the target sample could include students from different majors and from different academic levels, including those who were currently enrolled at the Applied English Center (AEC) and those who were taking academic classes. Additionally, Arab classmates and community members were also asked to spread the word and to suggest people who might participate in the study. To increase participation, the researcher went to the Islamic Center of Lawrence, a location that was physically near the University of Kansas where many Arab students gather regularly. In the course of informal interactions with those students, the researcher introduced himself and explained the nature of the study.

Data collection from NES took place in Spring 2013. NES subjects were recruited from educational technology classes offered during Spring 2013. Students of four educational technology classes (three undergraduate and one graduate level) at the School of Education at the University of Kansas were asked to take part in this study. The three undergraduate classes focus on teaching students strategies and technology skills to integrate technology in elementary, middle, and secondary education, and the fourth class was a graduate class on designing and developing educational technology resources and systems. The researcher taught one of these classes, while the other three classes were offered by other faculty members from the School of

Education at the University of Kansas. Permission was obtained from the instructors of the other classes to conduct the study. The researcher contacted the instructors who taught these classes asking for permission to gather the data during class time.

During class time, the researcher explained the nature of the study and informed the students in the classes that participating in the study was voluntary and that there would be no consequences for either participating or refusing to participate in the study. The students were also informed that the data collected from them in the study would be kept confidential by the researcher and would not affect their grades.

Description of the Participants

A total of 95 participants took part in this study. Forty-two of the participants were NES, and 53 were NNES mainly from Arabic-speaking countries including Saudi Arabia, Kuwait, United Arab Emirates, Egypt, Iraq, and Libya. Table 2 shows NNES and NES frequencies of nationalities. Twenty-five of the NNES subjects were current students at the Applied English Center (AEC) at the University of Kansas, while 28 were at the academic levels (AL) taking academic classes; five were undergraduate students and 23 were graduate students. Thirty-seven of the NES were undergraduates and five were graduate students; all of them were in the field of Education (Table 3). The majority (40 out of 53) of NNES were male, while the majority (29 out of 42) of the NES were female (Table 4). Nineteen of the NNES were majoring in education, while 34 of them were from non-education fields.

Table 2

Participants' Nationalities

Country	# of Participants	%
Egypt	1	1.1
Iraq	3	3.2
Kuwait	1	1.1
Libya	3	3.2
Saudi Arabia	44	46.3
United Arab of Emirates	1	1.1
USA	42	44.2
Total	95	100

Table 3

Participants' Education Level

Education Level	# of NNES Participants	# of NES Participants
Applied English Center (AEC)	25	0
Bachelor	5	37
Master	6	5
Doctoral	17	0
Total	53	42

Table 4

Participants' Gender

	NNES		NES	
Gender	# of Participants	%	# of Participants	%
Male	40	75.5	13	31
Female	13	24.5	29	69
Total	53	100	42	100

Materials

This section focuses on the process of developing the materials of this study. The design of the study's materials included the hosting website, description of each instructional strategy, selecting and defining the technology integration terms, creating a narration for those terms, choosing the appropriate media (pictures and videos), creating videos, and designing the practice questions for each term.

The Host Website

The three instructional strategies were computer-based and delivered through a host website. They can be accessed from any computer with access to the Internet. Hyper Text Markup Language (HTML) and Cascading Style Sheet (CSS) were used to build and control the appearance and formatting of the webpages. Appropriate font, size, spacing, and color contrast were taken into consideration. Also, the definition of each term either in T, V, or Q was viewed in a pop-up window so that learners did not need to navigate out of the webpage. A web page with a list of 21 terms divided into three columns was created for each of the three presentation modes (A, B, and C). The web pages look exactly the same, but the type of the instruction was counterbalanced across the three presentation modes. The terms in each page were ordered

alphabetically, and when a term was clicked on, a pop-up window appeared showing the definition of that term. Depending on the presentation mode of that term, the definition could be text only (T), text plus video (V), or text plus video plus question (Q). Clicking outside of the pop-up window, which only occupied a part of the screen, would close it. In each presentation mode, participants were exposed to the definition of seven terms in textual format (T), seven terms in text and video format (V), and seven terms in text, video, and practice question format (Q).

Description of the Instructional Strategies (T, V, and Q)

The first instructional strategy (T) provided learners with the definition in on-screen textual format. The definitions were written in English words and were brief but comprehensive. An appropriate font and size were chosen so the letters and words could be easily recognized. The definition of each term was reviewed for content accuracy. The textual definition appeared in a pop-up window in the middle of the webpage when a term was clicked on. The pop-up window has the title of the term listed at the top of it with the definition underneath (Figure 1). Clicking outside of it closed the pop-up window. Providing definition in words (textual format) is a popular format when defining concepts, as it does not require additional effort to prepare as is required with visual aids. According to Monroe and Pendergrass (1997), this method is a common procedure used to teach vocabulary. In this method, the definitions are provided to learners in words and students then memorize them. Some researchers believe that a textual format is ideal, especially when defining abstract words, as it gives accurate meaning better than visuals (O'Bryan, 2005; Paivio, 1990).

The second instructional strategy (V) built on the first strategy and consisted of a combination of on-screen text and an explanatory video that visualized the definition of each

term. The explanatory video had no additional information other than what was in the textual definition; it is a visual representation of the textual format. In this strategy, when a term was clicked on, a pop-up window appeared with textual definition and an explanatory video beneath. The video played in the pop-up window when the term was clicked on that could be paused, and the participants were free to navigate within the recording. Again, clicking outside the pop-up window closed it. According to Mayer (2001), adding redundant on-screen text is based on the information delivery hypothesis that states that delivering instruction with more paths improves learning more than delivering instruction with fewer paths. The more paths used to deliver the instruction, the higher the exposure, which would result in better learning. Also, when more delivery methods are available, learners can choose the one that best fits with their learning styles (p.190). Chun and Plass (1996) state that when learning a language, in addition to providing learners with videos depicting the meaning of the words, the textual definition should be available at all times since videos would not give a clear meaning of the words. Toh et al. (2010) also suggest that when presenting multimedia instruction for second language learners, the idea of using redundant text is optimal and can facilitate learning since it is hard for novice language learners to understand narration without redundant text: "Non-native learners of English have to exert greater cognitive effort to understand the narration, which leads to taking up their mental resources at the expense of the actual task of learning" (p. 995). In addition to using multiple formats of instruction for this strategy, this study gave learners control over the multimedia instruction. In other words, learners might first watch the video and then read the on-screen text or vice versa. They can also pause the video, rewind, and forward it, giving learners control over the learning materials that can eliminate the negative effect of redundancy (Toh et al., 2010).

The third instructional strategy (Q) was similar to the second strategy with the addition of having a practice question. The practice question was a brief multiple-choice question that required learners to select the correct answer. Its aim was to check learners' understanding of the definitions of the terms they were reviewing. The practice question was designed to be brief and to direct the attention of learners to important characteristics of the term to be learned or to give them a general idea about the meaning of the terms. It also gave learners the opportunity to interact with the content and thus become engaged in the learning process.

When a term was clicked on, a pop-up window appeared showing the textual definition and an explanatory video of the term. At the bottom of the screen, there was a short question followed by the answer and two to three distractors. Learners were directed, by an arrow pointing to the question that appeared at the end of the video, to take the quiz after they finished viewing the video (Figure 6). When an answer was selected, whether it was right or wrong, the learners received appropriate feedback. The feedback appeared in the same frame, and if a wrong answer was chosen, the learner could try again, many times, until he or she received the right answer.

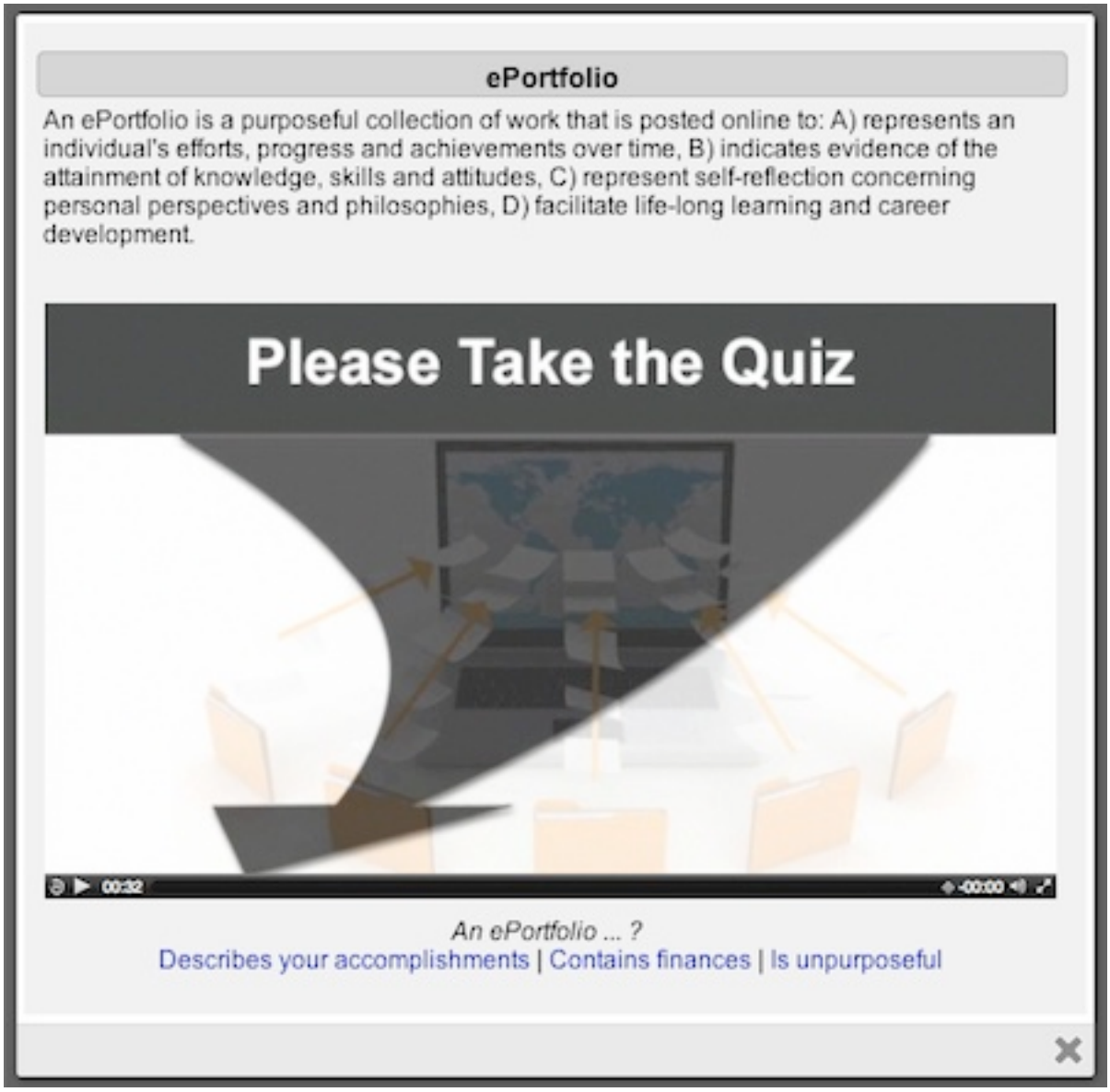


Figure 6. Explanatory video with an arrow pointing to the practice question.

Previous research has shown that explanatory feedback that focuses the attention of learners on the task could enhance learning (Moreno, 2004; Moreno & Mayer, 2005). To facilitate this, the feedback page appeared as a separate page but in the same pop-up window. The feedback page consisted of a picture representing the term being reviewed, a picture representing the right or wrong answer, a sentence showing if the answer was correct or wrong,

and the right definition of the term (Figure 7). If a learner chose a wrong answer, he or she needed to click on “Try again” to go back and choose a new answer. If the learner chose the right answer, he or she received appropriate feedback but could not change the response.

Figure 7. Feedback page

The Selection of Technology Integration Terms

As opposed to covering technical or vendor terms (e.g., algorithm, scanner, projector, bandwidth, Apache, or Blackboard), the terms that were more valuable in this study were those that can help educators understand new strategies for integrating technology into teaching and learning (e.g., webquest, digital storytelling, global classrooms, and ePortfolio).

One goal of this study was to target the terms that could increase teachers' understanding of how technology can be integrated into various activities to support students' learning both inside and outside the classroom. Those terms could put different technologies to use in meaningful ways and help teachers gain insight into effective means of technology integration in education.

A variety of procedures were used to select the technology integration terms used in this study. After reviewing the relevant literature, a list of terms that imply novel ways of teaching and learning with technology was developed. A focus group of students in an educational technology seminar at the University of Kansas reviewed the list of the terms, and more terms were added to the list. A survey that contained 41 terms was developed and sent to experts in the field of educational technology to ask which of these terms were not critical and to request more terms they thought were critical (see Appendix H). Based on the results of this survey, a list of 59 terms was developed with the modifications that these experts made. Afterwards, two faculty members who teach educational technology classes at the University of Kansas reviewed the list of 59 terms to identify the most relevant terms (see Appendix I). Based on their suggestions, some terms were removed from the list. The final list of terms was forwarded to experts in educational technology at different universities in the United States. Experts were asked to rate 38 terms on a scale of 1 (unimportant) to 10 (very important) (see Appendix J) and to add more

terms. A total of 11 educational technology experts rated the 38 terms, and 21 of them were chosen by the researcher to be included in this study. The criteria for choosing the 21 terms to be included in the study were that they have comparable difficulty and also that they reflect how different technology can be utilized in educational practices. Some terms, such as educational games and interactive whiteboard, were identified by the 11 experts as critical, but they were not included in this study since they were self-explanatory.

Definitions

Definitions were selected from relevant resources in educational technology, including websites, articles, and books. Modifications were performed on the definitions to delete irrelevant details or to add important facts missing from the definitions. With many different available definitions for some of the terms, it was important to come up with definitions that could comprehensively clarify the meaning of the terms in a brief manner. After selecting the definitions of each term, and rewriting some of them, technology integration experts made revisions and modifications. The researcher showed the definition of each term to a group of experts, including graduate students in the educational technology program and a faculty member. Accuracy and clarity of the content definition, as well as word choice, were taken into consideration while revising. Modifications were made to some of the definitions and then revised by the group of experts again to ensure that they were accurate.

Audio

After validating the definitions of the terms, they were sent to a native-English speaker who recorded the narration of the terms. Wetzel et al. (1994) pointed out that when narration is added to pictures, it increases and enhances the effectiveness of multimedia instruction and helps learners better retain information. The use of audio in multimedia instruction can serve as a

medium for delivering content and can also add a sense of energy to the instruction, which can attract students' attention and thus promote learning. Wetzel et al. (1994) also stated that the voices of women and children have been found to be more engaging for students.

For this study, a female native English speaker was chosen to record the narration for the technology integration terms. The narrator was considered a professional in this field, since she works as a radio producer and host. A list of 80 terms with their definitions was sent to her, including the target terms in this study. Educational technology graduate students and a faculty member from the educational technology program reviewed the definitions of the terms for content accuracy. The narrator was asked to make the narrations easily understood by adults who were undergraduate and graduate students. The narrator was also instructed to record the definition of each term in separate audio files so there would be 80 audio files, one for each term. The narrator was also told to first read the term, pause, and then read the definition. She was instructed that when points are delineated by A, B, and C, she should not read A, B, and C before each point, but she should pause briefly before delineating the points. After the narrator had finished recording the narrations, a CD with 80 audio files was sent back to the researcher. The narrations were reviewed for content accuracy and found to be accurate and very clear.

The Selection of Visuals

This section will describe the graphic design process for this research study. Explaining technology integration terms is difficult as much of what needs to be understood and explained is conceptual. That is, the terms define concepts rather than physical items. As a result, unlike a word, which defines something concrete and can be illustrated with a single picture, such as a table, chair, or a glass, a single picture will not be sufficient for defining a concept. Terms such

as digital storytelling, webquest, and telementoring have no physical pictures that represent them; that makes visualizing these terms challenging.

Clark and Lyons (2010) stated that there is no formula for choosing appropriate pictures that could promote learning. Instead, the instructional value of an image depends on its relevance to the content and its ability to help learners construct meaning. However, Van Mondfrans and Houser (as cited in Don, 1971) suggested a paradigm for selecting appropriate media when presenting basic concepts. In their paradigm, Van Mondfrans and Houser recommended that concepts should be divided into their defining attributes, and then each attribute can be presented with media such as pictures and videos. Lohr (2003) also developed a model for designing effective instructional visuals. The model consists of three phases that people need to follow: Analyze, Create, and Evaluate (ACE). The Analyze phase requires people to identify the objectives of the instruction, to prepare and organize the information to be easily understood, and to specify what needs to be visualized and what visuals to use. In the Create phase, people convert the organized information into something that can be seen. They select or create visuals for each sub idea, arrange the visuals to convey the instructional message, and observe how visuals are related to other parts of instruction. In the last phase, people review their works and seek feedback from others to see what needs to be modified. Van Mondfrans and Houser's paradigm and Lohr's model were followed to define the technology integration terms using visual instruction.

The definitions of the technology integration terms were carefully reviewed, and the distinctive attributes of each term were identified. The next step was to find images relevant to each attribute and to visually clarify the meaning. Finding appropriate pictures for each attribute required extensive research in various image websites. Most of the pictures and clips were

purchased from istockphoto.com, Shutterstock.com, and photos.com, but some were found on Google image (2012). For example, in defining the term “Global Classroom,” it was thought that the most important attributes would be showing a picture of a globe that has many flags, two classes communicating from a distance, and some communication tools (see Figures 8 – 10).

Figure 8. A picture of a globe with flags introducing the term “Global Classroom”

Figure 9. Two classes communicating from distance (Global classroom, 2011; One laptop per child, n.d)

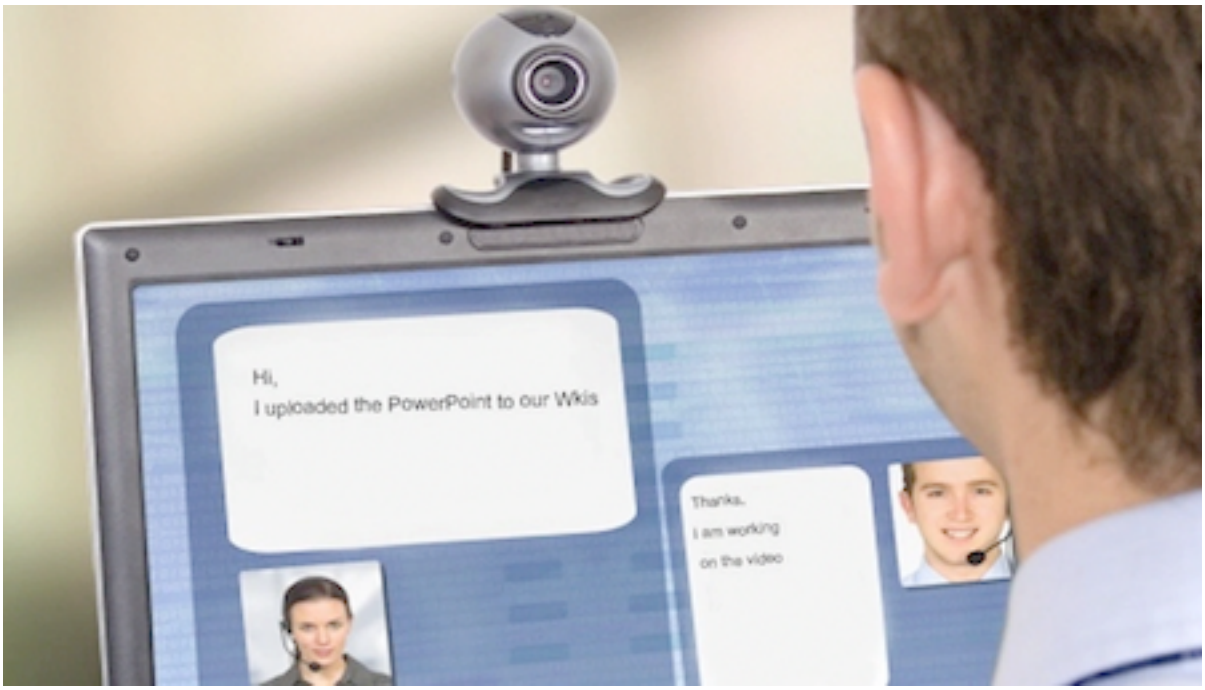


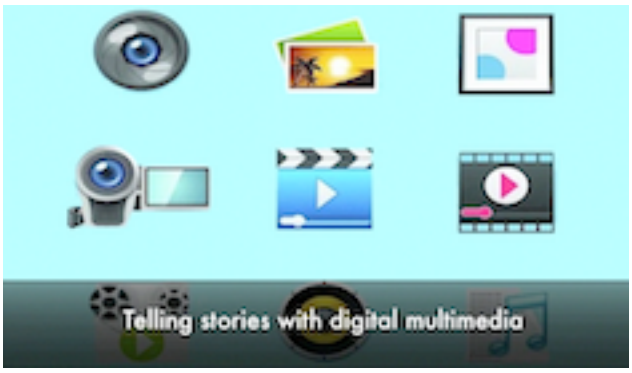
Figure 10. An example of a communication tool

Some of the pictures were edited and altered to provide a more accurate meaning of the attributes they represented. The researcher used photo-editing software to alter the pictures in order to make them fit with the concept they represented and also to give a more accurate meaning. For example, a term such as eImpersonation (online role-playing) is defined as taking on the persona of a famous or well-know person. In order to visualize this idea, a picture that shows a person covering his face with the picture of a famous historical character, such as Abraham Lincoln, was thought of to convey the meaning of eImpersonation (online role-playing). Therefore, manipulating, merging, and editing images were necessary to make the pictures more depictive (see Figure 11).

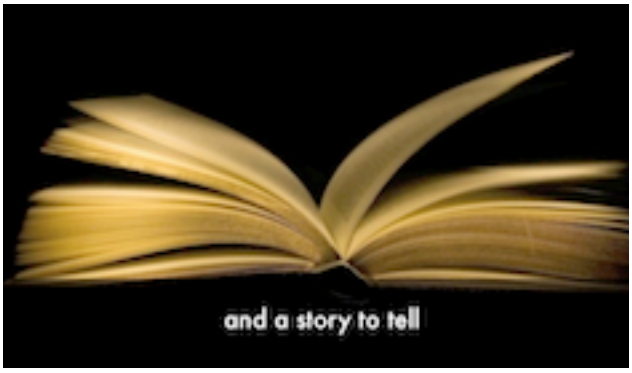
Figure 11. The picture on the left is the original picture, and the one on the right is the manipulated picture.

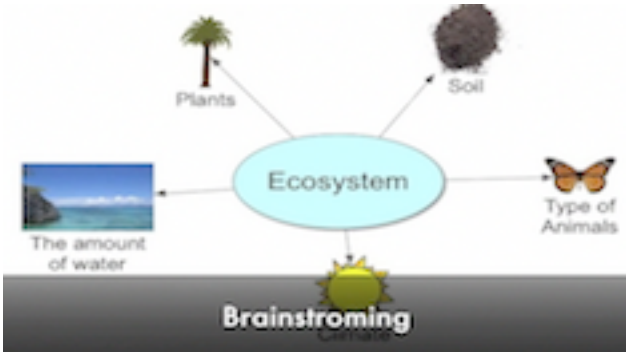
In this design phase, each term was defined using a series of images representing its most important attributes. However, there was no connection between the attributes, and the goal was to help learners make sense of the concept as a whole, not just each single attribute of the term. Therefore, as opposed to looking at each attribute as a separate component, the idea shifted to

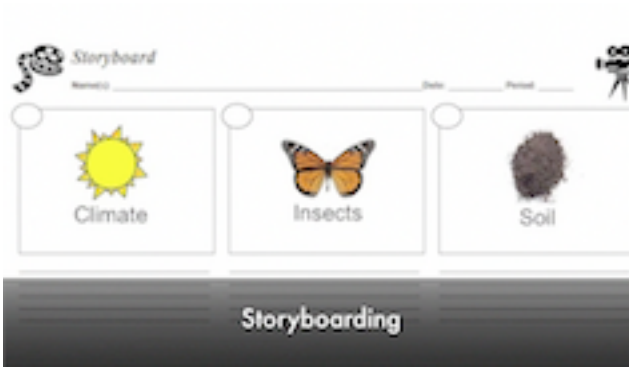
making each attribute serve the whole idea of the concept and bridge the gap between the attributes. That led to the idea of telling a story about each term using pictures and labels. The use of pictures and labels was not only meant to help learners focus on the important elements of each term, but the organization and the sequence of the pictures also can tell a story that expresses the meaning of each term. Learners could rely on the images to infer the meaning of the story, and their inference of the meaning would be confirmed by reading a textual label. In other words, the combination of the pictures and text worked together to help learners create meaning. For example, in explaining the meaning of digital storytelling, the most important attributes were identified as telling the story with multimedia, having a computer, having a story to tell, and listing six key elements of digital story telling: (a) brainstorming, (b) storyboarding, (c) writing scripts, (d) choosing multimedia, (e) editing, and (f) sharing. In visualizing the six key elements, instead of just finding pictures for each element, the researcher tried to help learners make a connection between these elements by choosing a specific topic for example Ecosystem, and then applying the six elements to this topic (Figure 12).


Telling stories with digital multimedia


Have a computer


and a story to tell


Plants
Soil
Ecosystem
Type of Animals
The amount of water
Brainstroming


Storyboard
Climate
Insects
Soil
Storyboarding


Writing scripts

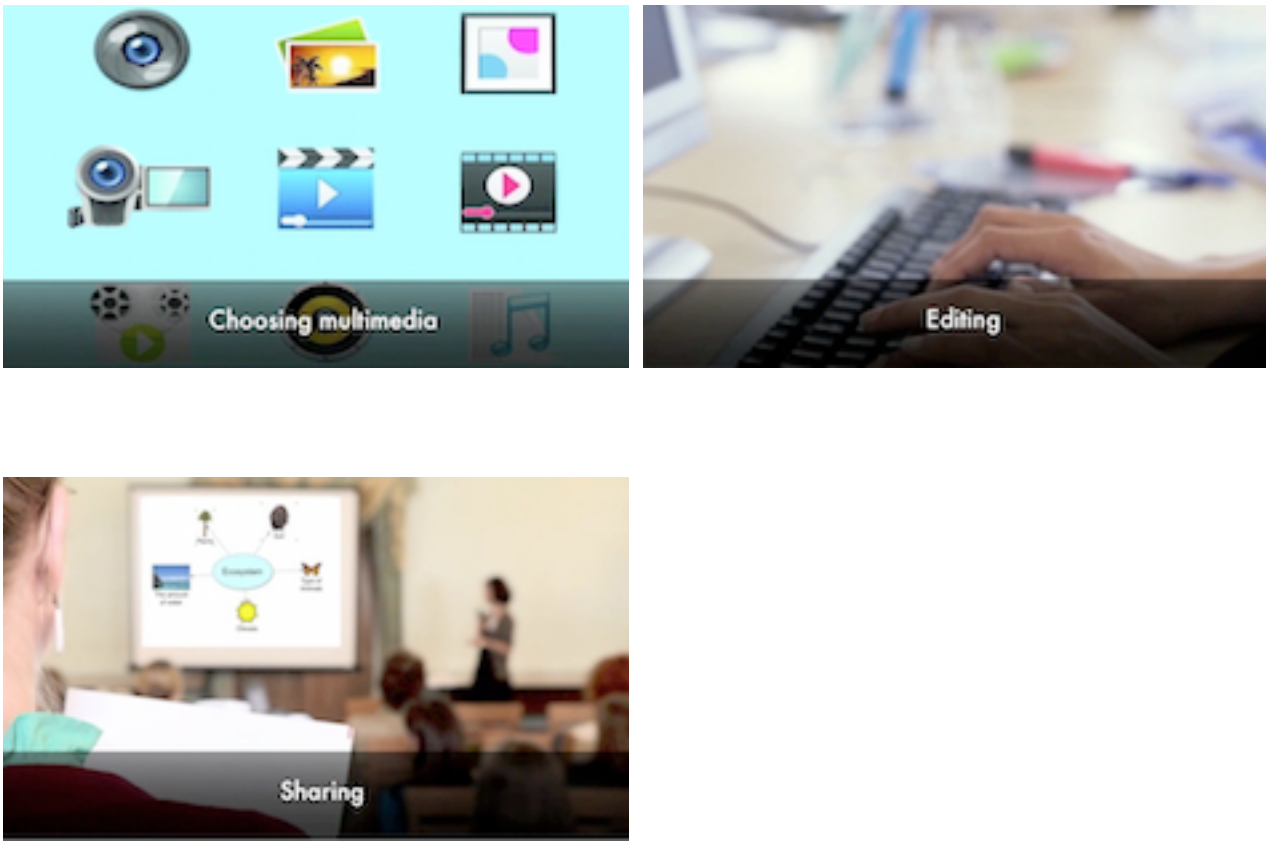


Figure 12. A series of images defining the term "Digital Storytelling"

Many procedures were followed to make sure the pictures adequately illustrated the meaning of each technology integration term. First, during the selection of the pictures for each term, several pictures were selected that were next shown to a group of non-native English speakers to see what pictures could help them understand the meaning of the terms. After selecting the pictures for each term, they were imported into video-editing software, iMovie. A video for each term was created from a series of pictures. The first version of the video was shown to a group of students on a projector in the School of Education to evaluate the appropriateness of the pictures to the terms they were defining. This group of students included NES and NNES and students from the educational technology program and other programs. The group watched the videos for the target terms, and they provided suggestions to improve them.

Based on their suggestions, pictures were replaced or manipulated. Second, a faculty member in the educational technology program at the University of Kansas reviewed each video and also provided suggestions. Third, students in an educational technology class at the University of Kansas were asked to evaluate the effectiveness of the final version of the videos on a Likert scale ranging from 1 to 5 (1 = Very ineffective, 2 = Somewhat ineffective, 3 = Neutral, 4 = Somewhat effective, 5 = Very effective). A webpage that has a list of 23 terms defined with the textual and explanatory video was created, and a survey with a link to that page was sent to the students with the instructor's permission. Three students participated in that survey, and 22 of the terms had effectiveness means over 3. Only the term "Cyberhunt" had a mean of 1.67, and this term was removed from the final list used in the study as was the term "educational games," as it appeared to be self-explanatory. Appendix L presents the results of the survey. Finally, an expert who teaches educational technology classes at the University of Kansas was consulted to evaluate if the pictures conveyed the meaning of the attributes for each term. Based on his comments, changes and adjustments were made.

The four steps that were followed to visualize the technology integration terms can be summarized as follows:

1. Analyzing: Understanding the main points of the terms' definitions in order to visualize these points and therefore develop a clear meaning of these terms.
2. Visuals Selection: Selecting relevant pictures that would work best with the main points of the definitions and help learners construct meaning.
3. Feedback: Extensive review of the visualized materials by subject domain experts and a sample of learners for whom the materials were designed.

4. Modification: Based on the feedback received from the experts and the sample of learners, modifications were made. The modified materials were reviewed again.

Video Creation

For this study, a video for each term was created using video editing application iMovie; each video consisted of pictures, but some videos had clips in addition to the still pictures representing the defining attributes of the term along with a caption and narration. The images and clips for each term were organized and sequenced in a way that could help learners make a connection between the attributes and thus infer the right meaning. The design of the videos was based on the contiguity principle that states people learn better when the word and the picture are presented at the same time, and learners engage in active learning when the narration is aligned with them (Mayer & Anderson, 1992). The aspect ratio for all the videos was set to be medium, and the size of all images were adjusted to fit with the ratio. The duration of each picture was also adjusted so viewers could have enough time to see the picture and read the label. The length of each video was less than a minute, ranging from 24 to 43 seconds.

Data Collection

A comprehension test and questionnaire were used for data collection. The comprehension test consisted of 21 questions measuring students' understanding of 21 terms related to technology integration. The questionnaire consisted of three major parts: demographic information, attitudes toward technology integration, and self-evaluation of technology experience.

The Comprehension Test

Mayer (2005b) stated that multimedia instruction could result in two kinds of learning: remembering and understanding. Remembering is the ability to recognize and recall the

presented material, while understanding is the ability to apply what has been learned in another situation. Mayer believed that the process of transferring knowledge to a new context requires high-quality learning. In learning words, Read (2000) drew attention to the distinction between a receptive word and a productive word. He pointed out that people could recognize and comprehend words more than they use; therefore, it is important to distinguish between comprehension and the use of a word. Read (2000) noted, "Comprehension means that learners can understand a word when they encounter it in context or while listening and reading, while use means that the word occurs in their own speech or writing" (p. 156). Therefore, an assessment should consider whether the words are receptive or productive.

The goal of the comprehension test for this study was to assess subjects' understanding of critical terms related to technology integration in education. The researcher wrote short scenarios that embodied technology-based learning activities that corresponded to each of the terms being presented by the multimedia instructional strategies. According to Clark and Lyons (2010), short scenarios could be one of the most effective ways to best represent abstract concepts. Although writing scenario-based questions is time consuming and requires careful attention to design, it is structured and could measure high-level understanding that goes beyond simple recognition of content (Schreyer Institute for Teaching Excellence, n.d). When learners' knowledge of a concept is being measured using a scenario-based question, they need to have deep understanding of the concepts being studied and be able to recall the most important facts and features of the concept.

The comprehension test was a multiple-choice test consisting of 21 items covering 21 terms. Each item was a brief scenario about an activity that integrates technology and reflects the meaning of a technology integration term included in the study. The scenario had several

distinctive attributes of that term. Each scenario was a story about a teacher or a trainer who integrates technology in daily teaching or in training activities; the answer was a term among the 21 terms included in the study. The researcher made sure that there were no words in the scenarios themselves that were associated to the terms of interest. In other words, the target technology integration terms were not included in the scenarios. This eliminated the possibility that learners might determine the right answer due to word association. Test takers needed to choose the right terms that described the scenario.

The test takers needed to know what the term was that best described a specific scenario. Each item was followed by four options. The options were technology integration terms that imply new ways of teaching and learning with technology. One of the options was the correct answer, and the others were distractors. The researcher made sure there was only one correct answer among the options for each item, and the location of the correct answers was different among the 21 questions of the comprehension test. The distractors were made plausible as the correct answer (Haladyna, Downing, & Rodriguez, 2002). The participants were required to choose the term that best described the activity. For each correct answer, participants received one point and zero points for any incorrect answer. The multiple choice format is considered one of the most widely used methods for measuring vocabulary knowledge and all aspects of language proficiency for both native speakers and second language learners (Read, 2000, p. 78). The following is an example:

> Sara is teaching social studies at a secondary school in Austin, Texas. As part of a unit on immigration, Sara decided to pair her students with students from classes in Australia and England. These students worked together in groups using both synchronous and

asynchronous technologies in order to understand better the immigration policies, cultures, and customs in their respective countries.

This can best be described as ____.

□ a webquest □ a global classroom □ telementoring □ an eAppearance

Two versions of the comprehension test were created: one in English and the other one in Arabic. The English version was administered to NES, and the Arabic version was administered to the NNES for whom Arabic is their native language. Participants were given the comprehension test in their native language so they could fully understand the content of the test. This also would require less time, for when participants read the questions in their native language, they could invest extra time thinking about the content instead of thinking about the meaning of unknown words in each question.

Questionnaire

The questionnaire includes three major parts: demographic information, attitudes toward technology integration, and the level of technology experience.

The goal of the demographic information survey was to elicit information about participants, such as major, gender, their native language, their academic status (undergraduate or graduate), and their level of proficiency in reading and listening in English. These two skills were included in the demographic information as they were critical to the instructional interventions. Participants needed to evaluate themselves on these two skills (listening and reading) on a Likert scale, ranging from 1 to 5 (1= Poor, 2 = Passing, 3 = Average, 4 = Good, 5 = Excellent). The second part of the survey gathered information about students' attitudes toward technology integration. The goal of this part was to gather information about what subjects

thought was the most important aspect in teaching. Subjects rated statements regarding the importance of content, technology, technology integration, and collaboration with other educators in their profession on a scale of 1-5, with 1 being unimportant and 5 being very important.

The last part of the survey was about participants' technology experience. The goal of this part was to gather information about participants' expertise with some computer programs and multimedia skills that are important for all educators in developing multimedia instructional materials. The survey consisted of 15 multimedia tools and programs: web search engines, web design, graphic editing, word processing, presentation, animation, video editing, audio editing, collaboration, survey, teleconferencing, social networks, email programs, synchronous discussion, and community publishing. These tools have been identified as essential by educational technologists and technology professionals (Martin & Winzeler, 2008). Subjects were required to rate their experience with each technology tool and program on a scale of 1-5, with 1 representing no experience and 5 representing extensive experience.

Translation from English to Arabic

An Arabic version of the comprehension test was developed to make sure that the Arab participants were able to understand its items. The participants had varying degrees of English proficiency, since some of them were students in the Applied English Center and some others were taking academic classes at the University of Kansas. Translating the instruments into Arabic reduced the effect of the varying English proficiency among Arabic participants. Since understanding the comprehension questions is critical to the study, many procedures were implemented to make sure the translation was accurate including extensive revisions of the translated text and back-translation procedure. Su and Parham (2002) state that "The cross-

cultural research literature indicate that generating a valid translation of an instrument is not a simple matter of directly translating from one language to another" (pp. 581-582). One of the procedures used to generate a valid instrument is the back-translation procedure. This procedure requires that a bilingual translator translate the source version of the instrument to the target language, followed by another bilingual translator who translates the translated version back to the source language without seeing the original version. After that, the source version and the back-translated version are checked to see if the back translation maintains the same meaning as in the source version.

The comprehension test was first translated into Arabic by the researcher. Some items in the comprehension test had words that were not translatable because there are no equivalent words for them in Arabic. In these cases, the meanings of these words were translated into Arabic instead of the literal words, as suggested by Sechrest et al. (1972). These translations were sent to a doctoral student at the University of Kansas who is an expert in both languages (Arabic/English). That student was asked to compare the Arabic text of the comprehension test with the English text to make sure the Arabic version conveyed the meaning of the English version. He also was asked to check for word choice and clarity, in particular because some words in the English version have no equivalent in Arabic. The Arabic text was refined and terminology was replaced, if necessary. Afterwards, a doctoral student majoring in educational technology who was competent in both English and Arabic languages proofread the revised Arabic translation of the comprehension test to be certain that the translated content still retained its accuracy and would measure participants' understanding of the terms being tested appropriately.

The translated Arabic text was then given to a doctoral student majoring in linguistics to translate the Arabic edition back to English. The translator did not have access to the source version. After the Arabic edition was translated back to English, a table that contained the original English edition and the back-translated edition was sent to a native English speaker who is a doctoral student in the educational technology program. The reviewer was asked to compare the two editions to see if there was a significant difference between them. The reviewer was asked to evaluate the similarity of each item in the two editions of the comprehension test on a scale of 1 to 10, with 1 being very different and 10 being very similar. There was no significant difference between the two versions.

Validity

When a test is claimed to be valid, it measures what it is supposed to measure or it predicts what it is supposed to predict (McIntire & Miller, 2006). Many procedures were put in place to ensure the test validity. The comprehension test consists of 21 scenario-based questions representing 21 terms, or a scenario for each term. Before writing the scenario-based questions, the definition of each term was carefully reviewed, and then a scenario for each term was developed. Each scenario was based on the important attributes of each term. After creating the scenarios to be very specific to the terms and clarifying what each term was, the next step was to make the distractors more plausible so that the test-taker would have to know the accurate meaning in order to be able to distinguish the right answer. Having distractors that are too different can help test-takers to deduct the correct answer by eliminating the incorrect answers (Haladyna et al., 2002).

To make sure the test was valid and could assess accurately the knowledge of the technology integration terms, a focus group of students (Masters and Ph.D.) from the educational

technology program at the University of Kansas reviewed the test items. Based on their suggestions, modifications were made to increase the accuracy of the test items. Next, two doctoral students majoring in educational technology reviewed the second edition of the questions. Finally, the comprehension test was sent to two educational technology instructors at the University of Kansas to review the final edition before applying the study. The test was applied after many reviews and after the reviewers agreed that the test seemed well designed and would work reliably to measure the knowledge of the target terms.

Correlation coefficients were conducted among the three groups of scores representing the instructional strategy types. A *p* value of less than .05 was required for significance. The results of the correlational analyses presented in Table 5 show that the correlations between the three types of instruction were statistically significant. In other words, participants, whether they were native or non-native English speakers, scored high in the text-only format but scored higher in the text and video format, and text, video, and a practice question format. The fact that there is a strong significant correlation between the scores on T, V, and Q parts of the test confirms that they all test the same construct (knowledge of technology terms). That is an expected finding.

Table 5

Correlations among the Comprehension Scores that Represent the Three Instructional Strategies T, V, and Q

			T	V	Q
NNES	T	Pearson Correlation		.53*	.63
		Sig. (2-tailed)		.000	.000
		N		53	53
	V	Pearson Correlation	.53		.32
		Sig. (2-tailed)	.000		.02
		N	53		53
NES	T	Pearson Correlation		.61	.70
		Sig. (2-tailed)		.000	.000
		N		42	42
	V	Pearson Correlation	.61		.73
		Sig. (2-tailed)	.000		.000
		N	42		42

The technology expertise survey was created based on the results of the study conducted by Martin and Winzeler (2008) who surveyed 28 educational technologists and technology professionals to identify the most important multimedia knowledge, skills and tools that educational technology students should have. The result of the multimedia tools survey showed that 18 multimedia tools were reported as important. In this study, the most important 13 items were chosen from that survey, and two items, social networks and community publishing, were

added based on the suggestion of educational technologists consulted at the University of Kansas.

A relationship was found between the terms identified as critical to technology integration and the technology skills used in the technology experience survey. The terms that were rated as critical in technology integration utilized all of the technology skills that were rated as important skills for technology integration. For example, a term such as digital storytelling requires teachers to be aware of the video, audio, and graphic editing tools and their capabilities of producing digital stories.

Reliability

Reliability is considered an important attribute of a measurement instrument. Reliable measurement gives trustworthy data. McIntire and Miller (2006) stated, "A reliable test is one we can trust to measure each person in approximately the same way every time it is used" (p. 181). When a measurement instrument is not carefully designed and has vague or poorly written questions, the reliability of the test is decreased, and thus the data that is derived from the measurement instrument is not trustworthy (McIntire & Miller, 2006). One of the methods of estimating the reliability of a test is the coefficient alpha that calculates the internal consistency of a homogeneous test. It describes the degree to which the items of a test or subscales are interrelated. Researchers do not have a fixed value to consider a test reliable, but most agree that a coefficient alpha of .70 is acceptable to consider a test internally consistent (McIntire & Miller, 2006).

For this study, Cronbach's coefficient alpha was computed during pilot testing to estimate the reliabilities of the English version of the comprehension test and of the technology

experience survey. With one item deleted, item 20, the comprehension exam shows a Cronbach alpha of .90, while the technology experience survey had a Cronbach alpha of .92.

Pilot Study

Two pilot studies were conducted to validate the data collection instrument, and also to gain insight into how to apply the study.

In the first pilot study, thirteen graduate students taking a seminar class in educational technology were asked to participate. Four of the participants were NES and nine were NNES. The researcher showed the participants a list of 21 terms related to technology integration in education on a projector and clicked on each term to show its definition. The 21 terms were defined by three instructional strategies, seven terms for each strategy. After the researcher showed the participants all the definitions, they took a comprehension test consisting of 21 multiple-choice items. The goal of this pilot study was to make sure that the comprehension test was well written and that each scenario described the right term and had only one answer. Some of the participants in the seminar were students in the educational technology graduate program. Those students reviewed the items of the comprehension test carefully and provided feedback. The data obtained from this pilot study was coded into SPSS 20 to calculate Cronbach's alpha to examine the internal consistency of the items. With one item deleted, item 20, Cronbach's alpha for the comprehension test was .90. The researcher edited the item that was confusing to the participants in the pilot study.

The second pilot study was conducted to practice the administration of the study, to ensure that the instruction would be understood, the website and video would work properly, and also to gain insight into the appropriate time that NNES would need to finish studying the 21 terms. The participants of this pilot study were six NNES: two participants were from Saudi

Arabia, two from Turkey, one from China, and one from Korea. As the participants entered the computer lab, they picked a number from a bowl that corresponded to the computer they would use. Envelopes with the comprehension test and questionnaire that includes demographic information, attitudes toward technology integration, and technology experience were placed next to the computers and labeled with the computer's number.

Before participants started studying the terms, the researcher showed them how to view the terms using the term "Virtual Field Trip" as an example, which was not one of the terms included in the conditions. Participants were instructed to view the list of terms online and click on each term to learn its meaning. Once a term was clicked on, a pop-up window appeared with the definition based on the presentation mode the participants were assigned to. Participants were able to close the pop-up window by clicking outside of the window. Participants were informed that they had 20 minutes to finish reviewing the terms and they could view each term as many times as they wanted. A timer was set, and participants were asked to start at the same time. When the 20 minutes were over, the participants were asked to close the browser window and to open the folder placed next to the computer. After the participants were done answering the questions, they confirmed that 20 minutes was the ideal time to finish studying the 21 terms.

Consent to Conduct the Study

A request to conduct this study was sent to the Human Subject Committee in Lawrence (HSCL), and approval was granted.

Procedures

Evaluation of the instructional strategies conditions took place in two computer labs at the University of Kansas. The first lab was the School of Education Computer Lab with 40 computer tables placed in four rows, with 10 computers in each row. The computers were current

generation iMac with 17” screens with headphones attached and the volume and sound level adjusted. The second computer lab where this study was conducted was the Budig Hall Computer Lab. It also had iMac with 17” screens with headphones attached and volume level adjusted before conducting the study. The collection of data happened in many sessions in the two labs. However, the participants were told not to share the content of the study with others. The procedures that the researcher followed were the same, with the exception of location. The web page for the treatment condition included 21 terms related to the integration of educational technology (see Figure 13).

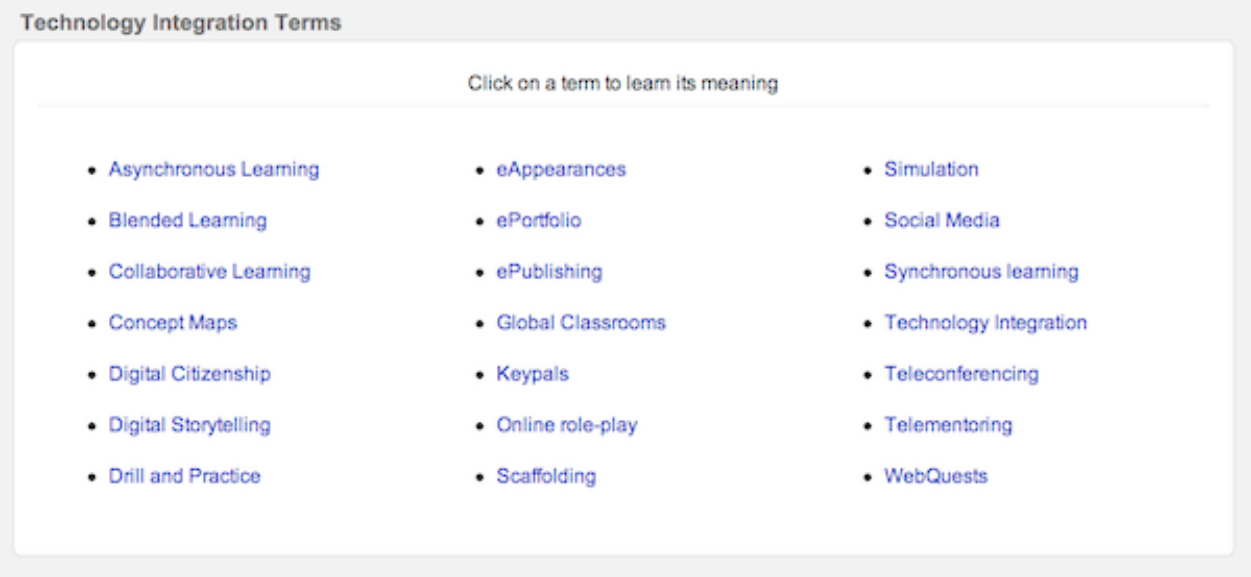


Figure 13. A webpage representing one of the three presentation modes A, B, and C.

Prior to the intervention, the web page with the 21 items was preloaded into the Safari browser on the computer labs. Each row in the computer lab was set to one of the three presentation modes, A, B, and C; the first row for the presentation mode A, the second row for B, and the third row for C. In each of the three presentation modes, the terms were rendered in each of the three formats of instruction, T, V, and Q, and counterbalanced across the three treatment modes (Figures 1-3 show examples of the three formats of instruction). A headset was

attached to each computer with the volume level adjusted not to be either too high or low. The researcher also made sure that the webpage on each computer was rendering properly. An envelope with an information statement about the study, the comprehension test and questionnaires that included demographic information, attitudes toward technology integration, and technology experience was placed next to each computer and labeled with the computer's number and the presentation mode.

Once all participants were seated, the researcher explained the nature of the study and the time expected to finish it. The researcher also told participants that participation in the study was voluntary and data would be kept confidential. Next, the researcher demonstrated how to access the term "Virtual Field Trip" that appeared the same as the conditions but was not one of the terms included in the study. Participants were instructed to view a list of terms online and click on each term to learn its meaning. Once a term was clicked on, a pop-up window appeared with the definition based on the presentation mode the participants were assigned to. Participants were able to close the pop-up window by clicking outside of the window. Participants were informed that they had 20 minutes to finish reviewing the terms, and they could view each term as many as they want, and they needed to spend the entire 20 minutes studying the terms. They were also asked not to go to any other webpages on the Internet. A timer was set, and participants were asked to start at the same time. When the 20 minutes were over, participants were asked to close the browser window and to open the envelope placed next to the computer. They were instructed to read the information statement and next to take the comprehension test and complete the questionnaires, and when they were done, put them back in the envelope. The same procedures were followed for all the data collection sessions.

Data Analysis

Separate data analysis was conducted for the NNES and NES. These two groups of participants represented different populations; therefore, it was not optimal to combine them in one group. Combining these groups would take advantage of inherent language proficiency differences and produce significant results not due to this study. It was assumed that both groups would not benefit equally from three instructional strategies as they have different levels of English proficiency. The NES group is considered experienced with the language more than the NNES, so they were analyzed separately to see what format of instruction works best for each group. An evaluation of the descriptive statistics, one-way repeated measures ANOVA, and Pearson correlation coefficient were used to address the research questions for this study. Statistical Package for Social Science (SPSS), version 20, was used to analyze the data.

Research Questions

RQ1: What are the key technology integration terms that imply new ways of teaching and learning with technology that education students should understand?

RQ2: What multimedia instructional strategy (Text alone, Text plus Video, Text plus Video plus Question) is the most effective for learning specialized terms related to technology integration in education by native-English speakers and non-native English speakers?

RQ3: Is there a relationship between participants' English language proficiency and their comprehension of technology integration terms?

RQ4: Is there a relationship between participants' technology expertise and their comprehension of technology integration terms?

This study required the alpha level at .05 for all the analysis and a *p* value of less than .05 in order to conclude that the result is significant. For question 1, descriptive statistics were used to evaluate the importance of a list of technology integration terms. For question 2, a one-way repeated measure, ANOVA, was the statistical procedure used to determine what instructional strategy among the three (T, V, Q) was the most effective in aiding the target participants' understanding of critical terms related to technology integration in education.

For question 3, correlation analysis was also used to evaluate the relationship between participants' language proficiency level and their score on the comprehension test. For question 4, correlation analysis was conducted to examine the relationship between subjects' technology expertise and their performance on the comprehension test of technology integration terms

CHAPTER FOUR

Results

Introduction

In this chapter, the results of the data analysis for each research question are presented. This study aimed to identify critical terms related to technology integration in education that imply new ways of teaching and learning with technology and to compare the effectiveness of three online instructional strategies: textual definition only (T); the combination of textual definition and instructional/explanatory video (V), and; the combination of textual definition, instructional/explanatory video, and a practice question (Q) in aiding target participants (NES and NNES) in learning critical terms of technology integration in education. In addition, this study explored if the level of English language proficiency and prior experiences of technology were correlated to the students' performance on the comprehensive test of critical technology integration terms. The purpose of this chapter is to report a description of the participants of this study and to address each research question and report findings from the data analyses.

Description of the Participants

The sample for the study consisted of 95 participants; 42 of them were Native-English Speakers (NES) and 53 were Non-Native English Speakers (NNES). Participants were asked to rate the least and most important task in their profession on a Likert scale, ranging from 1 to 5 (1 = Unimportant; 2 = Slightly Important; 3 = Neutral; 4 = Important; 5 = Very Important). Table 6 shows that all these items were reported as important with means exceeding 4, important. Participants reported that understanding content is the most important thing people should be able to do (M = 4.79); collaboration with others to support professional growth was the next most important task (M = 4.34). The participants rated assessment as the third most important task (M

= 4.16), then making effective presentation (*M*=4.03), and finally the integration of technology (*M* = 4.2).

Table 6

The Least and Most Important Task in Profession as Reported by Participants

	Overall mean as reported by NNES and NES		NNES		NES	
	M	*SD*	*M*	*SD*	*M*	*SD*
1. Understanding my content.	4.79	.46	4.75	.48	4.83	.44
2. Making effective presentation.	4.03	1.00	3.72	1.08	4.43	.74
3. Assessing students appropriately.	4.16	1.06	3.68	1.09	4.76	.62
4. Integrating technology effectively.	4.02	.92	4.15	.84	3.86	1.00
5. Collaborating with others to support my professional growth	4.34	.81	4.17	.87	4.54	.67

English Language Proficiency as Reported by Participants

The level of English language proficiency of participants was obtained using self-evaluation. Participants were asked to rate their reading and listening abilities on a 5- point Likert scale, ranging from 1 to 5 (1= Poor, 2= Passing, 3= Average, 4= Good, 5= Excellent). These two skills were targeted since they are related to the instructional strategies where reading and listening are important elements. For example, the first instructional strategy text only (T) has on-screen textual definition of each technology integration term and participants are required to read these definitions. The second strategy has a combination of text and video (V) that requires participants to read and also to listen to the video narration. Reading and listening skills are also required in the third strategy that has a combination of text, video, and a practice question (Q).

Regarding the reading ability, 5.7% of the NNES rated their reading ability as excellent, 41.5% as good, 28.3% as average, and 24.5% as passing, while no participant rated his or her reading ability as poor. Of the NNES subjects, 47.2% were current students at the Applied English Center (AEC). Of these students, 44% rated their reading ability as passing, 28% as average and 28% as good. The reading mean for the AEC students was 2.84. NNES who were at the academic level (AL) had a reading mean of 3.68, and 53.7% of them rated their reading ability as good, 28.6% as average, 10.7% as excellent, and 7.1% as passing. On the other hand, NES rated their reading ability as the following: 14.3% as very good and 85.7% as excellent (Table 7).

NNES rated their listening ability in English as follows: 22.6% rated their listening ability as excellent, 37.7% as good, 30.2% as average, and 9.4% as passing, while no participant reported poor listening ability. However, NNES who were at the academic level had a listening mean of 4.00 while those who were current students at AEC had mean in the listening skill of 3.44. The majority of NES rated their listening ability as excellent at 90.5% versus 9.5% who rated themselves as very good (Table 8).

The overall language proficiency was calculated as the mean of the listening and reading ability. NNES had a mean of 3.51. Those who were at the AL had English proficiency of 3.84, and those who were still at the AEC had a mean of 3.14. NES had a mean of English proficiency of 4.88. Figure 14 shows the mean for the language proficiency of NNES including those at the AEC and those at the AL, as well as NES.

An independent sample t-test was conducted to compare the language proficiency for AEC participants and those who were at the AL. There was a significant difference in the English proficiency mean for participants at AL (M = 3.84, SD = .72) and those at the AEC (M =

3.14, *SD* = .78); *t* (51) = 3.83, *p* = .001. Another independent sample t-test was conducted to compare the language proficiency for NES and NNES. There was a significant difference in the English proficiency mean for NES (*M* =4.88, *SD* = .22) and NNES (*M* = 3.51, *SD*= .82); *t* (93) = 10.50, *p* < .001.

Table 7

English Reading Ability as Reported by Participants

	NNES		NES	
Reading Ability	Frequency	%	Frequency	%
Poor	0	0.0	0	0
Passing	13	24.5	0	0
Average	15	28.3	0	0
Good	22	41.5	6	14.3
Excellent	3	5.7	36	85.7
Total	**53**	**100**	**42**	**100**

Table 8

English Listening Ability as Reported by Participants

	NNES		NES	
Listening Ability	Frequency	%	Frequency	%
Poor	0	0.0	0	0
Passing	5	9.4	0	0
Average	16	30.2	0	0
Good	20	37.7	4	9.5
Excellent	12	22.6	38	90.5
Total	**53**	**100**	**42**	**100**

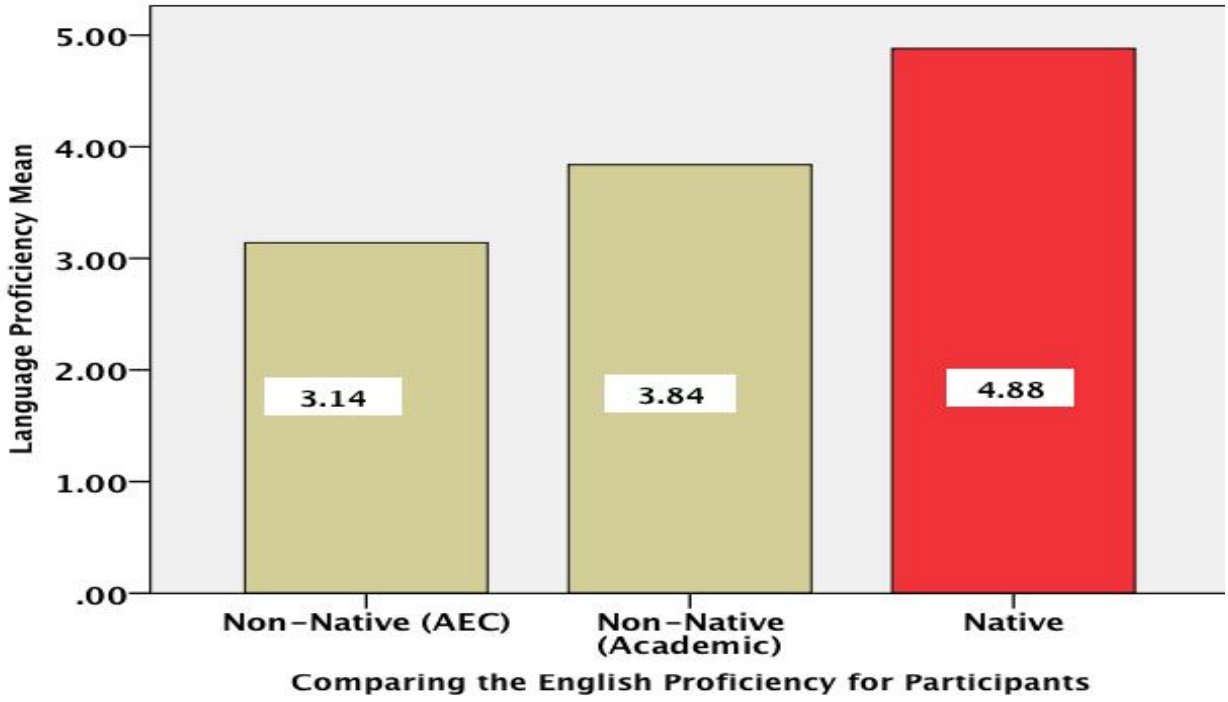


Figure 14. English proficiency as reported by native and non-native English speakers

Technology Experience

Participants were asked to rate their experience with important educational technology tools on a Likert scale, ranging from 1 to 5 (1= No experience, 2= Poor, 3= Average, 4= Good, 5= Very good). These educational technology tools are commonly used in activities that integrate technology in the classroom. Five educational technology tools were identified by participants as the most well known tools ($M > 4.0$). Search engine was the best-known tool that participants reported ($M = 4.60$, $SD = .68$); the second tool was email programs ($M = 4.50$, $SD = .86$). The third tool was Word processing program ($M = 4.31$, $SD = .87$). The fourth tool was social networks (M=4.18, SD=1.04). The fifth tool was presentation program ($M = 4.02$, $SD = 1.08$). However, participants reported less experience with animation, web design, audio, video, and survey programs. Table 9 illustrates the experience of native and non-native English speakers with each educational technology tool.

An independent sample *t*-test was conducted to examine if there was a significant difference between native English speakers (NES) and non-native English speakers (NNES) in technology expertise. The results showed that there was no statistically significant difference in the level of technology expertise between the two groups, with $t(92) = .48$, $p = .63$.

Table 9

Technology Experience as Reported by Participants

	Overall mean as reported by NNES and NES		NNES		NNES	
	M	*SD*	*M*	*SD*	*M*	*SD*
Educational Technology Tools						
1. Search engines (i.e., Google, Yahoo)	4.60	.68	4.50	.75	4.71	.55
2. Web design (i.e., HTML, Dreamweaver)	2.03	1.13	1.98	1.20	2.10	1.05
3. Graphics editing (i.e., Photoshop)	2.54	1.24	2.60	1.19	2.48	1.31
4. Word processing (i.e., MS Word)	4.31	.87	4.08	.97	4.60	.63
5. Presentation programs (i.e., PowerPoint)	4.02	1.08	3.90	1.12	4.17	1.01
6. Animation (i.e., Flash)	1.82	.98	2.04	1.07	1.55	.80
7. Video editing (i.e., iMovie, Final Cut)	2.10	1.22	2.31	1.29	1.83	1.08
8. Audio editing (i.e., Audacity)	1.87	1.18	2.08	1.34	1.62	.91
9. Collaboration tools (i.e., Wiki, Google Doc)	2.59	1.30	2.54	1.36	2.64	1.23
10. Survey (i.e., Survey Monkey, Qualtrics)	2.20	1.40	1.90	1.30	2.57	1.43
11. Teleconferencing (i.e., Skype, iChat)	3.10	1.41	3.08	1.41	3.12	1.43
12. Social networks (i.e., Facebook)	4.18	1.04	3.98	1.18	4.43	.77
13. Email programs (i.e., Gmail, Yahoo)	4.50	.86	4.42	1.00	4.60	.66
14. Asynchronous discussion (i.e., Discussion Boards)	3.32	1.39	3.06	1.53	3.64	1.12
15. ePublishing (i.e., Flicker, YouTube)	3.73	1.13	4.02	1.08	3.38	1.10

1 = no experience, 2 = poor, 3 = average, 4 = good, 5 = very good

Research Findings

This section reports the findings of each of the following research questions

Research Questions

RQ1: What are the key technology integration terms that imply new ways of teaching and learning with technology that education students should understand?

RQ2: What instructional strategy (Text alone, Text plus Video, Text plus Video plus Question) is the most effective for learning specialized terms related to technology integration in education by native-English speakers and non-native English speakers?

RQ3: Is there a relationship between participants' English language proficiency and their comprehension of technology integration terms?

RQ4: Is there a relationship between participants' technology expertise and their comprehension of technology integration terms?

Research Question One

The first question aims to identify critical terms that imply new ways of teaching and learning with technology that teacher education students need to know. Eleven educational technologists were asked to rate the importance of a list of 38 terms that were identified initially as relevant to the technology integration by experts, on a scale ranging from 1 (unimportant) to 10 (very important). The terms that received high scores indicated high importance; those that received a lower score indicated lower importance. The means of importance scores for 38 terms were calculated. Table 9 reports the mean for each term. All the 38 terms were identified as important ($M > 5.0$); however only 5 terms had means less than 6.0. These 5 terms are

Brainstorming, eImpersonation (Online Role-Play), Reusable Knowledge, Digital Immigrants, and Digital Natives.

Table 10

List of Critical Technology Integration Terms as Identified by Experts

Technology Integration Terms	***M***	**Technology Integration Terms**	***M***
Educational Technology	9.7	Electronic Whiteboard	7.7
Synchronous Learning	9.5	Constructivism	7.6
Social Media	9.3	Telementoring	7.5
Asynchronous Learning	9.2	eBook	7.4
ePortfolio	9.0	WebQuest	7.4
Wiki	8.9	Concept mapping	7.3
Teleconferencing	8.8	Global Classrooms	7.2
Learning Management System (LMS)	8.7	eLearning	7.1
Podcasting	8.7	Drill and Practice	6.8
Blended Learning	8.5	Educational Gaming	6.5
Simulation	8.4	Tutorial	6.5
Collaborative eLearning	8.2	Hypermedia	6.3
Digital Divide	8.2	Keypals	6.2
Mobile Learning	8.2	eAppearances	6.1
Digital Citizenship	8.1	Brainstorming	5.8
Students Response System	8.1	eImpersonations (Online Role-Play)	5.8
Universal Design for Learning	7.9	Reusable Knowledge	5.8
Digital Storytelling	7.8	Digital Immigrants	5.5
Data Driven Decision Making	7.7	Digital Natives	5.1

Research Question Two

The second research question was "What instructional strategy (Text alone, Text plus Video, Text plus Video plus Question) is the most effective for learning specialized terms related to technology integration in education by native-English speakers and non-native English speakers?." The comprehension test consisted of 21 multiple-choice questions in which the participants were asked to choose the correct answer for each question. One point was awarded for the correct answer and zero for the wrong answer. The total possible score was 21: seven points represent the performance under the text only strategy (T), seven points represent the performance under the combination of text and video (V), and seven points represent the performance under the combination of text, video, and practice question (Q).

A one-way repeated measures ANOVA was performed to evaluate which instructional strategy was the most effective in aiding NNES in learning critical terms related to technology integration. The independent variable was the type of the instructional strategy (T, V, Q), and the dependent variable was the score on a comprehension test on terms related to technology integration in education. The means and standard deviations for the scores that represent the performance under three instructional strategies are presented in Table 11. The results for the ANOVA indicate a significant difference of NNES scores on the comprehension test under all three instructional strategies, F (2,51) = 6.41, $p < .01$, multivariate $\eta^2 = .20$. Pairwise contrasts found that the instructional strategy that has the combination of text and video (V) ($M = 4.70$, $SD = 1.55$) was significantly better than text alone (T) ($M = 4.04$, $SD = 1.93$), $p < .01$. Also, the instructional strategy that has a combination of text, video, and a practice question (Q) ($M = 4.72$, $SD = 1.63$) was significantly better than text alone ($M = 4.04$, $SD = 1.93$), $p < .01$. However, no significant difference was found between (V) and (Q) (see table 12).

Table 11

Comprehension Scores for the Three Instructional Strategies (Non-Native English Speakers).

The Instructional Strategy	*M*	*SD*
T	4.04	1.93
V	4.70	1.55
Q	4.72	1.63

Note. The maximum score for each instructional strategy was 7.

Table 12

Differences in Comprehension Scores by Instruction Strategies (Non-Native English Speakers).

Pairwise contrasts between the three instructional strategies		Mean Difference	*P*
T	V	-.66	.007*
	Q	-.68	.003*
V	Q	-.02	.941

**P < .05*

Also, a one-way repeated measures ANOVA was performed to evaluate which instructional strategy was the most effective in aiding NES learning critical terms related to technology integration. The results showed that no significant difference between the three instructional formats, F (2,40) = .59, p <= .56, multivariate η^2= .03. The results illustrate that NES performed equally well under the three instructional strategies (T, V, Q), and adding visuals and a practice question did not make any difference (Table 13).

Table 13

Comprehension Scores for the Three Instructional Strategies (Native English Speakers)

The Instructional Strategy	*M*	*SD*
T	6.10	1.10
V	6.21	1.14
Q	6.26	1.40

Note. The maximum score for each instructional strategy was 7.

Research Question Three

Correlation coefficients were computed to examine the relationship between the level of English proficiency and NNES comprehension scores under the three instructional strategies. A *p* value of .05 was required for significance. The results of the correlational analyses presented in Table 14 showed that the correlation between the language proficiency of NNES participants and the score that represent the performance under the text alone strategy (T) was statistically significant ($r(53) = .31$, $p < 0.05$). On the other hand, the correlation of the English proficiency with the other instructional strategies was not significant (for V condition, $r(53) = .20$, $p > 0.05$; for Q condition, $r(53) = .002$, $p > .05$). In general, the results revealed that the higher the English proficiency for NNES was, the better they were able to understand the definition of the technology integration terms from reading text alone. However, the scores also indicate that the performance under the instructional strategies V and Q was not dependent on the language proficiency.

Another correlation coefficient was computed to examine the relationship between the level of English proficiency and NES comprehension scores under the three instructional strategies. The correlation between the scores of NES under the three instructional strategies and

the language proficiency was not significant since there were no variances of English proficiency among the NES participants. The majority of them reported that they have excellent English proficiency.

Table 14

Correlation between Language Proficiency and Comprehension Scores by Instruction Strategy.

			T	V	Q
NNES	Language proficiency	Pearson Correlation	.31*	.20	.002
		Sig. (2-tailed)	.02	.16	.99
		N	53	53	53
NES	Language proficiency	Pearson Correlation	.10	.06	-.06
		Sig. (2-tailed)	.53	.72	.73
		N	42	42	42

* $P < .05$

Additional Findings

Participants of this study represent different levels of language proficiency. NES have high English proficiency as English is their first language. On the other hand, because the NNES in this study had different levels of English proficiency, they were divided into two groups: participants who were still at the AEC and participants who were at the AL. It was of interest to explore if these groups would perform differently on the comprehension test.

A one-way analysis of variance was conducted to compare the mean scores on a comprehension test of technology integration terms for two groups of participants, NES and NNES. The scores on the comprehension test were grouped by the instructional strategy into

three groups (T, V, Q), with one group representing the scores of text only strategy (T), a second group representing the scores of the text and video strategy (V), and a third group representing the score of the text, video, and question strategy (Q). The maximum possible score for each group was 7 points. A *p* value of .05 was required for significance. The overall *F* for the one-way ANOVA regarding the performance under the instructional strategy (T) was statistically significant, $F(1, 94) = 37.88$, $p < .001$. The overall *F* for the one-way ANOVA regarding the performance under the text and video format (V) was statistically significant, $F(1, 94) = 28.10$, $p < .001$. The overall *F* for the one-way ANOVA regarding the performance under the text, video, and question format (Q) was statistically significant, $F(1, 94) = 23.76$, $p < .001$. The results showed that NES outperformed significantly NNES under the three-multimedia instructional strategies (Table 15).

Table 15

Difference between Native and Non-Native English Speakers on Comprehension Scores by Instructional Strategy.

		df	Mean Square	*F*	*P*
T	Between Groups	1	99.19	37.88	.000
	Within Groups	93	2.62		
	Total	94			
V	Between Groups	1	53.86	28.10	.000
	Within Groups	93	1.92		
	Total	94			
Q	Between Groups	1	55.93	23.76	.000
	Within Groups	93	2.35		
	Total	94			

As the knowledge of language appeared to have an impact on the performance on the comprehension test of technology integration terms, another analysis was conducted to investigate if there was a difference in terminology comprehension between NNES who were still at the AEC and those who were at the AL.A one-way analysis of variance ANOVA was conducted to investigate if these two groups, AEC participants and AL participants, would perform differently on the comprehension test based on the instructional strategy they experienced. The results showed that there was a statistically significant difference between the scores of the two groups when the instructional strategy was text alone (T) ($F(1, 52) = 36.46$, $p = .001$) and also when the instructional strategy was the combination of text and video (V) ($F(1, 52) = 15.82$, $p = .009$). However, no statistically significant difference was found when the instructional strategy was the combination of text, video and question (Q) ($F(1, 52) = 7.46$, $p = .095$).

Table 16

Differences between Comprehension Scores by Instructional Strategy for AEC and AL Students.

		Sum of Squares	*df*	Mean Square	*F*	*P*
T	Between Groups	36.46	1	36.46	11.81	.001
	Within Groups	157.47	51	3.09		
	Total	193.93	52			
V	Between Groups	15.82	1	15.82	7.38	.009
	Within Groups	109.35	51	2.14		
	Total	125.17	52			
Q	Between Groups	7.46	1	7.46	2.90	.095
	Within Groups	131.30	51	2.57		
	Total	138.76	52			

P < .05

Research Question Four

Pearson correlations were performed to determine if the scores on the comprehension test of technology integration terms were related to the level of technology experience based on a self-report survey administered to participants. The scores on the comprehension test were grouped by the instructional strategy into three groups (T, V, Q), with one group representing the scores of text alone strategy (T), a second group representing the scores of the text and video strategy (V), and a third group representing the score of the text, video, and question strategy (Q). The maximum possible score for each group was 7 points. Please note that one participant did not fill out the technology experience survey. A p value of .05 was required for significance. The results of the correlational analyses presented in Table 17 shows that there was no statistically significant correlation between technology experience and the scores of each of the three groups of scores. In general, the results suggest that the performance on the comprehension test was not related to how experienced NNES and NES were with technology. However, it may be noteworthy that the effect size of the correlation between text-only condition and NES participants' technology experience is of moderate size, even though it is not statistically significant ($r(42) = .30$, $p = .055$).

Table 17

Correlation between Technology Experience and Comprehension Scores by Instructional Strategy for Native and Non-Native English Speakers.

			T	V	Q
NNES	Technology Experience	Pearson Correlation	.03	-.20	-.08
		Sig. (2-tailed)	.85	.16	.59
		N	52	52	52
NES	Technology Experience	Pearson Correlation	.30	.24	.27
		Sig. (2-tailed)	.055	.13	.09
		N	42	42	42

Chapter Summary

This chapter presented the results of the investigated research questions. The results of this study revealed the following:

1. All the 38 technology integration terms gathered in this study were rated by educational technology experts as important ($M > 5$ out of 10), which indicates that they are critical to technology integration.
2. The combination of text and video (V) and the combination of text, video, and a practice question (Q) were more effective than text only (T) in aiding NNES understating technology integration terms. However, no significant difference was observed between V and Q. Also, no significant differences were found between the three formats of instruction (T, V, Q) among NES.

3. Significant statistical correlation was found between the level of English proficiency that was obtained through a self-evaluation survey and the text only format of instruction (T) among the NNES. On the other hand, the results showed that the performance of NNES under the instructional formats V and Q was not dependent on the level of English proficiency. NES reported similar levels of English proficiency; therefore, no variances among them were found to be correlated with the performance on the comprehension test.
4. NES outperformed NNES under the three instructional formats T, V, and Q. NNES at the AL outperformed NNES who were current students at the AEC under the instructional strategies T and V, but no significant difference was found between the two groups under the instructional format Q.
5. No significant correlation was found between the level of technology experience and the performance on the comprehension test under the three format of instruction T, V, and Q for both groups NNES and NES.

CHAPTER FIVE

Discussion and Conclusion

This chapter is divided into the following sections: a brief overview of the study, discussion of the research questions findings, implications, conclusion, the limitation of the study, and recommendations for future research.

Overview of the Study

This study gathered critical terms related to technology integration in education and compared the effectiveness of three online instructional interventions/strategies: textual definition alone (T); the combination of textual definition and instructional/explanatory video (V), and the combination of textual definition, instructional/explanatory video, and a practice question (Q) in aiding native and non-native English speakers learning these terms. In addition, this study explored whether English language proficiency and prior experience of technology were correlated to the students' performance on the comprehension test of technology integration terms.

Key terms related to technology integration in education were gathered over many phases and rated on their importance for technology integration by experts in educational technology. Twenty-one terms were chosen to be included in this study. The sample for the study consisted of 95 participants; 42 of them were Native-English Speakers (NES), and 53 were Non-Native English Speakers (NNES). The participants studied the 21 critical terms defined using the three instructional strategies (T, V, and Q) for 20 minutes. The webpage for the treatment conditions included seven terms defined by the instructional strategy T, seven terms by V, and seven terms by Q. The instructional strategies were counterbalanced so each critical technology integration term was defined in the three different formats (T, V, or Q) in three presentation modes (A, B, C).

Participants in the three presentation modes were exposed to the same list of terms; however, for each of the presentation modes, participants were exposed to all three formats of the instruction (T, V, and Q).

Data collection instruments included a comprehension test consisting of 21 multiple-choice questions measuring participants' understanding of the 21 terms studied, and a questionnaire that consisted of three parts: demographic information, a technology integration attitudes survey, and a technology experience survey. The comprehension test and the questionnaire were administered immediately after subjects finished studying the terms.

Descriptive analysis was used to identify the most critical terms related to technology integration in education. Within-subject repeated measure was used to investigate the effect of the three instructional strategies (T, V, and Q) on learning the technology integration terms. Pearson correlation was used to examine the relationship between experience with technology and performance on the terminology comprehension test, and another Pearson correlation was conducted between English language proficiency and performance on the terminology comprehension test.

Discussion of Findings

The findings of the following four research questions are discussed in this section:

RQ1: What are the key technology integration terms that imply new ways of teaching and learning with technology that education students should understand?

RQ2: What instructional strategy (Text alone, Text plus Video, Text plus Video plus Question) is the most effective for learning specialized terms related to technology integration in education by native-English speakers and non-native English speakers?

RQ3: Is there a relationship between participants' English language proficiency and their comprehension of technology integration terms?

RQ4: Is there a relationship between participants' technology expertise and their comprehension of technology integration terms?

Research Question 1

One goal of this study was to gather critical terms related to technology integration in education that imply new ways of teaching and learning with various technologies. The list of terms identified by experts as critical can be categorized into the following: types of learning and interaction, Internet-based activities, software-based activates, hardware, and learning theories. In general, those terms stress the integration of technology to support teaching and learning in or out the classroom, entirely or partly.

The list included terms that describe different types of learning and interaction that integrate technology such as asynchronous learning, synchronous learning, blended learning, collaborative eLearning, mobile learning, and eLearning. Those terms describe ways of learning with technology and especially they describe kinds of online learning where learners and instructors communicate and exchange information from distance and also where instructors take advantage of online resources to support face-to-face instruction. eLearning is a general term that implies the incorporation of different multimedia technologies in learning practices. eLearning can be synchronous and asynchronous. While asynchronous learning requires learners and the instructor to be in different places and at different times and to use asynchronous communication tools, synchronous learning requires the presence of the learners and instructor at the same time and can be at separate places. Blended learning refers to the partly use of online resources to support face-to-face instruction. For example, teachers can refer students to websites or give

them videos to watch or online exercises to support the classroom activities. Collaborative eLearning stresses the use of technology to work together online.

In addition to the type of learning and interaction, the list included some applications that could support online interaction and exchange of information. The experts identified applications that allow students to interact, exchange information, and work collaboratively from distance to build content. Those applications are Wiki, learning management systems, social media, and teleconferencing applications. These applications support different types of online learning, and they seem to be important especially with the growth of online learning and the increasing use of the Internet tools in classrooms. The results of the national 2007 Speak Up survey revealed that one-third of teachers showed interest in taking an online class. Also, 8% of high school students reported that they had an online class, and 9% said that they had a class that had an online component that supported the traditional face-to face environment (Project Tomorrow, 2008). It is predicted that by 2019, fifty percent of the courses in high school will be offered online (Hanover Research, 2011). That has put more emphasis on different kinds of online learning and delivery methods, and thus terms such as collaborative eLearning, synchronous or asynchronous learning, blended learning, and eLearning should be important, as should the applications that support these kinds of learning.

Terms describe Internet-based activities such as global classroom, telementoring, webquest, keypals, and podcasting were also identified as critical. The importance of these terms might rest with giving teachers meaningful ways to use the Internet. Technology that has multiple uses like the Internet does not tell teachers how to use it to support learning, and that require teachers to find ways to utilize them meaningfully. According to Zhao (2003), "a more generic technology…while it allows more creativity, does not suggest any direct connection to

an educational problem, making it more difficult for teachers to see how it can be used in their teaching" (p.6). The majority of the terms that describe Internet-based learning activities in this study were identified by Harris (1998) as effective ways to integrate the Internet meaningfully for learning purposes.

Educational technologists also identified terms describe software-based activates as critical such as digital storytelling, concept mapping, educational games, simulation, drill and practice, and tutorials. These are important terms that reflect the use of software and multimedia technology in learning practices. Mandell, Sorge and Russell (2002) stated that drill and practice, tutorials, simulation software, and the Internet are important and popular applications used in classroom. Drill and practice also is considered one of the most activities used by classroom teachers (Project Tomorrow, 2008). Drill and practice can take the form of educational games that teachers use to help students practice or master a skill in different disciplines. Tutorials give students instruction on a topic which they then can practice using drill and practice activities. Digital storytelling and concept maps utilize different multimedia tools such as pictures, audio, and video. Teachers can enhance instruction by creating such venues or students can create their own digital storytelling and concept maps to reflect a particular topic in order to present information in new ways. Simulation is another term that is considered important as it describes how technology imitates the real world and thus gives students a way to practice skills in a safe environment. Ulutak and Ataizi (2013) stated that providing students with examples from real life can enhance their learning, and simulation helps students get examples similar to real life.

ePortfolio, social media, Wiki, and social networking were also addressed in many studies as being critical learning tools. In a study conducted by Ottenbreit-Leftwich et al. (2012) to address the gap between what teachers educators do to prepare pre-service teachers to use

technology and how teachers use technology in classroom, teachers educators reported that ePortfolio , webquest, and collaborative learning using Web 2.0 are important concepts in teacher education programs. In the same study, several teachers reported that student response systems, learning management systems, social networking, Wiki, and social media are important and commonly used in classrooms. Frei, Gammil and Iron (2007) identified webquest, ePortfolio, and drill and practice among common ways to integrate technology effectively into curriculum.

Constructivism was listed also as one of the most critical terms related to technology integration in education. This term emphasizes the role of learners in constructing their knowledge by themselves based on their previous experience; the role of teachers is to create a suitable environment for those learners. Ulutak and Ataizi (2013) described the constructivist environment as technology-based in which technology plays a major role in learners' interactions with the environment. Technology is believed to create meaningful leaning environments in which learners can use technology as a tool to explore, construct knowledge, and reflect upon their learning. For example, webquests or digital storytelling are technology-based activities that support the constructivism theory. These technology-based activities engaged students to use various technologies such as the Internet or audio and video applications to learn topics and produce audio or video products that demonstrate their understanding of the topics.

Although the goal of this research was not to focus on hardware or tools, the list included two hardware forms that experts believe are important: Interactive whiteboard and students' response system. The importance of these two tools might be because they are increasingly used in today's classrooms as an important teaching tool. Unlike other terms, the interactive whiteboard and students' response system both do not need teachers to consider other possible

uses, as their usage in classrooms is more focused. According to Roberston and Green (2012), " the Interactive White board has become a common tool found in many educational environments--most notably in K-12 classrooms. It appears that the use of this device will continue to grow" (p.15).

In general, the list focused more on terms that evoke practical uses of technology in educational settings instead of focusing on objects such as projectors or computers; this idea seems to be consistent with what Zhao (2003) found regarding what teachers need to know about technology. Zhao (2003) stated that there is a move from the simple operation of technology toward the practical functions of technology in educational settings. It is noticed that the Internet's tools and applications received much attention so that many terms related to the use of the Internet in the educational practices were identified by educational technologists as critical. It was also interesting to see in the list some terms that do not describe specific technology-based activity but instead describe groups of technology users (digital native, digital immigrants) or regulate the use of technology (digital citizenship).

Research Question 2

The second research question investigated what instructional strategy, T, V, or Q, was the most effective in learning terms related to technology integration in education by native and non-native English speakers. The results of this research question revealed that the combination of text and video (V) and the combination of text, video, and a practice question (Q) were more effective than using text only format; they lead to better learning of terms related to technology integration in education among NNES. However, NES performed similarly very well under the three instructional strategies. The superiority of the instructional strategies V and Q in enhancing NNES performance in the comprehension test is consistent with the dual coding theory proposed

by Paivio (1990, 1991), which stated that when information is presented in verbal and visual formats, that can help learners make connections and thus learn better. Having multiple modes of instruction is also supported by the information delivery hypothesis, which states that when information is delivered through many paths, the possibility of absorbing the information increases as learners can choose the path that works best with them (Mayer, 2001).

This finding is also consistent with the study conducted by Al-Seghayer (2001), who found that combining text and video was the most effective strategy for learning vocabulary by second language learners. He found that providing learners with the definition in a combination of text and video had a better effect than using text only or text, and static picture. Al-Seghayer (2001) attributed the effectiveness of using videos for learning words to their ability to attract learners' attention and to inspire their curiosity, which results in higher concentration and consequently better learning: that could be the case in this study. Video features such as high quality pictures and narration would make learning more engaging than using text only; this may be especially true in that NNES might find the videos more interesting due to the visual aids. NNES might rely on pictures to understand the meaning of the terms, as pictures would compensate for the deficiency in their reading ability. In this study, the high quality pictures that were relevant to the content and the high quality narration that was done by a professional narrator were effective features that made the video more attractive to learners, and that may have resulted in a better effect than the text only.

Another reason that might contribute to the superiority of the videos is that the instructional strategies V and Q gave learners multiple sources of information (visual and verbal) to use to infer meaning. Therefore, the components of the strategies V and Q, which included multiple modes, reinforce each other and therefore result in better learning of the terms.

Sherwood, Kinzer, Hasselbring, and Bransford (1987) explain the superiority of the combination of text and video over text only in terms of what they called the redundancy hypothesis, which claims that a video coupled with a redundant text gives a learner more sources of information than text only. When there are multiple sources of information, the learners interact with more cues and thus they perform better. In other words, the more cues available for learners to interact with, the better the learning (Adulseranee, 2007). Visuals would compensate the deficiency that non-native-English speakers might have when they read words. Visuals would give them a clue about what the terms are about in order to increase the likelihood that the learners decode what they read. The series of pictures in each video might help the subjects to create the right model representation about the terms they were studying, and also viewing the video might guide them as they read the textual definition so they can guess the right meaning of the words. Each video consisted of a series of pictures representing the key attributes in the definitions of each terms, and the same attributes were written in words in the text strategy. When watching the video and then reading the text, learners would gain the meaning from the video, and reading the text would reinforce learning. The text-only strategy required subjects to infer the meaning only from words; the subjects were only able to rely on their reading ability to understand the definition of the terms. Any misunderstandings of some words might mislead the readers and result in a wrong interpretation of the term's meaning.

However, no significant differences were found between the three instructional strategies (T, V, Q) among NES. NES participants have a higher level of English proficiency than NNES; therefore, it is assumed they easily make their own mental representation of what they read from text only. It is important to note that adding visual elements and a practice question to the textual definition did not make a difference for NES. It is apparent NES participants understood the

material from the textual format, and the additional instructional aids did not enhance their learning. NES performed very well regardless of the instructional strategies they experienced, which can be linked to their strong knowledge of the English language.

Clark and Mayer (2011) stated that presenting materials in multiple modes (words and graphics) would not be beneficial to all learners. Presenting materials with words and pictures would work best for learners who have low knowledge about the materials being studied, but learners with high knowledge could create their own pictorial representation of the materials from reading text alone. On the other hand, supplementing text with pictures could help low knowledge learners "relating the text to a useful pictorial representation" (Clark & Mayer, 2011, p. 83). That is also consistent with the results of a study conducted by ChanLin (2001), who compared the effectiveness of three formats of computer-based instruction (text, picture, and animation) on learning physic concepts. The result revealed that there were no significant differences between the three formats of instruction among learners with high prior knowledge. ChanLin (2001) concluded, "Experienced learners possessing potential prior knowledge might learn equally from different treatments. This is because domain-specific knowledge can compensate for different in presentation formats" (p. 417).

Finally, it was assumed that adding a practice question would enhance learning as it was intended to help learners interact with the content and reflect on what they have learned. Previous research has shown a positive effect of using a practice test on the learning outcome and information recalling (Hannafin, 1987; Martin & Klein, 2008; Vural, 2013). However, the results of this study revealed that the instructional strategy that has a practice question (Q) was more effective than the text alone strategy (T) but not better than the text and video strategy (V) in aiding NNES in learning terms related to technology integration in education. The difference

that was found between the instructional strategy Q and T might be attributed to the effect of video more than to the practice question effect, especially since no difference was found between V and Q.

One reason that might weaken the effectiveness of the practice questions could be related to their design. The design of the practice questions supported simple recognition of fact related to the definitions instead of supporting comprehension of the term. According to Clark and Mayer (2011), not all the practice questions in multimedia instruction could be able to promote learning. Questions that focus on simple recognition of information presented in the materials being studied require superficial level of information processing and thus do not add any instructional value or enhance learning. The design of the practice questions for this study targeted the recognition of some facts related to the definitions of the terms or asked about some important elements of the definition. By contrast, the comprehension test that was administered to the students went beyond the simple recognition of facts. For example, the practice question for digital storytelling was "which is not an element of digital storytelling?" The options were editing, copying, storyboarding, and sharing. On the other hand, the comprehension question was a short learning activity that integrated technology and had many attributes that were mentioned in the definition. The question did not ask directly about the element that was practiced during the instruction:

> In a secondary science class, students wrote a story about environmental changes in a pond by their school. They took pictures of the animals and plants near the pond and made some video and audio recordings in the morning and at night. Once they finalized their ideas, they created a storyboard, edited the media and developed a video that they shared in class.
>
> This can best be described as ____.
>
> □ digital citizenship □ digital storytelling □ ePublishing □ scaffolding

While the practice questions asked about one element in the definition, the comprehension test required learners to combine together several element of information from the definition in order to answer the questions. Previous research showed that people could answer practiced information better than the piece of information not practiced. Martin and Klein (2008) claim that for effective practice questions embedded in multimedia instruction, practice questions should be aligned with the objectives of the lesson and the assessment. Practice questions that can attract learners' attention and promote learning are those that require learners to form new ideas or to apply their understanding into a new situation but not questions that focus on rote learning (Dirksen, 2011, p. 145).

Another element that might weaken the effectiveness of the engagement question is its position in the pop-up window. The practice question for each term was placed in the same window with the textual and video definition; learners could access the answer by looking at the definition, and they did not need to rely on their memory when answering. According to Roediger and Karpicke (2006), the effectiveness of testing does not happen by additional exposures to the materials to be learned, but with learners' ability to retrieve the information from memory (p.2). Therefore, the position of the question in the same window with the definition did not force learners to rely on their memory to retrieve the information.

Also, previous research showed that testing has a positive affect on the long-term memory more than it has on the short-term memory. Roediger and Karpicke (2006) examined the effectiveness of testing over different periods of times. Students studied a set of topics on science, with some of them taking a recall test while others did not take a test but instead restudied the material. Then a final test was administered at three different periods of time: after 5 minutes, 2 days, and 1 week. The results revealed that the restudying group performed better

than the recall-tested group when the final test was administered after 5 minutes. However, the recall-tested group outperformed the restudying group when the final test was administered after 2 days and 1 week. Halamish and Bjork (2011) provided several examples of research findings that showed that the effect of practice was observed when the final test was administered after days or weeks of taking the practice. This indicated that the usefulness of testing as a way to enhance the retention of information appear over a long time of period. This study administered the comprehension test immediately after participants finished studying the terms, and previous research has shown that the effect of test would not be noticed on a short period of time.

In conclusion, the effectiveness of the practice question in this study seemed to be influenced by many factors. First, the practice question and the final test were not aligned in that they appear to measure different kinds of learning. The comprehension test did not directly measure the understanding of the practiced materials. Second, the practice test did not give learners the opportunity to rely on their memory to see if they could remember the definition and recall the practiced information; since learners could get the answer by reading the on-screen text, it might give them additional exposure to the definition more than a test on the practiced information. Third, the administration of the comprehension test happened right after learners finished studying the terms, and the effect of practice might need a long period of time in order to be observed. It can be concluded that the practice test embedded in the instructional video played the role of engagement to promote learner interaction more than it was a learning tool that leaners might gain knowledge from.

Research Question 3

Research question 3 explored whether there was a correlation between the English proficiency as reported by participants on a 5-point Likert scale and the scores on the

comprehension test that represent the three instructional strategies (T, V, Q). Participants studied a list of 21 terms: seven were defined using text alone (T), seven were defined using text and video (V), and seven were defined using text, video and practice question (Q). The possible score on the comprehension test were 21 divided into three groups corresponding to the three instructional strategies.

The results showed that there was a significant correlation between the English proficiency of NNES and the scores that represent the text alone strategy (T). However, the scores under the intervention V and Q were not dependent on the language proficiency. NNES with high English proficiency obtained a high score on the comprehension test from reading text alone. In other words, NNES who have good English background were able to understand the meaning of the target terms from reading textual definition of the terms and were able to score high on the comprehension test. According to Ozuru, Dempsey, and McNamara (2009), those who have high reading ability are not only able to decode words into their memories, but they can also relate reading text ideas into a meaning representation that enables them to make sense of the reading materials. Clark and Mayer (2011) point out that learners with high prior knowledge about the learning materials are able to understand the materials and create their own mental representation from reading text, and those with low prior knowledge need a visual representation of the information to aid them to comprehend the materials. Kozma (1991) found text to be sufficient for those with high reading ability to comprehend the learning materials, but those with less reading ability used pictures as another source of information. Kozma (1991) observed that learners with low reading ability tend to consult a picture for clarification when they encounter difficulties understanding what they read, and they also use them as a visual organizer that can help them build a schema about what they read.

In terms of the difference in the scores between NNES and NES, the scores on the comprehension test reflect different levels of English proficiency of the members of the two groups. NES got higher scores than NNES participants in the comprehension test regardless of the formats of the instruction they experienced. The range of scores among NESs was 13 to 21, except one participant who scored a 4. On the other hand, the scores of NNES range from 7 to 20. The effect of varying English proficiency also affected two groups of NNES participants. Those who were current students at the AL outperformed participants who were still in the AEC program in two of the multimedia instruction strategies, T and V, while no statistically significant difference was found when the multimedia instruction was Q. It seems that the engagement question helped slightly improved the performance of the AEC students but did not with AL. As the practice questions only support simple recognition of facts, it would help novice learners to recall some information, but those questions might not promote learning for more advanced students.

Research Question 4

Research question 4 explored whether there was a correlation between the technology experience as reported by participants on a 5-point Likert scale and the scores on the comprehension test that represent the three instructional strategies (T, V, and Q).

Although the target terms of this study require understanding of the critical capacity of technological tools, the results showed that there was no significant correlation between the technology experience and the performance on the comprehension test. Technological tools are considered an important component of the definition of each term, and they can give a clue about each term. For example, email and discussion boards are important tools for asynchronous learning, but tools such as iChat are important in synchronous learning. Technological tools were

embedded in the comprehension tests as additional clues that can guide the test takers to the right answer. For instance, when asking about the term asynchronous learning, communication tools such as email and discussion boards was embedded with the scenario to inform the test takers that these are asynchronous communication tools. However, the results of this study showed that there was not correlation between the technology experience and the performance on the comprehension test.

It seems that language proficiency was the most influential factor for understanding the technology integration terms. It is true that having technology experience is important for the ability to integrate technology in teaching and learning, but in the case of understanding the definitions of terms related to technology integration, language proficiency seems to be more influential. That was especially true for non-native English speakers (NNES).

Implications

This study aimed to identify key terms that describe novel ways of teaching and learning with technology and to compare the effectiveness of three online instructional strategies in aiding learners with various levels of English proficiency comprehending them. We believe that this study has a useful implications and applications to the field of education.

- Teachers' preparation programs are concerned about what to teach to future teachers so that they will be able to integrate technology into their teaching. The list of terms identified in this study could be a part of the course content of any educational technology class. Studying these terms could increase the awareness of novel ways of teaching and learning with technology. Also, newcomers to the field of educational technology might find this list of terms beneficial as it includes important well-defined concepts.

- The terms gathered in this study show the function of many technologies in a broad way, and teachers and practitioners might need to reinterpret the applications of these concepts in their own field. Some terms describe simple functions of technology such as drill and practice that educators might not have concerns regarding implementation, but others describe complex functions of technology such as webquest, digital storytelling, ePortfolio and podcasting that require teachers to rethink about their best use for their content area. We suggest that when learners understand those terms, the next step is to develop learning-activities that can put these terms in context.
- This study implies that different levels of prior experience of the domain knowledge might interact with different instructional strategies and influence learning outcome. Therefore, students with different prior knowledge might need different instructional formats. The results of this study showed that adding visual to text enhanced the learning of those with low prior knowledge of English (Non-native English Speakers). On the other hand, the effectiveness of visuals was not apparent with Native English Speakers who have high English proficiency. That implies that when there are learners with different prior knowledge about the materials being studied, having multiple modes of instruction could assist students who have various levels of experience.
- The results also confirmed that multimedia instruction could be beneficial in teaching any concept. Several research studies available examined the effect of multimedia on learning topics in different disciplines, such as science (Mayer & Anderson, 1992; Mayer & Gallini, 1990), social studies, (Adulseranee, 2007), and language learning (Al Ghafli, 2011; Al-Seghayer 2001; Chun & Plass ,1996), and these studies revealed that using multimedia could lead to better learning. This study also revealed that the combination of

text and visuals enhanced learning outcome of learners with low knowledge about English. This study had an implication for language learning as it demonstrated that multimedia instruction was effective in enhancing the learning of specialized terms of technology integration that had conceptual meanings.

- As the incorporation of video has shown a positive effect on the learning outcomes among non-native English speakers, it is important to emphasize that visual instruction should be carefully designed to positively affect learning. Todays' teachers have access to high quality images that can be used to supplement their instruction and make learning more engaging and interesting. However, that accessibility requires them to judge what pictures are relevant to their topics and have an instructional value, especially when working with information that is hard to be visualized (Lohr, 2003). Therefore, teachers need to be creative when deciding to incorporate pictures in their instruction, as irrelevant pictures might overload learners' working memory and hinder learning. Lohr (2003) suggests that when developing visual instruction, instructional designers might find it useful to seek inspiration by looking at some good examples created by others and then create their own work through multiple revisions until reaching high quality materials. Teachers who are not familiar with visual design might encounter difficulties preparing visual materials at first; however, with many tries and inspiration through examining examples similar to what they are developing, they could produce high quality materials. The designer of visual instruction might also need to seek feedback from the target audience who will be learning the material and from experts familiar with the materials. It is possible that the first draft of the work would not be good enough; therefore, others' feedback is important to produce high quality work that can achieve the design goals.

Frequent revision of the work helps improve its quality, and that is especially true when working with materials that can be open to interpretation such as visualizing abstract terms. The instructional designer might have his or her own approach when choosing the material and organizing it, and possibly that approach will be different from the target learners. Therefore, feedback is important for designing effective instruction.

Conclusion: Drawing Meaning from Arbitrary and Tangible Symbol Systems

The results of this study revealed that non-native English speakers learned more about specialized terms related to technology integration when the terms were presented as a combination of text and video as compared to a text-only format. For native English speakers no significant differences in comprehension scores were found under the three instructional strategies (Text only, Text plus Video, and Text plus Video plus Question). Non-native speakers are at a disadvantage in understanding meaning solely from a secondary arbitrary symbol system (language) because they do not fully understand the subtleties of the language, and therefore, they may miss part or all of the meaning. When the term's meaning is conveyed in both tangible imagery symbols as well as arbitrary symbols (language), non-native speakers are likely to draw more benefits from tangible images that are universally understood across languages. Thus the meaning drawn from a universally understood tangible symbol system is especially beneficial for non-native speakers because they do not need to rely solely on drawing meaning from the words and grammar of a secondary arbitrary system (language).

On the other hand, native speakers come to understand meaning through language in early childhood, and their ability to gain meaning from their native language increases throughout their lives. Their ability to gain meaning from their first language is naturally greater than non-native speakers. In this study, native speakers understood concepts that were relatively

simple for them as evidence by their high scores on the comprehension questions. The native speakers gained sufficient meaning from the definitions in their primary language to respond correctly to the comprehension test. Thus any benefits from the addition of tangible symbols may have been masked by a ceiling effect. Had the technology integration terms been more complex, or the comprehension questions more challenging, the benefit of the tangible imagery system may become more apparent with native speakers.

When comparing the self-rating English proficiency level of native and non-native English speakers who participated in this study, the results showed that non-native English speakers reported lower English proficiency than native English speakers. Therefore, the nonlinguistic cues (the use of tangible symbol system) worked as an additional support for non-native speakers and possibly compensated for the deficiency in English language. The superior benefits of using visuals in conjunction with words on learning outcomes over text only are consistent with previous research in multimedia learning. Previous research found that instruction that consists of words and visuals is more effective than words alone (Al-Seghayer, 2001; Nugent, 1982; Paivio, 1990) and works best with learners who have low prior knowledge of the presented materials (ChanLin, 2001; Mayer & Gallini, 1990). The positive correlation between the level of English proficiency and the comprehension scores under the text-only instructional strategy, as well as the performance of native English speakers on the comprehension test, supports the assumption that learners with high prior knowledge are able to construct sufficient meaning from reading text only (Clark & Mayer, 2011).

This study also hypothesized that adding practice questions to instructional materials would be more effective than instruction without these questions. However, the benefit of adding practice questions was not evident in this study. Considering the level of difficulty of the practice

questions used in this study, they are considered easy and support simple recognition of facts. This type of question is believed to have smaller learning benefit (Clark & Mayer, 2011). More difficult practice questions that go beyond simple recognition of facts may be more beneficial to learning. If the practice questions were more difficult, they could support in-depth processing of information and help learners manipulate and synthesize different pieces of the learning materials, which in turn could lead to better learning.

Limitations

This study had several limitations. The level of English proficiency was obtained from the participants of this study through self-evaluation survey. On a 5-point Likert scale, participants were asked to evaluate their English reading and listening abilities. This evaluation was considered intuitive since it was not based on a valid test or clear criteria.

Another limitation of this study was that the terms related to technology integration in education were chosen based on their importance and practical use, not on their difficulty. People with reasonable background knowledge of English might be able to identify the meaning of some terms, such as asynchronous learning or synchronous learning, without using the intervention.

Also, the findings of this study were based on a 20-minute exposure to 21 terms explained by three instructional strategies (T, V, and Q). All participants in this study spent 20 minutes reviewing the 21 terms before taking the comprehension test, but this study did not track how many times each term was viewed by the participants. Words are learned better through repeated exposure (Coady & Huckin, 1997). Some terms might be viewed more than others and might be better coded than those that were viewed less.

Finally, the measurement that was used to measure participants' understanding of the 21 targeted terms related to technology integration in education was only concerned with the receptive knowledge of the target terms and did not reflect the production. Although the multiple-choice comprehension test was designed to measure the knowledge of the target terms beyond simple recognition, it still targeted only the receptive knowledge. The comprehension test also was not tested before for validity and reliability. It was designed by the researcher and administered for the first time in this study.

Future Research

This study gathered critical terms related to technology integration that imply new ways of teaching and learning with technology. The study also investigated which instructional strategy (T, V, or Q) was more effective in aiding native and non-native English speakers learning the target terms. The study found that adding video to a text can enhance learning specialized terms related to technology integration in education by non-native English speakers. However, more studies are needed to address different questions related to learning specialized terms with multimedia instruction:

- This research focuses on learning specialized terms intentionally. Participants in this study were given a list of terms to intentionally view their definitions using different multimedia formats. Future research needs to examine the effectiveness of multimedia annotations in an incidental vocabulary-learning environment. Therefore, reading comprehension can be investigated using the multimedia instructional strategies provided in this study as online aids.
- A need exists to examine the effectiveness of these instructional strategies on long-term retention, especially since previous research showed that the effectiveness of practice

question appeared on a long time interval more than on taking immediate test right after taking the practice test.

- This study could be replicated with a more homogeneous sample. The sample of this study consisted of students with different language proficiency and from various disciplines. Future research might consider having more homogeneous sample.
- This study could be replicated through the use of practice questions that target high level of information processing. The practice questions embedded with the multimedia instruction in this study focused on simple recognition of facts related to the definition of the technology integration terms; therefore, the effectiveness of more advanced practice questions embedded with the multimedia instruction that focus on the comprehension needs to be tested.
- The practice question component also could be tested with other multimedia instruction formats, with other annotation conditions, with other kinds of terms such as concrete terms, or with other kinds of terms from a different domain.
- This study can be replicated with providing the subjects with the definitions of the terms in their first language.
- Future studies may consider the learning benefits of combining arbitrary (language) and tangible symbol systems across different abilities within the same language. That is, learners with poorer reading skills may benefit more from the combined text and video than learners with more advanced reading skills.
- With the advancement of technology and pedagogy, many other terms that imply new ways of teaching with technology might emerge. Therefore, future research might consider identifying these terms.

- The opinions of classroom teachers about the most critical terms related to technology integration in education could be considered in future research. This study only surveyed teachers educators about what terms related to technology integration in education that imply new ways of teaching and learning that educators need to know. Classroom teachers' opinion could be considered in future research, utilizing a large sample from both teachers' educators and in-service teachers.

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Appendix A

Approved by the Human Subjects Committee University of Kansas, Lawrence Campus (HSCL). Approval expires one year from 10/1/2012 HSCL # 20413

Information Statement

The Department of Educational Leadership & Policies at the University of Kansas supports the practice of protection for human subjects participating in research. The following information is provided for you to decide whether you wish to participate in the present study. You should be aware that even if you agree to participate, you are free to withdraw at any time without penalty.

The primary objective of this study is to investigate the acquisition and comprehension of critical technology integration terms. The content of the study should cause no more discomfort than you would experience in your everyday life. Your participation is solicited, although strictly voluntary, and your name will not be associated with the research findings. Your identifiable information will not be shared unless (a) it is required by law or university policy, or (b) you give written permission. Participation in this study may benefit your understanding of important technology integration terms. You will likely complete the survey in less than 35 minutes.

If you would like additional information concerning this study before or after it is completed, please feel free to contact us by phone or mail. Completion of the study indicates your willingness to participate in this study and that you are at least 18 years old. If you have any additional questions about your rights as a research participant, you may call (785) 864-7429 or write the Human Subjects Committee Lawrence Campus (HSCL), University of Kansas, 2385 Irving Hill Road, Lawrence, Kansas 66045-7563, email irb@ku.edu.

Sincerely,

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Appendix B

The English Version of the Comprehension Test

Choose the term that best describes the activity.

Q 1) Sara is teaching social studies at a secondary school in Austin, Texas. As part of a unit on immigration, Sara decided to pair her students with students from classes in Australia and England. These students worked together in groups using both synchronous and asynchronous technologies in order to better understand the immigration policies, cultures, and customs in their respective countries.

This can best be described as ____.

□ a webquest □ a global classroom □ telementoring □ an eAppearance

---

Q 2) Teachers at a middle school in Miami have an online magazine that contains students' short stories, essays, poems, photos, and videos. Every month a note goes out to parents and students across Florida to announce a new addition of the magazine and to highlight the students' work.

This can best be described as ____.

□ concept mapping □ scaffolding □ a cyberhunt □ ePublishing

Q 3) Secondary students in Washington, DC were studying about the risks and accomplishments of space flights. Their teacher asked them to search this topic and prepare questions to ask NASA's launch director, Omar Baez. The teacher then set up a videoconference with director Baez using a web camera, and students asked the director questions and listened to his responses about the precautions taken during the launch process. After completing the interview with director Baez, the students did some additional research and produced a PowerPoint presentation about NASA's safety procedures.

This can best be described as ____.

□ asynchronous learning □ an eAppearance □ telementoring □ keypals

---

Q 4) A middle school teacher in San Francisco decided to identify math and science experts in the Bay area who would agree to assist students in reviewing their projects and career decisions. Students were encouraged to communicate at least once a week via video conferencing or e-mail, and they were instructed to keep a record of their interaction with their expert.

This can best be described as ____.

□ drill and practice □ an eAppearance □ an online role-play □ telementoring

---

Q 5) In a lesson about famous historical Americans, a social studies teacher in Los Angeles invited her historian friend in Boston to portray Benjamin Franklin, one of the leaders who helped to develop the United States constitution in 1776. The students in the class used email and a live teleconference to ask questions and hear the story of Franklin. They later gave a biographical presentation about Franklin to their class.

This can best be described as ____.

□ an online role-play □ a global classroom □ keypals □ a virtual field trip

---

Q 6) In a secondary science class, students wrote a story about environmental changes in a pond by their school. They took pictures of the animals and plants near the pond and made some video and audio recordings in the morning and at night. Once they finalized their ideas, they created a storyboard, edited the media and developed a video that they shared in class.

This can best be described as ____.

□ digital citizenship □ digital storytelling □ ePublishing □ scaffolding

---

Q 7) Fred, an eighth grade Spanish teacher from Albuquerque, invited his teacher friend Alberto from a Juárez, Mexico school to start an e-mail partners exchange with his students. Fred randomly assigned each student in his class to a partner student in Alberto's class. The purpose

of the activity was to compare life in the two cultures and to help American students practice their Spanish skills.

This can best be described as ____.

□ telementoring □ keypals □ an eAppearance □ ePublishing

Q 8) Steve, a trainer with Sprint Telecommunications, wanted to expand his course on fiber optics to include better representations of the data transmission and switching strategies offered by different manufactures. He recorded and posted many of his lectures online along with the manufacturers' videos and photos. During his weekly class sessions, Steve used an online syllabus to show the students where they could find the lectures, manufacturers' media, and the online quizzes that he had created. This allowed Steve's students to spend more in-class time on hands on activities with the equipment.

This can best be described as ____.

□ synchronous learning □ blended learning □ collaborative eLearning □ a webquest

---

Q 9) Heather understood that her students must have excellent addition and multiplication skills if they were to succeed in solving higher order mathematic problems. Heather used flash cards and software programs, so that the students could try out their mathematic skills until they mastered them. She wanted to make sure that her students would provide the correct answers automatically whenever they were asked any single digit addition or multiplication problems.

This can best be described as ____.

□ a webquest □ scaffolding □ telementoring □ drill and practice

---

Q 10) Britney had a research paper due in her science class. She found useful information related to her research on the web, so she copied and pasted a paragraph from that website to her paper and handed the research in to her teacher. After reviewing the paper, the teacher told Britney that she had committed plagiarism by copying the paragraph without the appropriate citation. Britney

told her teacher that she now understood what plagiarism was, and that she would never do it again.

This can best be described as ____.

□ digital storytelling □ ePublishing □ digital citizenship □ a cyberhunt

---

Q 11) John decided to have his students in Seattle participate in research on global warming. First, his students searched for articles and evaluated websites on global warming, and then they collected temperature data for their region and posted their findings along with the findings from other partner schools in different locations around the world. The students then compared all the data that had been collected by the partner schools across the globe. Next, they created a model comparing changes in temperature across urban and rural areas. John's students used this analysis to draw conclusions about global warming, create a media presentation, and write a research paper explaining their perspectives on global warming.

This can best be described as ____.

□ drill and practice □ an eAppearnce □ ePublishing □ a webquest

---

Q 12) In Amy's science lesson, students were learning about the water cycle. Each student created a diagram of the water cycle using software for constructing diagrams. They started by creating a circle showing the term water cycle in the center, and then added arrows that branched out from the circle showing the key aspects of the water cycle. They also labeled the arrows with words or short phrases that described the relationship between the connected aspects of the water cycle. Students added pictures and links to websites to each idea in the diagram.

This can best be described as ____.

□ an ePortfolio □ a simulation □ concept mapping □ drill and practice

---

Q 13) Richard divided his world history students into six groups and assigned each group to an online project. Richard explained the objectives of each project and posted a large calendar that showed important deadlines for each aspect of the project. He encouraged students to

communicate with each other via email, videoconferencing, and social media. The teams listed their objectives for the projects and identified the roles and responsibilities for each team member. Then, they worked on media presentations for their projects while Richard monitored their progress. Finally, the students presented their topic to their classmates.

This can best be described as ____.

□ telementoring □ asynchronous learning □ an ePortfolio □ collaborative eLearning

---

Q 14) Michael was working full time, and he decided to take a fully online class that was self-paced. He chose this online class because he did not need to drive to campus, he could work on class projects at night, and he was not required to be online at a specific time. For this class, the instructor posted all lectures and reading materials online, so that students could access the resources at their own pace. The instructor also provided feedback and answered questions using email. Michael was allowed to finish the activities and exams according to his schedule as long as all required components were posted before the end of the course.

This can best be described as ____.

□ synchronous learning □ digital storytelling □ asynchronous learning □ teleconferencing

---

Q 15) Instructors at Western University asked their nursing students to create a website that included their philosophy toward nursing and working with patients. Each student's website was organized around the state standards for nursing education. Students provided a description of how they would achieve the standards through media examples showing their clinical experience, and included other evidence that demonstrated their competencies for each standard. All evidence and self-reflection were recorded in a digital format and were accessible on the Internet for faculty and administrator review.

This can best be described as ____.

□ eImpersonation □ an ePortfolio □ telementoring □ keypals

Q 16) The first week of each month, new employees at the Chicago Starbucks Coffee Company go to their local training center. There they learn to make coffee and work successfully with customers. The trainers from the Seattle headquarters greet the new trainees via television monitors and show them the step-by-step procedures for making coffee. The trainers directly observe the trainees and provide tips and suggestions. A mock customer appears on the screen, and the trainees interact with the customer in real time while the experts offer suggestions.

This activity can best be described as____ .

□synchronous learning □a global classroom □asynchronous learning □a cyberhunt

---

Q 17) George, who teaches at Columbia University, created a blog for his class on the application of technology in education. He also asked his students to create personal blogs, and then subscribe to the class blog. Each week George posted the reading, assignments and the announcement to his class blog. Students were asked to post relevant websites, completed assignments, and reflections on their personal blogs. They also received feedback from their instructor and classmates through their blogs. At the end of the semester, all students collectively built a Wiki to synthesize and express what they had learned.

This can best be described as ____.

□ social media □ concept mapping □ telementoring □ an ePortfolio

---

Q 18) Sharon, a nursing school professor, gave her students an interactive software lesson that depicted clinical scenarios in real life situations. The students practiced nursing skills by interacting with these scenarios, answering questions, and suggesting therapies.

This can best be described as ____ .

□ collaborative eLearning □ drill and practice □ a simulation □ an online role-play

---

Q 19) Principal Williams recognized that many of the students in Park Hills Secondary would need information technology skills in the careers they would enter after they graduated. He decided to require students to bring a portable computer to school each day; all textbooks and

other instructional materials were available in a digital format for the students' notebooks. The teachers were also required to post their syllabi and assignments on the school's website, so that students and their parents would easily know what was being taught.

This can best be described as ____.

□ scaffolding □ a simulation □ a webquest □ technology integration

---

Q 20) In a university seminar class, students had to present their final project on the last day of classes. Two of the students told the instructor they would not be able to attend the class because they would be out-of-town at a professional meeting. The instructor set up an interactive connection with the students, so that they could interact live in the class using a video camera and microphone. The out-of-town students presented their projects, listened to the other presentations, and participated in discussions with their classmates at the university.

This can best be described as ____.

□ asynchronous learning □ an eAppearance □ teleconferencing □ a global classroom

---

Q 21) Some of the students in Emily's reading class were having difficulty understanding the new, more complex, stories. In order to improve their reading, Emily first gave her students wordless books containing only pictures, and gradually she increased the difficulty level of the reading materials. In class, she paired the struggling students with more knowledgeable readers in activities where they read to each other. Then, Emily gave students more advanced reading with guided questions. Students recorded what they read and emailed their reading list to Emily and their parents.

This can best be described as ____ .

□ scaffolding □ a simulation □ a webquest □ drill and practice

Appendix C

The English Version of Questionnaire

Part I) Demographic Information:

1- What is your gender?

□ Male □ Female

2- Where are you from? …….

3- What is your current class year?

□ Freshman □ Sophomore □ Junior □ Senior □ Graduate Student

4- What is your current or intended major?

…….

5- What is your Native language?

□ English □ Spanish □ Chinese □ Arabic □ other, specify_____

6- Check the number that best describes your English abilities:

1=Poor, 2=Passing, 3=Average, 4=Good, 5=Excellent

Reading: 1__ 2__ 3__ 4 __ 5__

Listening: 1__ 2__ 3__ 4 __ 5__

Part II) Which is most and least important in your profession? Rate each statement on the following scale:

1=Unimportant; 2 = Slightly Important; 3 = Neutral; 4 = Important; 5 = Very Important

	1	2	3	4	5
1- Understanding my content.	❍	❍	❍	❍	❍
2- Making effective presentations.	❍	❍	❍	❍	❍
3- Assessing individuals appropriately.	❍	❍	❍	❍	❍
4- Integrating technology effectively.	❍	❍	❍	❍	❍
5- Collaborating with others to support my professional growth.	❍	❍	❍	❍	❍

Appendix D

Technology Experience Survey

Part III) Rate your experience of the these technologies using the following scales

1 = No experience; 2 = poor; 3 = Average; 4 = Good; 5 = Very Good

	Item	1	2	3	4	5
1	Web Search Engines (i.e. Google, Bing, Yahoo)	❍	❍	❍	❍	❍
2	Web Design (i.e. HTML, Dreamweaver)	❍	❍	❍	❍	❍
3	Graphic Editing (i.e. Photoshop)	❍	❍	❍	❍	❍
4	Word Processing (i.e. Microsoft Word)	❍	❍	❍	❍	❍
5	Presentation (i.e. PowerPoint, Prezi)	❍	❍	❍	❍	❍
6	Animation (i.e. Flash)	❍	❍	❍	❍	❍
7	Video Editing (i.e. iMovie, FinalCut)	❍	❍	❍	❍	❍
8	Audio Editing (i.e. Audacity, Garage band)	❍	❍	❍	❍	❍
9	Collaboration (i.e. Wikis, Google Docs)	❍	❍	❍	❍	❍
10	Survey (i.e. SurveyMonkey, Qualtrics)	❍	❍	❍	❍	❍
11	Teleconferencing (i.e. Adobe Connect, iChat, Skype)	❍	❍	❍	❍	❍
12	Social Networks: (i.e. EdModo, Facebook, MySpace)	❍	❍	❍	❍	❍
13	E-mail Programs (i.e. Gmail, Yahoo, Hotmail)	❍	❍	❍	❍	❍
14	Asynchronous Discussions (i.e. Discussion Boards)	❍	❍	❍	❍	❍
15	Community publishing (i.e. Flicker, YouTube)	❍	❍	❍	❍	❍

Thank you

Appendix E

The Arabic Version of the Comprehension Test

الرجاء اختيار المصطلح المناسب لكل سيناريو من الأنشطة التالية:

س١) "ساره" مدرسة علوم اجتماعيه في احدى ثانويات تكساس. أثناء تدريسها لموضوع حول الهجره, قررت "ساره" ان تجعل طلابها يتواصلون مع طلاب اخرين في صفوف مختلفه في استراليا وبريطانيا. عمل طلاب هذه الصفوف في مجموعات مع بعضهم البعض باستخدام تقنيات الإتصال التزامنيه وغير التزامنيه ليفهموا بشكل افضل قوانين الهجرة, والثقافات, والأزياء في هذه البلدان.

يمكن ان يطلق على هذا النشاط:

□ webquest □ global classroom □ telementoring □ eAppearance

س٢) يشرف مدرسوا احدى المتوسطات في ميامي على مجلة الكترونيه تضم أعمال مختلفه للطلاب من قصص قصيرة, ومقالات, وقصائد, وصور, وفيديوهات. في كل شهر يتم نشر اعلان في كافة أنحاء فلوريدا عن صدور عدد جديد من المجلة يشمل الأعمال الجديدة للطلاب.

يمكن ان يطلق على هذا النشاط:

□ concept mapping □ scaffolding □ cyberhunt □ ePublishing

س٣) عند دراسة طلاب احدى الثانويات في واشنطن للمخاطر والإنجازات التي تحققت في رحلات الفضاء, طلب المعلم منهم البحث في هذا الموضوع وجمع أسئلة لإلقائها على أحد خبراء وكالة ناسا ويدعى عمر باز. قام المعلم بإجراء لقاء على الإنترنت باستخدام دائرة تلفزيونيه مع عمر باز والذي تحدث عن الإحتياطات التي يتم اتخاذها في رحلات الفضاء, كما قام بالإجابة على أسئلة الطلاب. فور انتهاء اللقاء قام الطلاب بالبحث في هذا الموضوع وقدموا عرضا مصورا باستخدام البوربوينت تضمن اجراءات السلامة التي تتخذها وكالة ناسا في رحلات الفضاء.

يمكن ان يطلق على هذا النشاط:

□ asynchronous learning □ eAppearance □ telementoring □ keypals

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س٤) قرر أحد معلمي المرحلة المتوسطة في سان فرانسيسكو البحث عن خبراء في الرياضيات والعلوم في مقاطعة "Bay" لكي يقوموا بمراجعة مشاريع الطلاب وقراراتهم المهنيه. بعد أن تم تحديد هؤلاء الخبراء , طلب المعلم من الطلاب التواصل معهم مرة واحدة في الاسبوع كحد أدنى باستخدام الإيميل او محادثات الفيديو. كما تم توجيه الطلاب بتوثيق جميع المراسلات والمحادثات التي تمت مع الخبراء.

يمكن ان يطلق على هذا النشاط:

□ drill and practice □ eAppearance □ online role-play □ telementoring

---

س٥) قام معلم الدراسات الإجتماعية في احدى مدارس لوس انجلوس بدعوة صديقه المؤرخ في مدينة بوستن للقيام بدور بنجامين فرانكلين الذي يعد أحد القادة الذين ساهموا في صياغة دستور الولايات المتحده الامريكية عام ١٧٧٦. قام هذا المؤرخ بتجسيد شخصية بنجامين فرانكلين وسرد قصته عن طريق دائرة تلفزيونيه, كما أجاب على أسئلة الطلاب التي كانت ترد اليه عن طريق الايميل ومحادثات الفيديو المباشرة. وفور انتهاء الدرس قدم الطلاب عرضا مصورا للسيرة الذاتيه لبنجامين فرانكلين.

يمكن ان يطلق على هذا النشاط:

□ online role-play □ global classroom □ keypals □ virtual fieldtrip

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س٦) في احد مواضيع مادة العلوم, قام مجموعة من طلاب المعلمة "كايلي" بكتابة نص يشرح التغيرات البيئية في احدى البحيرات القريبة من المدرسة. بعد ذلك تم التقاط صور لبعض الحيوانات التي ترتاد هذه البحيرة, وصور اخرى توضح التغيرات البيئيه الحاصلة في محيط البحيره. كما تمكن الطلاب من تسجيل مقاطع صوتيه وتصوير مقاطع فيديو اثناء النهار والليل توضح هذه التغيرات, ثم قاموا بترتيب تسلسل الاحداث واختيار الصور ومقاطع الصوت والفيديو المناسبة لكل حدث تمهيدا لعمل فيديوا يحكي التغيرات البيئيه في البحيرة. وفور الانتهاء من انشاء الفيديو تم عرضه على جميع الطلاب.

يمكن ان يطلق على هذا النشاط:

□ digital citizenship □ digital storytelling □ ePublishing □ scaffolding

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س٧) طلب "فريد" معلم اللغة الإسبانية للصف الثاني المتوسط في احدى المدارس الأمريكية من صديقه "ألبرتوا" المعلم في احدى المدارس المكسيكية إقامة نشاط يتبادل فيه طلابهما الإيميلات. قام "فريد" بالتنسيق مع "ألبرتوا" بربط كل طالب من

صفه بطالب اخر من صف "ألبرتوا". كان الغرض من النشاط مقارنة الحياة في البلدين وأيضا مساعدة الطلاب الأمريكيين على ممارسة اللغة الاسبانية.

يمكن ان يطلق على هذا النشاط:

□ telementoring □ keypals □ eAppearance □ ePublishing

س٨) "ستيف" مدرب في شركة سبرنت للإتصالات حيث يقوم بتدريس مقررعن الألياف البصرية. أراد ستيف ان يدعم المقرر بالعديد من المراجع الإلكترونية التي توضح أساليب نقل المعلومات المقدمة من قبل عدة شركات. قام ستيف بتسجيل العديد من المحاضرات بالإضافة الى جمع بعض الفيديوهات والصور عن بعض المصانع ووضعها على موقع المقرر. أثناء المحاضرات الأسبوعيه يستخدم ستيف مفردات المقرر الإلكترونية ليوضح للطلاب اين يمكن ان يجدوا المراجع الإلكترونية والإختبارات. يقوم الطلاب بزيارات منتظمة لموقع المقرر للاستفادة من المراجع ولأخذ الاختبارات. هذه الطريقة مكنت ستيف من التركيز بشكل اكبر على التطبيقات العملية اثناء المحاضرة.

يمكن ان يطلق على هذا النشاط:

□ synchronous learning □ blended learning □ collaborative eLearning □ webquest

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س٩) تؤمن المعلمة "هاذر" بأنه يجب على طلابها ان يتقنوا مهارات الجمع والضرب اذا ارادوا أن يكونوا قادرين على حل مسائل رياضية اصعب. لتحقيق هدفها قامت "هاذر" بإعطاء طلابها بطاقات تعليمية بالاضافة الى بعض البرامج التي تمكن الطلاب من ممارسة المهارات الأساسية في الرياضيات بشكل مستمر الى أن يتم الوصول الى اتقان هذه المهارات. أرادت "هاذر" أن تجعل طلابها قادرين على الإجابة بشكل سريع وتلقائي على أي عملية جمع او ضرب.

يمكن ان يطلق على هذا النشاط:

□ webquest □ scaffolding □ telementoring □ drill and practice

---

س١٠) أثناء أدائها لورقة بحثية في مادة العلوم, وجدت "بريتني" معلومات مفيدة على شبكة الإنترنت. قامت "بريتني" بنسخ هذه المعلومات وتضمينها في بحثها دون الإشارة الى مصدر هذه المعلومات. بعد مراجعة البحث من قبل المعلمة, قامت المعلمة بإبلاغ "بريتني" ان ما فعلته يعتبر سرقة أدبية وذلك بأخذها معلومات من الاخرين دون الإشارة إليهم. أخبرت بريتني معلمتها انها لم تكن تعلم أن ما فعلته مخالف لحقوق النشر ووعدتها بعدم تكرار ذلك.

يمكن ان يطلق على هذا النشاط:

□ digital storytelling □ ePublishing □ digital citizenship □ scaffolding

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س١١) قرر "جون" أن يجعل طلابه في مدينة سياتل يشاركون في بحث عن الإحتباس الحراري. قام الطلاب بالبحث عن مقالات وتقييم مواقع إلكترونية في هذا الموضوع. بعد ذلك جمع الطلاب بيانات عن درجات الحرارة في مدينتهم سياتل ونشروا النتائج التي توصلوا إليها على أحد المواقع الذي يحتوى على بيانات عن درجات الحرارة في مناطق مختلفة حول العالم تم جمعها عن طريق عدة مدارس. قام الطلاب بمقارنة البيانات الموجودة على هذا الموقع وأنشؤوا رسما بيانيا يوضح التغيرات الحرارية الحاصلة في المناطق الريفية والصناعية.هذه التحليلات مكنت الطلاب من عمل استنتاجات عن ظاهرة الإحتباس الحراري حيث تم انشاء عرض تقديمي كما تم تقديم بحث يشرح وجة نظر هؤلاء الطلاب حول هذه الظاهرة.

يمكن ان يطلق على هذا النشاط:

□ drill and practice □ eAppearance □ ePublishing □ webquest

س١٢) عند دراسة طلاب مادة العلوم في صف "ايمي" لموضوع دورة الماء في الطبيعة, قام كل طالب بإنشاء رسم توضيحي لهذه الظاهرة باستخدام برنامج حاسوبي مخصص لهذا الغرض . قام كل طالب برسم دائرة في المنتصف كتب فيها دورة الماء في الطبيعة, ثم قاموا برسم عدة أسهم تتفرع من هذه الدائرة وتبين عناصر دورة الماء في الطبيعة. تم توصيف هذه الأسهم بوضع بعض الكلمات او العبارات التي توضح العلاقة بين عناصر دورة الماء في الطبيعة كما تم اضافة صور وروابط الكترونية لكل عنصر من عناصر هذا الموضوع.

يمكن ان يطلق على هذا النشاط:

□ ePortfolio □ simulation □ concept mapping □ drill and practice

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س١٣) قام ريتشارد بتقسيم طلابه الى ست مجموعات وأعطى كل مجموعة مشروعا يتم العمل عليه عبر الإنترنت. شرح ريتشارد اهداف كل مشروع كما وضع جدولا يبين فيه مواعيد وتواريخ هامة لكل جزئية من جزئيات المشروع. كما شجع طلابه على التواصل مع بعضهم البعض عن طريق الايميل, أو محادثات الفيديو, أو عن طريق شبكات التواصل الاجتماعي. قام أعضاء كل مجموعة بوضع قائمة بأهداف مشروعهم كما قاموا بتوزيع الأدوار والمسؤوليات فيما بينهم. عمل أعضاء كل مجموعة على إنشاء عرض بالوسائط المتعددة لمشروعهم, وقدموه لزملائهم في الصف.

يمكن ان يطلق على هذا النشاط:

□ telementoring □ asynchronous learning □ ePortfolio □ collaborative eLearning

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س١٤) قرر مايكل أن يدرس مقررا يقدم بالكامل عن طريق الإنترنت بحيث يغنيه عن الذهاب الى الجامعة وأيضا لا يتطلب تواجده في وقت محدد. في هذا المقرر يتم وضع المحاضرات ومواد القراءة على موقع المقرر حتى يتسنى للطلاب عرضها وتحميلها متى ما أرادوا. كذلك يقوم استاذ المقرر بالتواصل والرد على اسئلة الطلاب باستخدام الإيميل. طبيعة هذا المقرر تتيح لمايكل ان ينهي جميع الأنشطة والإمتحانات حسب الوقت المتاح له طالما ان جميع هذه الأنشطة والإمتحانات سيتم ارسالها قبل نهاية الفصل الدراسي.

يمكن ان يطلق على هذا النشاط:

□ synchronous learning □ digital storytelling □ asynchronous learning □ teleconferencing

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س١٥) كلف أساتذة قسم التمريض بجامعة ويسترن كل طالب من طلاب القسم بتصميم موقع على الانترنت يحتوي على التالي: فلسفة الطالب في التمريض والتعامل مع المرضى, معايير الولاية في مهنة التمريض, وبعض الأمثلة والأدلة التي توضح كفاءة الطالب في كل معيار من معايير الولاية. قام كل طالب بسرد فلسفته وبوصف الطريقة التي سوف تمنكه من تحقيق كل معيار من المعايير على الموقع كما تم وضع أمثلة في صيغة رقمية لكل معيار لتدلل على كفاءة الطالب في هذا المعيار. جميع الأمثلة ومحتويات الموقع كانت على صيغة رقمية لكي يتمكن الأساتذة والإداريون من الوصول اليها.

يمكن ان يطلق على هذا النشاط:

□ eImpersonation □ ePortfolio □ telementoring □ keypals

س١٦) في الأسبوع الأول من كل شهر يذهب الموظفون الجدد في مقهى ستار بكس الى مركز التدريب في شيكاغو. هناك يتعلمون كيفية عمل القهوة والأساليب المثالية في التعامل مع الزبائن. أيضا يقوم المدربون في المركز الرئيسي في سياتل بالتواصل مع المتدربين الجدد مباشرة عبر دائرة تلفزيونية حيث يقومون بتعليمهم خطوات عمل القهوة, كما يقومون بمراقبة أداء المتدربين واعطاء بعض النصائح والإرشادرات. احد هذه التدريبات عبارة عن زبون يظهر على الشاشة ويقوم المتدربون بخدمته تحت مراقبة الخبراء من سياتل والذين يقدمون التوجيهات والنصائح.

يمكن ان يطلق على هذا النشاط:

□ synchronous learning □ global classroom □ asynchronous learning □ A cyberhunt

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س١٧) قام جورج مدرس تطبيقات التكنولوجيا في التعليم في جامعة كولمبيا بتصميم مدونه (blog) لمقرره الذي يدرسه .كذلك طلب من طلابه انشاء مدونات شخصية (blogs) والإنضمام الى مدونة المقرر حتى يتمكن جورج من الإطلاع على محتويات هذه المدونات . في كل أسبوع, يقوم جورج بتحميل مواد القراءة والواجبات والاعلانات على مدونة المقرر. كما أن الطلاب ملزمون بوضع جميع واجباتهم وتعليقاتهم وروابط المواقع ذات الصلة بمواضيع القراءة المحددة لهم على مدوناتهم الشخصية. في نهاية الفصل الدراسي, يقوم جميع الطلاب وبشكل جماعي بإنشاء Wiki يجمع ما تم تعلمه خلال الفصل الدراسي ويعكس مدى استيعاب الطلاب للمقرر.

يمكن ان يطلق على هذا النشاط:

□ social media □ concept mapping □ telementoring □ ePortfolio

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س١٨) شارن , استاذة في كلية التمريض, قامت بإعطاء طلابها برنامجا حاسوبيا تفاعليا يحتوي على سيناريوهات طبيه تحاكي الحياة الواقعية لعمل الممرض والممرضة داخل المستشفى. استطاع الطلاب ان يمارسوا بعض مهارات التمريض عن طريق التفاعل مع هذه السيناريوهات حيث كان بإمكانهم تشخيص الحالات واقتراح العلاج اللازم.

يمكن ان يطلق على هذا النشاط:

□ collaborative eLearning □ drill and practice □ simulation □ online role-play

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س١٩) أدرك وليامز مدير مدرسة بارك هيلز الثانوية أن مهارات تقنية المعلومات من الأمور المهمة للغاية والتي يحتاجها الطلاب في الحياة العملية بعد تخرجهم من المرحلة الثانوية. لذلك قرر وليامز أن يطلب من الطلاب احضار كمبيوتراتهم المحمولة الى المدرسة كل يوم ,كما تم توفير جميع الكتب الدراسية وكذلك المواد التعليمية المساندة في صيغه مستندات الكترونية. طلب وليامز أيضا من مدرسي المدرسة أن يضعوا مفردات المقررات الدراسية على الموقع الإلكتروني للمدرسة حتى يستطيع الطلاب وأولياء أمورهم معرفة ما يدرس لأبنائهم بشكل ميسر وسهل.

يمكن ان يطلق على هذا النشاط:

□ scaffolding □ simulation □ webquest □ technology integration

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س٢٠) في أحد المقررات الجامعية, كان على الطلاب أن يقدموا المشروع النهائي في المحاضرة الأخيرة للمقرر في نهاية الفصل الدراسي. لكن اثنين من الطلاب أخبرا أستاذ المقرر بأنهما لا يستطيعان الحضور في هذا اليوم لأنهما سيكونان خارج المدينة لحضور اجتماعات تخص عمليهما. قام المعلم بتجهيز اتصال تفاعلي مباشر تم فيه استخدام الكاميرا والميكروفون لتسهيل التواصل مع الطالبين الذين كانا خارج المدينة .تمكن الطالبان من عرض مشروعيهما, والاستماع الى العروض الأخرى وكذلك شاركا في المناقشات التى دارت في هذا اليوم.

يمكن ان يطلق على هذا النشاط:

□ asynchronous learning □ eAppearance □ teleconferencing □ global classroom

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س٢١) يوجد لدى بعض طلاب مادة القراءة في صف المعلمة "إيميلي" صعوبات في فهم المواضيع والقصص الجديدة الأكثر تعقيدا. من أجل تحسين قرائتهم, في البداية قدمت إيميلي كتبا تحتوي على صور بدون كلمات. وبشكل تدريجي قامت إيميلي بزيادة مستوى الصعوبة في المواد المطلوب قرائتها. في أنشطة القراءة الصفية, قامت "إيميلي" بضم كل طالب لديه صعوبة في القراءة مع طالب اخر لديه مهارات عالية في فنون القراءة لكي يقرأ كل منهما للاخر. بعد ذلك أعطت "إيميلي" نصوصا للقراءة أكثر تقدما مع بعض الأسئلة المساعدة على استيعاب هذه النصوص. قام طلاب" إيميلي" بتسجيل قراءاتهم وارسالها عن طريق الإيميل لمعلمتهم إيميلي ولوالديهم.

يمكن ان يطلق على هذا النشاط:

□ scaffolding □ simulation □ webquest □ drill and practice

Appendix F

The Arabic Version of the Questionnaire

القسم الأول: المعلومات الشخصية

١ الجنس: [ ] ذكر [ ] أنثى

٢ المستوى الدراسي الحالي:

طالب في معهد اللغه في المستوى: [ ] الأول [ ]الثاني [ ]الثالث [ ]الرابع [ ]الخامس

طالب بكالوريوس: [ ] السنة الأولى [ ] السنة الثانية [ ] السنة الثالثة [ ] السنة الرابعة

طالب دراسات عليا: [ ] ماجستير [ ] دكتوراه

٣ التخصص: [.....].

٤ كيف تقيم مستوى القراءة لديك في اللغة الإنجليزية :

[ ] ضعيف [ ] متوسط [ ] جيد [ ] جيد جدا [ ] ممتاز

كيف تقيم مستوى الإستماع لديك في اللغة الإنجليزية :

[ ] ضعيف [ ] متوسط [ ] جيد [ ] جيد جدا [ ] ممتاز

القسم الثاني: من وجهة نظرك , أي من العبارات التالية تعتبر اكثر اهمية في التعليم ؟ الرجاء وضع علامة (X) او تظليل الخيار المناسب بناء على المقياس التالي:

١= غير مهم ٢= مهم نوعا ما ٣= لا رأي لي ٤= مهم ٥= مهم جدا

		١	٢	٣	٤	٥
١	فهم المحتوى	❍	❍	❍	❍	❍
٢	عمل عرض تقديمي فعال	❍	❍	❍	❍	❍
٣	تقييم الأفراد بشكل جيد	❍	❍	❍	❍	❍
٤	دمج التكنولوجيا مع المحتوى	❍	❍	❍	❍	❍
٥	التعاون مع الاخرين كوسيلة لدعم وتطوير المهارات	❍	❍	❍	❍	❍

القسم الثالث: قيم خبرتك في البرامج التالية بوضع علامة (X) او تظليل الخيار المناسب حسب المقياس التالي:

١= لا توجد لدي أي خبره ٢= خبرة ضعيفه ٣= خبرة جيدة ٤= خبرة جيدة جدا ٥= خبرة ممتازة

		١	٢	٣	٤	٥
١	محركات البحث (i.e. Google, Bing, Yahoo)	❍	❍	❍	❍	❍
٢	تصميم صفحات على الإنترنت (i.e. HTML, Dreamweaver)	❍	❍	❍	❍	❍
٣	برامج تحرير ومعالجة الصور (i.e. Photoshop)	❍	❍	❍	❍	❍
٤	برامج معالجة النصوص (i.e. Microsoft Word)	❍	❍	❍	❍	❍
٥	برامج العروض التقديمية (i.e. PowerPoint, Prezi)	❍	❍	❍	❍	❍
٦	برامج الصور المتحركه (i.e. Flash)	❍	❍	❍	❍	❍
٧	برامج تحرير ومعالجة الفيديو (i.e. iMovie, FinalCut)	❍	❍	❍	❍	❍
٨	برامج تحرير الصوتيات (i.e. Audacity, Garage band)	❍	❍	❍	❍	❍
٩	قنوات العمل التعاوني (i.e. Wikis, Google Docs)	❍	❍	❍	❍	❍
١	برامج انشاء الإستبانات الالكترونية (i.e. SurveyMonkey, Qualtrics)	❍	❍	❍	❍	❍
١ ١	برامج عقد المؤتمرات والتواصل عن بعد (i.e. Adobe Connect, iChat, Skype)	❍	❍	❍	❍	❍
١	شبكات التواصل الاجتماعية (i.e. EdModo, Facebook, MySpace)	❍	❍	❍	❍	❍
١	برامج الإيميل (i.e. Gmail, Yahoo, Hotmail)	❍	❍	❍	❍	❍
١	المحادثات الغير تزامنية ومنتديات الحوار (i.e. Discussion Boards)	❍	❍	❍	❍	❍
١	برامج النشر الإجتماعية (i.e. Flicker, YouTube)	❍	❍	❍	❍	❍

شكرا لمشاركتكم

Appendix G

Translation Accuracy

Rate the equivalence between **the source version** and the **back-translated** version of this instrument where **1** means Not equivalent and **10** very equivalent

Item	Source Language (original) version	Back-translated Version	Degree of Equivalence
1	Sara is teaching social studies at a secondary school in Austin, Texas. As part of a unit on immigration, Sara decided to pair her students with students from classes in Australia and England. These students worked together in groups using both synchronous and asynchronous technologies in order to better understand the immigration policies, cultures, and customs in their respective countries.	Sara is a social studies teacher in a school in Texas. While teaching a subject about immigration, Sara decided to pair her students with others from Australia and Britain. Students worked together in groups using synchronous and asynchronous communication techniques to understand the regulations that govern immigration, culture and fashion in these countries.	9 Comments:
2	Teachers at a middle school in Miami have an online magazine that contains students' short stories, essays, poems, photos, and videos. Every month a note goes out to parents and students across Florida to announce a new addition of the magazine and to highlight the students' work.	Middle school teachers in Miami supervise an electronic magazine that includes various students' assignments such as short stories, articles, poems, pictures and video clips. Each month, a new issue of the magazine containing recent students' pieces is advertized.	Degree of Equivalence 10 Comments:

3	Secondary students in Washington, DC were studying about the risks and accomplishments of space flights. Their teacher asked them to search this topic and prepare questions to ask NASA's launch director, Omar Baez. The teacher then set up a videoconference with director Baez using a web camera, and students asked the director questions and listened to his responses about the precautions taken during the launch process. After completing the interview with director Baez, the students did some additional research and produced a PowerPoint presentation about NASA's safety procedures.	As high school students in Washington were studying risks and achievements of space voyages, the teachers asked them to reseach this topic and prepare questions to address Omar Baz one of NASA's experts. The teacher prepared an internet conference/ interview using television with Baz who talked about the measures that is met in space voyages and responded to students' inquiries. By the end of the conference/ meeting, students conducted a research about the topic and prepared a Power Point presentation that explained the safety precautions that NASA implement in Space voyages.	Degree of Equivalence 10 Comments:
4	A middle school teacher in San Francisco decided to identify math and science experts in the Bay area who would agree to assist students in reviewing their projects and career decisions. Students were encouraged to communicate at least once a week via video conferencing or e-mail, and they were instructed to keep a record of their interaction with their expert.	A middle school teacher in San Francisco decided to look for experts in math and science in the Bay County to review / evaluate students' projects and job decisions. After locating these experts, the teacher asked students to communicate with them at least once a week using email or video conversation. Students were also advised to document the conversations and emails that were	Degree of Equivalence 10 Comments:

		made.	
5	In a lesson about famous historical Americans, a social studies teacher in Los Angeles invited her historian friend in Boston to portray Benjamin Franklin, one of the leaders who helped to develop the United States constitution in 1776. The students in the class used email and a live teleconference to ask questions and hear the story of Franklin. They later gave a biographical presentation about Franklin to their class.	A social studies teacher in one of Los Angeles's schools invited his historian friend from Boston to play the role of Benjamin Franklin who is considered one of the pioneers that contributed in framing the constitution of the United States in 1776. The historian narrated Benjamin Franklin's story through a televised conference/ interview. He also addressed students' questions that were received via email and live video feeds. At the end of the lesson, students delivered Power Point presentation about Benjamin Franklin journey.	Degree of Equivalence 9 Comments: "biographical" changed to "PowerPoint"
6	In a secondary science class, students wrote a story about environmental changes in a pond by their school. They took pictures of the animals and plants near the pond and made some video and audio recordings in the morning and at night. Once they finalized their ideas, they created a	In on of the science topics, a group of Ms. Kylee students wrote a piece explaining the changes in the environment in one of the lakes near the school. Later, pictures of animals from the lake and pictures of the environmental changes surrounding the lake were taken. Students were able to record audio	Degree of Equivalence 8 Comments: Where did the name "Ms. Kylee" come from?

	storyboard, edited the media and developed a video that they shared in class.	and video segment in day and night showing these changes. Then, they organized suitable pictures, audio and video to show a series of events that reflects changes in the lake. The final video was played for students.	
7	Fred, an eighth grade Spanish teacher from Albuquerque, invited his teacher friend Alberto from a Juárez, Mexico school to start an e-mail partners exchange with his students. Fred randomly assigned each student in his class to a partner student in Alberto's class. The purpose of the activity was to compare life in the two cultures and to help American students practice their Spanish skills.	Fared the Spanish teacher asked his friend Alberto the teacher at a Mexican school to allow their students to exchange emails. Fared connected each student from his class with a student from Alberto's class. The goal of the activity was to compare the life between the tow countries and to assets American students to practice Spanish.	Degree of Equivalence 10 Comments:
8	Steve, a trainer with Sprint Telecommunications, wanted to expand his course on fiber optics to include better representations of the	Steve an instructor at Sprint communication teaches a curriculum about fiber optics. He wanted to support the curriculum	Degree of Equivalence 8

	data transmission and switching strategies offered by different manufactures. He recorded and posted many of his lectures online along with the manufacturers' videos and photos. During his weekly class sessions, Steve used an online syllabus to show the students where they could find the lectures, manufacturers' media, and the online quizzes that he had created. This allowed Steve's students to spend more in-class time on hands on activities with the equipment.	with several electronic references that explains methods of information transportation from multiple companies. Steve recorded many lectures in addition to collecting some videos and pictures about factories and including them into the curriculum's web page. During weekly lectures, Steve uses electronic vocabulary to explain where students would find the electronic references and tests. Student regularly visit the web page to use references and take tests. This method enabled Steve to better concentrate on applications in lectures.	Comments: Steve uses electronic vocabulary to explain where students would find the electronic references and tests ? Where did this come from?
9	Heather understood that her students must have excellent addition and multiplication skills if they were to succeed in solving higher order mathematic problems. Heather used flash cards and software programs, so that the	Heather believes that students should master adding and subtracting skills if they desire to able to solve harder mathematical questions. To reach her goal, Heather distributed educational card to her students in addition to	Degree of Equivalence 9

	students could try out their mathematic skills until they mastered them. She wanted to make sure that her students would provide the correct answers automatically whenever they were asked any single digit addition or multiplication problems.	programs that enable students to constantly practice basic math skills until the skills is mastered. Heather wanted her students to be able to quickly and automatically solve any adding and subtracting question.	Comments:
10	Britney had a research paper due in her science class. She found useful information related to her research on the web, so she copied and pasted a paragraph from that website to her paper and handed the research in to her teacher. After reviewing the paper, the teacher told Britney that she had committed plagiarism by copying the paragraph without the appropriate citation. Britney told her teacher that she now understood what plagiarism was, and that she would never do it again.	During a preparation of a paper for a science class, Britney discovered useful information on the internet. She copied these information and included it in her paper with no reference to the source. After the teacher reviewed the paper, she informed Britney that what she did is concerned plagiarism. Britney informed her teacher that she did not know that what she did was a violation of the copy write law and she promised not to repeat her mistake.	Degree of Equivalence 9 Comments: "Committed" becomes "concerned" – very different words.
11	John decided to have his students in Seattle participate in research on global warming. First, his students	John decided to encourage his student to participate in a research about global warming in Seattle.	Degree of Equivalence 9

	searched for articles and evaluated websites on global warming, and then they collected temperature data for their region and posted their findings along with the findings from other partner schools in different locations around the world. The students then compared all the data that had been collected by the partner schools across the globe. Next, they created a model comparing changes in temperature across urban and rural areas. John's students used this analysis to draw conclusions about global warming, create a media presentation, and write a research paper explaining their perspectives on global warming.	Student searched for articles and evaluated web sites about the topic. Students gathered data about temperatures in their city Seattle and posted their results in a web site that include temperature data in different places of the world which was collected by other schools. Then students compared existing data on the web site and produced a chart that describes temperature change in rural and industrial areas. These analyses helped students to develop conclusions about global warming. Students prepared a power point presentation and a paper explaining their points of view over global warming.	Comments: "research" becomes "PowerPoint"
12	In Amy's science lesson, students were learning about the water cycle. Each student created a diagram of the water cycle using software for constructing diagrams. They started by creating a circle showing the term water cycle in the center, and then added arrows that branched out from the circle showing the key aspects of the water cycle. They also labeled the	While science students in Amy's class were learning the cycle of water in nature, each student prepared an illustration of this phenomenon using a custom/ special software. Each student drew a circle in the middle and wrote "Water Cycle in Nature". Then they several arrows coming from this circle and showing elements of the water cycle in	Degree of Equivalence 10 Comments:

	arrows with words or short phrases that described the relationship between the connected aspects of the water cycle. Students added pictures and links to websites to each idea in the diagram.	nature. These arrows were described putting by placing some words or phrases that show the relationship between the elements of the water cycle in nature. Also pictures and links for each element of the subject were added.	
13	Richard divided his world history students into six groups and assigned each group to an online project. Richard explained the objectives of each project and posted a large calendar that showed important deadlines for each aspect of the project. He encouraged students to communicate with each other via email, videoconferencing, and social media. The teams listed their objectives for the projects and identified the roles and responsibilities for each team member. Then, they worked on media presentations for their projects while Richard monitored their progress. Finally, the students presented their topic to their classmates.	Richard divided students into six groups. He gave each group a project to accomplish over the Internet. Richard explained the objectives of each project and placed a table showing important dates for each subset of the project. He also encouraged his students to communicate with each other via email, video chats, or through social networking. The members of each group developed a list of goals of their project. In addition, they distributed the roles and responsibilities among themselves. Members of each group created a multimedia presentation for their project, and presented it to their classmates.	Degree of Equivalence 10 Comments:

14	Michael was working full time, and he decided to take a fully online class that was self-paced. He chose this online class because he did not need to drive to campus, he could work on class projects at night, and he was not required to be online at a specific time. For this class, the instructor posted all lectures and reading materials online, so that students could access the resources at their own pace. The instructor also provided feedback and answered questions using email. Michael was allowed to finish the activities and exams according to his schedule as long as all required components were posted before the end of the course.	Michael who works full-time decided to take a curriculum entirely through the Internet so that he doesn't need to go to university and also does not require his presence at a specific time. In this curriculum lectures and reading materials are placed on a web page so that students view and download as they desire .Also, the teacher responds to questions from students using e-mail. The nature of this curriculum allows Michael to end all activities and examinations by the time available as long as all of these activities and examinations will be sent before the end of the semester.	Degree of Equivalence 10 Comments:
15	Instructors at Western University asked their nursing students to create a website that included their philosophy toward nursing and working with patients. Each student's website was organized around the state standards for nursing education. Students provided a description of how they would achieve the standards through media examples showing	Department of Nursing professors at the University of Western asked every student to design a web site that contains the following: student's philosophy in nursing and dealing with patents, state standards in the nursing profession, some examples and evidence that show the efficiency of the student in each criterion of state standards. Each student	Degree of Equivalence 10 Comments:

	their clinical experience, and included other evidence that demonstrated their competencies for each standard. All evidence and self-reflection were recorded in a digital format and were accessible on the Internet for faculty and administrator review.	explained his philosophy and describe the way in which will enable him to achieve each criterion on the web site. Also digital format examples for each standard to demonstrate the efficiency of the student in this standard were included. All examples and web site content were on a digital format so that teachers and administrators have access to it.	
16	The first week of each month, new employees at the Chicago Starbucks Coffee Company go to their local training center. There they learn to make coffee and work successfully with customers. The trainers from the Seattle headquarters greet the new trainees via television monitors and show them the step-by-step procedures for making coffee. The trainers directly observe the trainees and provide tips and suggestions. A mock customer appears on the screen, and the trainees interact with the customer in real time while the experts offer suggestions.	In the first week of every month, newly hired employees in Starbucks go to the training center in Chicago. There they learn how to prepare coffee and optimal methods in dealing with customers. Also instructors in the main center in Seattle directly communicate with new trainees via a video where they teach them steps of making coffee. They also monitor the performance of the trainees and give some advises/ tips. One of these exercises includes a client that appears on the screen and the trainees attend to his service under the supervision of experts from	Degree of Equivalence 10 Comments:

		Seattle, who provides guidance and advice.	
17	George, who teaches at Columbia University, created a blog for his class on the application of technology in education. He also asked his students to create personal blogs, and then subscribe to the class blog. Each week George posted the reading, assignments and the announcement to his class blog. Students were asked to post relevant websites, completed assignments, and reflections on their personal blogs. They also received feedback from their instructor and classmates through their blogs. At the end of the semester, all students collectively built a Wiki to synthesize and express what they had learned.	George the applied technology professor at Columbia University designed a blog for his curriculum. He asked his students to create personal blogs and join the curriculum blog so that he could see the contents of these blogs. Each week, George loads reading materials, assignments and advertising on the curriculum blog. Students are required to put all their assignments, their comments and related links on their personal blogs. At the end of the semester, all students and collectively create a Wiki combines what has been learned during the semester and reflects the students' understanding of the decision.	Degree of Equivalence 10 Comments:

18	Sharon, a nursing school professor, gave her students an interactive software lesson that depicted clinical scenarios in real life situations. The students practiced nursing skills by interacting with these scenarios, answering questions, and suggesting therapies.	Sharon, a professor at the College of Nursing, give her students an interactive computer program, containing medical scenarios simulate real-life work of a nurse in the hospital. Students were able to exercise some nursing skills by interacting with these scenarios, where they were able to diagnose cases and propose the necessary treatment.	Degree of Equivalence 10 Comments:
19	Principal Williams recognized that many of the students in Park Hills Secondary would need information technology skills in the careers they would enter after they graduated. He decided to require students to bring a portable computer to school each day; all textbooks and other instructional materials were available in a digital format for the students' notebooks. The teachers were also required to post their syllabi and assignments on the school's website, so that students and their parents would easily know what was being taught.	Williams, the principal of Park Hills High School realized that IT skills are very important to students which might come useful in life after graduation from high school. As a result, Williams decided to ask students to bring their laptops to school every day, and all textbooks and educational support materials were made available in digital format. Williams also asked school teachers to put vocabulary courses on the schools' website so that students and parents know what being taught to their children in an easy and accessible way.	Degree of Equivalence 9 Comments: "syllabi" became "vocabulary courses"

20	In a university seminar class, students had to present their final project on the last day of classes. Two of the students told the instructor they would not be able to attend the class because they would be out-of-town at a professional meeting. The instructor set up an interactive connection with the students, so that they could interact live in the class using a video camera and microphone. The out-of-town students presented their projects, listened to the other presentations, and participated in discussions with their classmates at the university.	In a university curriculum, students had to submit the final project at the last day of classes. But two students informed the instructor that they could not attend on that day because they will be out of town to attend meetings related to their work. The teacher prepared direct interactive connection using a camera and a microphone to facilitate communication with the students who were outside the city. The students were able to present their projects and to listen to other presentations and participated in the discussions that took place on this day.	Degree of Equivalence 10 Comments:
21	Some of the students in Emily's reading class were having difficulty understanding the new, more complex, stories. In order to improve their reading, Emily first gave her students wordless books containing only pictures, and gradually she increased the difficulty level of the reading materials. In class, she paired the struggling students with more knowledgeable readers in activities	Some students in Ms. Emily class have difficulties in understanding topics and more complex stories. In order to improve their reading skills, Emily presented books that contained pictures without words. She gradually increased the level of difficulty in the reading topics. In classroom reading activities, Emily paired each student that has difficulty reading with another student has a high reading skill so	Degree of Equivalence 10 Comments:

	where they read to each other. Then, Emily gave students more advanced reading with guided questions. Students recorded what they read and emailed their reading list to Emily and their parents.	each would read to that other. Then Emily gave more advanced texts with some questions to help absorb these texts. Emily's students record their readings and sent them via e-mail to their teacher Emily and their parents.	

Appendix H

Terms Selections Survey Experts A

Critical Educational Technology Terms

Critical Educational Technology Terms

We are seeking to develop a list of terms that all Educational Technology students should understand.

As opposed to covering technical or vendor terms (e.g. algorithm, bandwidth apache or blackboard) we are

targerting terms that will help educators understand new strategies for integrating technology in

teaching and learning (e.g. webquest, digital story telling and constructivism).

You have been identified as an expert in Educational Technology. We will greatly appreciate your thoughts on what terms should be included in this list.

Critical Educational Technology Terms

Below is a possible list of terms that teachers and educational technology students should understand.
Please indicate any terms that you believe should be added or deleted.

Asynchronous Learning , Blended Learning , Brainstorming , Collaborative eLearning

Concept Mapping , Conflict Resolution , Constructionism , Constructivism,

Data-Driven-Decision Making , Digital Divide , Digital Immigrant , Digital Impersonations ,

Digital Information , Digital Portfolio , Digital Storytelling , Drill and Practice , eBook ,

Educational Gaming , Educational Technology , eLearning , Electronic Appearances ,

Global Classrooms , Hypermedia , Immersive Learning , Keypals ,

Learning Management System , Mobile Learning , Podcasting , Rapid Prototyping,

Reusable Information , Simulation , Social Media, Storyboards , Student-Centered Instruction,

Synchronous Learning , Teleconferencing , Telementoring Tutorial , Videoconferencing ,

Virtual Classroom , Visual Learning , Webquest

List terms that should be ADDED

List terms that should be DELETED

Thank you for your participation

Appendix I

Terms Selections Survey Experts B

Are these terms relevant to technology integration?
Y = Relevant, ? = Not Sure, N = Not Relevant

Terms	Y	?	N	Terms	Y	?	N
Asynchronous Learning				Hypermedia			
Avatar				Immersive Technology			
Blended Learning				Interactive Whiteboard			
Brainstorming				Keypals			
Cloud Computing				Learner-Centered Instruction			
Collaborative Learning				Learning Management System			
Concept Mapping				Learning Objects			
Conflict Resolution				Mobile Learning			
Constructivism				Online Community			
Cyberhunt				Online Role-Play			
Data Driven Decision Making				Podcasting			
Data Mining				Reusable Knowledge			
Digital Citizenship				Scaffolding			
Digital Divide				Simulation			
Digital Immigrant				Social Media			
Digital Information				Storyboards			
Digital Natives				Students Response System			
Digital Storytelling				Synchronous Learning			
Distributed Learning				Technology Integration			
Drill and Practice				Teleconferencing			
eAppearances				Telementoring			
eBook				Threaded Discussion			
Educational Games				Tutorial			
Educational Technology				Universal Design for Learning			
eLearning				Virtual Classroom			
ePortfolio				Visual Learning			
ePublishing				WebQuest			
eTrip				Wiki			
Global Classrooms				Zone of Proximal Development			
Human Computer Interaction							

Appendix J

Terms Selections Survey Experts C

Attitudes scale

***We want to establish a list of 25 terms that teacher education major should understand on how to integrate educational technology. Please rank each terms from Unimportant to Very Important**

	Unimportant	2	3	4	5	6	7	8	9	very important
1. Asynchronous Learning	○	○	○	○	○	○	○	○	○	○
2. Blended Learning	○	○	○	○	○	○	○	○	○	○
3. Brainstorming	○	○	○	○	○	○	○	○	○	○
4. Collaborative-Learning	○	○	○	○	○	○	○	○	○	○
5. Concept Mapping	○	○	○	○	○	○	○	○	○	○
6. Constructivism	○	○	○	○	○	○	○	○	○	○
7. Data Driven Decision Making	○	○	○	○	○	○	○	○	○	○
8. Digital Citizenship	○	○	○	○	○	○	○	○	○	○
9. Digital Divide	○	○	○	○	○	○	○	○	○	○
10. Digital Immigrant	○	○	○	○	○	○	○	○	○	○
11. e-Impersonations	○	○	○	○	○	○	○	○	○	○
12. Digital Natives	○	○	○	○	○	○	○	○	○	○
13. e-Portfolio	○	○	○	○	○	○	○	○	○	○
14. Digital Storytelling	○	○	○	○	○	○	○	○	○	○
15. Drill and Practice	○	○	○	○	○	○	○	○	○	○
16. eBook	○	○	○	○	○	○	○	○	○	○
17. Educational Gaming	○	○	○	○	○	○	○	○	○	○
18. Educational Technology	○	○	○	○	○	○	○	○	○	○
19. e-Learning	○	○	○	○	○	○	○	○	○	○
20. e-Appearances	○	○	○	○	○	○	○	○	○	○
21. Electronic Whiteboard	○	○	○	○	○	○	○	○	○	○
22. Global Classrooms	○	○	○	○	○	○	○	○	○	○
23. Hypermedia	○	○	○	○	○	○	○	○	○	○
24. Keypals	○	○	○	○	○	○	○	○	○	○
25. Learning Management System	○	○	○	○	○	○	○	○	○	○
26. Mobile Learning	○	○	○	○	○	○	○	○	○	○
27. Podcasting	○	○	○	○	○	○	○	○	○	○
28. Reusable knowledge	○	○	○	○	○	○	○	○	○	○
29. Simulation	○	○	○	○	○	○	○	○	○	○
30. Social Media	○	○	○	○	○	○	○	○	○	○
31. Students response system	○	○	○	○	○	○	○	○	○	○
32. Synchronous-Learning	○	○	○	○	○	○	○	○	○	○

33. Teleconferencing										
34. Telementoring										
35. Tutorial										
36. Universal Design for Learning										
37. Webquest										
38. Wiki										

List terms that should be ADDED

Appendix K

Counterbalanced Terms and Strategies

A	B	C	Terms
T	V	Q	Asynchronous Learning
Q	T	V	Blended Learning
V	Q	T	Collaborative eLearning
T	V	Q	Concept Mapping
Q	T	V	Digital Citizenship
V	Q	T	Digital Storytelling
T	V	Q	Drill and Practice
Q	T	V	eAppearances
V	Q	T	ePortfolio
T	V	Q	ePublishing
Q	T	V	Global Classrooms
V	Q	T	Keypals
T	V	Q	Online role-play
Q	T	V	Scaffolding
V	Q	T	Simulation
T	V	Q	Social Media
Q	T	V	Synchronous Learning
V	Q	T	Technology Integration
T	V	Q	Teleconferencing
Q	T	V	Telementoring
V	Q	T	WebQuest

T= Text Only, V= Text + Video, Q= Text + Video + Question

Appendix L

The Results of the Video Effectiveness Survey

Terms	Mean
1- Asynchronous Learning	4.00
2- Blended Learning	4.33
3- Collaborative Learning	4.00
4- Concept Maps	4.33
5- Cyberhunt	1.67
6- Digital Citizenship	4.33
7- Digital Storytelling	5.00
8- Drill and Practice	3.33
9- Global Classrooms	5.00
10- Keypals	4.00
11- Online role-play	4.33
12- eAppearances	5.00
13- eBook	4.33
14- Educational Games	4.00
15- ePortfolio	4.67
16- ePublishing	4.33
17- Technology Integration	3.67
18- Teleconferencing	4.00
19- Telementoring	4.33
20- Scaffolding	3.33
21- Simulation	4.00
22- Synchronous Learning	3.67
23- WebQuests	3.00

Appendix M

The Percentage of the Correct Answer for Each Term (NNES)

		% of Correct Answer for Each Instructional Strategy			
Question #	**Correct Answer**	**T**	**V**	**Q**	**% Of Correct Answer**
1	Global classroom	79%	88%	100%	89%
2	ePublishing	88%	89%	82%	86%
3	eAppearance	42%	59%	71%	57%
4	Telementoring	32%	29%	71%	43%
5	Online role-play	53%	74%	71%	66%
6	Digital storytelling	71%	77%	58%	68%
7	Keypals	47%	65%	58%	57%
8	Blended learning	37%	47%	47%	43%
9	Drill and practice	88%	95%	94%	93%
10	Digital citizenship	32%	53%	47%	43%
11	Webquest	47%	47%	53%	49%
12	Concept mapping	88%	79%	100%	89%
13	Collaborative eLearning	53%	88%	63%	68%
14	Asynchronous learning	47%	42%	71%	53%
15	ePortfolio	59%	65%	37%	53%
16	Synchronous learning	26%	47%	35%	36%
17	Social media	65%	74%	82%	74%
18	Simulation	71%	77	53%	66%
19	Technology integration	82%	88%	90%	87%
20	Teleconferencing	77%	63%	65%	68%
21	Scaffolding	42%	59%	77%	59%

Appendix N

The Percentage of the Correct Answer for Each Term (NES)

		% of Correct Answer for Each Instructional Strategy			
Question #	**Correct Answer**	**T**	**V**	**Q**	**% Of Correct Answer**
1	Global classroom	93%	100%	93%	95%
2	ePublishing	100%	93%	100%	98%
3	eAppearance	73%	92%	71%	79%
4	Telementoring	87%	100%	93%	93%
5	Online role-play	86%	80%	100%	88%
6	Digital storytelling	92%	100%	87%	93%
7	Keypals	100%	93%	87%	93%
8	Blended learning	87%	69%	71%	76%
9	Drill and practice	86%	100%	92%	93%
10	Digital citizenship	80%	92%	93%	88%
11	Webquest	69%	86%	73%	76%
12	Concept mapping	86%	73%	100%	86%
13	Collaborative eLearning	100%	79%	93%	91%
14	Asynchronous learning	100%	100%	100%	100%
15	ePortfolio	100%	100%	93%	98%
16	Synchronous learning	80%	77%	78%	79%
17	Social media	57%	73%	100%	76%
18	Simulation	77%	86	87%	83%
19	Technology integration	100%	93%	93%	95%
20	Teleconferencing	79%	80%	85%	81%
21	Scaffolding	100%	100%	93%	98%