EFFECTIVENESS OF CONCEPT MAPS IN LEARNING FROM A COMPUTER-BASED INSTRUCTIONAL VIDEO RESOURCE

A Dissertation

by

OMER FARUK VURAL

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

December 2010

Major Subject: Educational Psychology

EFFECTIVENESS OF CONCEPT MAPS IN LEARNING FROM

A COMPUTER-BASED INSTRUCTIONAL VIDEO RESOURCE

A Dissertation

by

OMER FARUK VURAL

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Approved by:

Chair of Committee,	Ronald D. Zellner
Committee Members,	Michael J. Ash
	Robin A. Rackley
	Victor L. Willson
Head of Department,	Victor L. Willson

December 2010

Major Subject: Educational Psychology

ABSTRACT

Effectiveness of Concept Maps in Learning from a Computer-Based Instructional Video Resource. (December 2010)

Omer Faruk Vural, B.S., Orta Dogu Teknik University;

M.S., Syracuse University

Chair of Advisory Committee: Dr. Ronald D. Zellner

The purpose of this study was to investigate the effectiveness of two different concept mapping methods - learner-generated and expert-generated concept mapping - in computer-based video learning. The students' attitudes toward the use of the concept mapping and computer-based instruction in general were also investigated. The study was performed using the entire enrollment of the junior level undergraduate course (n = 65) Developmental Psychology for Educators (EPSY-320) class, the spring semester of 2010 at Texas A&M University. Using experimental research design, the relationship between student achievements and learning tools was observed. The convenience sampling method was used to assign the students randomly to two treatment groups. The study built on previous research findings on the instructional use of video and concept mapping. It focused on the relative influence of expert-generated versus learner-generated concept maps on student achievement during computer-based video instruction.

Results indicated that there were no significant differences among achievements of students who used either learner-generated concept maps or expert-generated concept maps in the study. However, the expert-generated concept mapping group spent significantly less time than the learner-generated concept mapping group interacting with the instructional tool. The findings revealed that concept map scores mediated the relationships between the numbers of clicks on the video player control, time spent creating concept maps, and time spent on all interaction and student achievement. Although the variables - the number of clicks on the video player control, time spent creating concept maps, and time spent on all interactions - did not have a direct effect on student achievement, they affected the concept map scores, which in turn affected student achievement.

The three variables - perceived usefulness, ease of use, and attitude toward use - were used to define the attitude of the students toward the instructional tool. The results showed that the attitude of the expert-generated group toward the instructional tool was significantly higher than the learner-generated group. Also, on average, the expert-generated concept mapping group expressed neutral feelings on using the instructional tool to improve their learning performance. Alternatively, the learner-generated group did not appreciate the value of this tool. Both groups reported neutral views about the ease of use of the instructional tool.

In conclusion, concept mapping might enhance cognitive learning after the basic skills are acquired and the learners become competent concept mappers. During the creation of concept maps, cognitive load might hinder student learning; therefore, students must be well trained before starting to use the learning tool. Moreover, concept map scores might be used as student grades in video-based learning.

DEDICATION

This dissertation is dedicated to my parents,

who always supported me while I reached my goal,

my wonderful wife, Selma Vural,

my precious treasure of my life, my loving daughter, Zeynep Ecrin Vural, and

my siblings and their families.

ACKNOWLEDGEMENTS

I would like to thank my committee chair, Dr. Ronald Zellner, for giving me the chance to work with him, for supporting me with his great ideas, and for his guidance throughout my graduate career. I want to extend my sincere gratefulness to the members of my dissertation committee, Dr. Victor L. Willson, Dr. Michael J. Ash, and Dr. Robin A. Rackley, who have generously given their time and competence to better my work. I thank them for their contribution and their helpful support. I also want to extend my gratitude to Dr. Joyce Juntune who allowed me to use the instructional tool and collect the data from her class and students who were willing to participate in the study. I also would like to thank Dr. Luana Zellner, who is wife of Dr. Ronald Zellner. She agreed to narrate the text to audio and allowed using it in the instructional video.

Thanks also my friends, colleagues, faculty, and staff for making my time at Texas A&M University a great experience. I will never forget the help of Paola Perez Guarda and Christina Marie Shimek who provided me with encouragement and writing support.

Finally, heartfelt thanks to my parents, and siblings and their families for their support and encouragement. I could not have accomplished the completion of this dissertation without my adorable wife, Selma.

NOMENCLATURE

CI	Confidence Interval
CMS	Course Management Systems
EPSY-320	Development Psychology for Educators
MANOVA	Multivariate Analysis of Variance
ANOVA	Analysis of Variance
TAM	Technology Acceptance Model

TABLE OF CONTENTS

Page

Page

Page

LIST OF FIGURES

Page

Page

LIST OF TABLES

Page

CHAPTER I

INTRODUCTION

Recent research on instruction indicates that a face-to-face teaching method is not necessarily essential for effective learning to take place (Chang, 2004). For example, video-based learning has been extensively incorporated to enhance instruction, particularly in distance learning formats. Chang (2004) determined that distance learners often prefer video-based instruction to other media. Related technologies such as the Internet can enhance the availability and the effectiveness of video-based instructional resources; i.e. instructional video may be viewed by the learners through the Internet or they may be able to download files for later viewing. However, simple, linear viewing of the video material generally results in poor long-term learning outcomes (Schluger, Hayes, Turino, Fishman, & Fox, 1987; Chang, 2004). Consequently, other learning methods should be integrated to insure that the video materials meet their potential to positively impact learning. One such learning method, concept mapping, has shown promise as a general means of enhancing learners' mastery of complex instructional content. It is likely that incorporating one or both of the two types of concept mapping strategies, learner-generated and expert-generated concept mapping, into video-based instruction can further enhance the effectiveness of the video content.

This dissertation follows the style and format of the *American Educational Research Journal.*

Concept Mapping

Concept maps have been used in educational research and practice at least since 1984 when Novak and his colleagues started using them in their instruction (Novak, 1998). A number of studies have supported the position that concept maps can be used to help teachers organize knowledge for instructional presentation and can also be used to help students comprehend the key concepts and principles found in their instructional material (Wandersee, Mintzes, & Novak, 1994; Novak, 1998). One of these studies reported that concept mapping has a positive effect on meaningful learning (Novak & Canas, 2008) since while constructing a concept map the learners relate new knowledge to the existing knowledge. As a result, a number of computer programs have been developed over the years to provide resources for creating interactive concept maps; examples include Inspiration, CMapTool, Mind Mapping, Visio, and VUE (Virtual Understanding Environment) (see Appendix J). Concept mapping resources have also been embedded as additional components in numerous education, business, and government instructional and productivity tools. As graphic organizers in instructional materials, concept maps are considered to facilitate students' understanding of conceptual knowledge by providing deep systematic analysis of learning materials (Sowa, 2000; Alpert, 2003; Chang & Chang, 2008). Concept maps are structured hierarchically; the most general concepts are placed at the top of the map and the more specific, sub-concepts are arranged in a network below them (Novak, 1998; Canas, Coffey, Carnot, Feltovich, Hoffman, Feltovich, et al, 2003).

Concept maps allow learners to adapt complex and disordered information and represent it in a meaningful order and structure (Novak, 1998); they provide a way to visually represent knowledge, simplify the conveyance of information, and foster discussion (Canas, et al., 2003; Clark & James, 2004). Reader and Hammond (1994) concluded that personal computers and computer software can support and enhance concept mapping and enhance the student's ability to effectively visualize complex content. The combination of concept mapping's basic ability to enhance understanding and interaction with the power and ease of use of computer-based resources should provide great promise for developing new highly effective electronic learning resources.

Video-Based Instruction

In another area of instructional resource development, video-based learning resources have been used extensively throughout education and training to teach a variety of subjects. Video has become even more popular in the last two decades as new digital technologies have emerged and become widely available for both developing and viewing instructional resources. Several studies have been performed to examine the role of video resources (Wetzel, Radtke, & Stern, 1994; Herron, Cole, & Corrie, 1999; Zhang, Zhou, Briggs, & Nunamaker, 2006) which have been found to be generally more effective than the traditional text-based instruction used in many online learning courses (Baggett, 1984; Choi & Johnson, 2005). For example, learners who were taught by video-based instruction remembered more concepts and propositions than the learners who were taught by the traditional text-based instruction in online learning (Choi & Johnson, 2005). The advantages might be because representations of both auditory and visual symbol systems may be better for building mental models than representations of only visual information.

Since concept maps have been shown to provide general advantages for enhancing learning in traditional media resources, they may also be able to enhance video-based instruction by providing an additional option for incorporating learner activities into the process of instructional viewing. For example, interactive concept maps can be embedded into a video-based instructional tool to provide learners with a means to more completely process and organize the instructional content. Such integrated concept mapping resources could support the general learning process by providing advantages such as increased meaningful learning, organization of instructional materials for individual courses, navigational aids for accessing hypermedia, and enhanced critical thinking skills (Canas, et al., 2003). Accordingly, such dynamic content maps can serve as an organizational, conceptual resource as well as means of easily navigating the extent of complex video content.

Statement of the Problem

There are many studies that have been conducted to provide evidence of the positive effects of using concept mapping to enhance instruction (Canas, et al., 2003; Chang, Sung, & Chen, 2002; Chiou, 2009); similarly, the benefits of video-based learning has been demonstrated by a number of researchers (Chang, 2004; Choi & Johnson, 2005). Research on the integration of such resources is now needed to show effectiveness, usability, and performance gains that might be obtained by embedding concept maps in other instructional systems (Canas, et al., 2003). In particular, little research has been conducted to investigate the effectiveness of combining the strengths of the two instructional techniques reviewed here, i.e. integrating concept mapping into video-based instructional resources.

There are a number of factors to be considered when implementing concept mapping into instructional resources. In an investigation comparing the effects of learner-generated and expert-generated concept maps Chang et al. (2002) found no statistically significant achievement differences between the learner-generated concept mapping group and the expert-generated concept mapping group. The researchers concluded that the act of constructing a concept map required a high “cognitive load” that might have paradoxically competed with the actual learning activity and resulted in little mental capacity available to learn the new content. Therefore, using expert-generated concept mapping resources might decrease such “cognitive load” to intermediate levels and, consequently, allows the students to interact in a more functional, thoughtful way with a new content.

Based on such research, this study was intended to investigate the relative benefits of embedding concept mapping resources to enhance cognitive construction and meaningful learning in video-based instruction. In particular, a comparison was made of the relative effectiveness of expert-generated concept maps and learner-generated concept maps when embedded as an interactive component in a video-based instructional resource.

Purpose of the Study

The purpose of this study was to investigate the effectiveness of two different concept mapping methods on learning from computer-based instructional video resources that were created for a junior level undergraduate Developmental Psychology for Educators (EPSY 320) class. The main focus was to compare learner-generated and expert-generated concept mapping activities in relation to learning outcome. The students' attitudes toward the use of the concept mapping and computer-based instruction in general were also investigated.

All of the training and instructional resources for the course unit were presented or accessed via the students' computers. Students in both learner-generated and expert-generated concept mapping groups initially received preparatory online video-based training that included the definition of concept maps, the theory behind concept mapping, and an illustration of how the resources are generally used in instruction. Each group then received specific training in relation to the activities that were to be used in their particular subsequent instructional resources. Specifically, the training of the learner-generated concept mapping group included instruction on how to use the associated tools to create a functional concept map while viewing the video content. This online concept mapping training was activated two weeks before the online instruction was presented and remained available throughout the instructional period to allow the learners to refresh their knowledge at any time if they desired. The online instruction consisted of two modules, each of which covered a full unit of the textbook. Each module contained an instructional video, an integrated concept mapping resource, two exercises, and quiz. The exercises and quiz scores were used to assess the achievement of the students. Two surveys, a pre- and post- were also administrated. The pre-survey was designed to assess computer knowledge and skill of the students, and the post-survey was designed to assess the attitudes of the students toward the instructional tool and their recent learning experience. The results of the study were focused on how the two different concept mapping activities affected the students' learning from video-based instruction.

Assumptions

Six assumptions were made in developing and conducting this study:

1. The participants would be all adults. Their ages would be between 18 and 30 years old.
2. The participants would be predisposed to learn from a variety of teaching methodologies and would have the ability to acquire, access, and interact with the training, and learning materials.
3. The participants had little or no experience using concept mapping in previous courses.
4. The participants would provide an honest response to the surveys.
5. The two groups would be created randomly from the class roster and be bias free.
6. The participants did not know that there are two different tools prepared for the two students groups.

Significance of the Study

A study investigating the effectiveness of two different concept mapping methods - learner-generated and expert-generated concept mapping - in computer-based video learning was important for developing professional computer-based video instruction and knowledge generation. The study built on previous research findings on the instructional use of video and concept mapping, and focused on the relative influence of expert-generated versus learner-generated concept maps on student achievement during computer-based video instruction. This study was designed to help ones who want to use video-based learning in their instruction. The study results gave information about how video instruction and concept mapping are used together embedded in computer-based instruction. Instructors, course designers, subject experts as well as students get benefit directly or indirectly from the results of the study.

This study added to the general knowledge for improved video-based teaching strategies and increased student learning. Concept mapping was developed based on Ausubel's (1968) cognitive learning theory that focuses on meaningful learning. This research also provided additional information for this theory related to meaningful learning. Video-based learning was supported by concept mapping to promote learning from passive to active meaningful learning. This study results gave an idea to other educational researchers to further investigation about how concept mapping should be embedded in video player window to promote meaningful learning.

Video-based learning has been used extensively in education as a supplemental instructional tool. The previous research asserted that simple watching instructional video results in poor learning outcomes (Schluger, Hayes, Turino, Fishman, & Fox, 1987). A variety of instructional materials and teaching methods have been tested to attempt to improve the effectiveness of video-based learning. De Simone (2007) claimed that learning from video can be more effective if learners actively engage in the learning process, and video presentations are designed and supplemented to increase learners' mental process. The previous research showed that creating nodes, finding relationships among nodes, and placed concepts in a hierarchical order require students to engage in complex, intentional learning activities (De Simone, 2007). Concept mapping requires learners engage in learning process by interacting with or constructing concept maps (Canas, et al., 2003). According to previous literature, we could claim that concept mapping in video-based learning could be more effective than the simple video-based instruction. The study results, in addition, gave information about which concept mapping method was more effective. The findings of this study may apply to the future design and development of the video-based instructional tools; the results might indicate how concept maps in video-based learning environments affect the students' cognitive learning process.

Definition of Terms

These terms are used in this study:

Assimilation theory – According to the theory, a learner assimilates the meaning of a new concept using previous knowledge. The learner searches out the relationships among concepts and builds links between new information learned and existing knowledge. (Daley, Canas, & Stark-Schweitzer, 2007).

Concept map – "A schematic device for representing a set of concept meanings embedded in a framework of propositions" (Novak & Gowin, 1984, p.15). Otherwise stated, a cognitive tool that is used for organizing and representing a knowledge structure by showing the concepts and the relationships among them.

Concept mapping – It is “the process of constructing a concept map” (Heinze-Fry & Novak, 1990, p. 461)

Cognitive load – For schema acquisition to occur, instruction should be designed to reduce working memory load. A learner engaging in complex activities that impose a heavy cognitive load and are irrelevant to schema acquisition will interfere with learning. Cognitive load theory is concerned with techniques for reducing working memory load to facilitate the changes in long term memory. (Sweller, 1994).

Cognitive tools - Cognitive tools are both mental and computational devices that support, guide, and extend the thinking processes of learners (Derry, 1990). Cognitive tools are generalizable computer tools that are intended to engage and facilitate cognitive processing (Kommers, Jonassen, & Mayes, 1992). “Cognitive tools actively engage learners in creating knowledge that reflects their comprehension and conceptualization of information and ideas rather than absorbing predetermined presentations of objective knowledge” (Jonassen & Reeves, 1996, p. 697)

Comprehension - An ability to understand the meaning or importance of something or the knowledge acquired as a result. In this study, comprehension is measured using a multiple-choice test and concept mapping.

Expert-generated concept maps – An expert generated concept map is one that has been created by one or more experts to present the content to be learned; the content is organized according to the structural view of the experts. This concept map is then subsequently used as a resource by the learners as a means of exploring and mastering the educational material; their interactions are guided by the structure and components deemed to be important by the experts.

Graphic organizers – Graphic organizers are visual representations of knowledge, concepts or ideas. Graphic organizers help to organize information and make it easier to understand (Meyen, Vergason, & Whelan, 1996).

Meaningful learning – New ideas or concepts connected with previously learned knowledge that integrates the new knowledge with the old knowledge. Meaningful learning occurs when an individual assimilates or accommodates new information within his/her existing prior knowledge (Ausubel, 1968; Reese, 2004).

Nodes – Concepts or propositions within a concept map. Graphical shapes, such as circles, or square shapes are used to represent concept.

Proposition – “Statements about some object or event in the universe, either naturally occurring or constructed. Propositions contain two or more concepts connected using linking words or phrases to form a meaningful statement.” (Novak & Canas, 2008, p.1). Propositios is sometimes called semantic units, or units of meaning.

Student-generated concept map – A concept map that is constructed by a student in the process of learning. The structure and components in the map are created by the student’s understanding and interpretation of the content; their creation causes the student to interact with the content more deeply and develop a greater understanding.

Subsumption - “Incorporation of new knowledge into a specifically relevant existing concept or proposition is a higher state of learning” (Novak, 1998, p. 282).

Video-based learning – It is a teaching method used video, which can incorporate film, slides, multimedia, audio, still photography, graphic art, and print elements, as an instructional material and published through a television or computer.

CHAPTER II

LITERATURE REVIEW

This study examined the effectiveness of using concept-mapping resources in computer-based video instruction to help students more fully engage in cognitive learning processes and develop a deeper, more meaningful understanding of new concepts. Two concept map strategies, learner-generated and expert-generated concept mapping, were compared in order to determine their relative effectiveness for enhancing video-based learning activities. This chapter provides definitions of video-based learning and concept mapping as an orientation to the conceptual components and then summarizes the literature and learning theories related to these two areas of research. Particular emphasis is placed on computer-supported concept mapping, paper versus computer-based concept mapping, and the relative effectiveness of two applied learning methods - learner-generated and expert-generated concept mapping. This chapter ends with research questions that focus on the integration of concept mapping with computer-based video instruction and form the basis for this research.

Video-Based Learning

Attributes of Video Materials

In a review of video attributes, Marlow (1992) listed several significant benefits of using video instruction in which video is widely perceived as a communications tool:

- Geographic reach - has the capability of communicating with geographically dispersed audiences,
- Intimacy – be a more “personal” communications medium,
- Technological flexibility – be an electronic technology containing all the other communications media,
- Accessibility – distribute a video message to various audiences in different locations,
- Communications effectiveness – be highly graphic and dramatic, and maintain viewer attention,
- Working through change – help people deal with change (pp. 2-8).

Marlow (1992) stated that video provides highly graphic and dramatic images, and includes audio components that can maintain viewer attention in a way that other media cannot match. Furthermore, Cartwright’s (1990) wrote that video has been widely accepted as an effective communication medium and listed a variety of significant attributes that can be applied specifically to creating training results:

1. Video delivers information consistently; everyone throughout the organization receives the same message.
2. Video provides convenience/availability. Programs are available when and where the viewer needs them.
3. Video is a visual medium that helps illustrate and demonstrate difficult concepts.

4. Video adds the dimension of motion· for skill building and behavior modeling.
5. Video is a cost-effective medium. Programs can be distributed to hundreds of viewers, creating training results at a fraction of the cost of traditional training methods.
6. Video is capable of handling a variety of training requirements; behavior modeling, skills and concepts can all be taught with video (p. 6).

Marlow (1992) defined six reasons about the benefits to use a video in training environment:

1. It is communications-effective.
2. It is cost-effective.
3. It provides training uniformity.
4. It has the ability to reach a nationwide audience.
5. It is self-instruction capable.
6. It provides production flexibility (p. 35).

Another attribute of video is the capability to use both auditory and visual symbol. In a review of Baggett study, Fencel (1994) wrote that learners are usually able to construct a conceptual representation of a story from either audio information or visual information. However, it appears that when a story is provided through video, each auditory and visual symbol provides additional and complementary information that retains some of the characteristic information from both. Consequently, information learned from an audio-video resource is retained longer than information that is learned either from audio or visual materials separately.

Analog Versus Digital Video

The term *video* (from the Latin word “videre” which means “I see”) refers to a variety of electronic formats used for storing moving pictures. From an educational perspective, video is described as a tool for efficient and effective “packaging” of messages (Atkin & Wallack, 1990). Marlow (1992) wrote that video consists of different media elements such as audio, pictures, slides, multimedia, graphic art, film, and print elements, and a video program has greater impact than the sum of its part. There are two major video format categories: analog video and digital video.

Analog video is video content that is transferred by an analog signal. It contains the brightness (luminance) and chroma (color) of the image, which may be carried in separate channels, as in component video and S-Video, or combined in one channel, as in composite video and radio frequencies (RF) connector (Jack, 2008). The most popular analog video format, commonly known as Video Home System (VHS) video, is used in both consumer and professional applications. In comparison, digital video is a type of video recording system that uses a digital video signal (Jack, 2008). Digital video comprises a series of digital images displayed in rapid succession at a constant rate. The video industry has established various format standards. *Format* for a video refers to the size of the tape or disc and the process by which it records and reproduces images and sound (Cartwright, 1990). There are more than 15 formats used for encoding videos. Some of the more popular formats used for digital videos are listed below:

- H.264 also known as MPEG-4: good for online distribution of large size video,
- MPEG-2: used for encoding Digital Video Disc (DVD), Super-VCDs, and many broadcast television formats,
- MPEG-1 is used for video compact disc (VCD).

Analog and digital videos each have relative advantages and disadvantages. Analog video is relatively inexpensive and easy to use. . It is stable, and it is not suddenly broken (*Camcorder basics: Digital video vs analog*, 2002). The main disadvantage of analog video is editing. This is difficult due to the linear storage and access aspect. It is difficult to jump to pre-specified locations in the content and identify particular sections accurately during editing and playback. In addition, analog video results in a loss of quality in subsequent generations of edited recordings. Digital video, on the other hand, provides extremely high quality edited generations and robust formats for storage and random access of the content during editing and playback. Resources and equipment for creating, editing, and delivering digital video are readily available to developers and educators. In addition, digital video is compatible with all computer platforms, allowing for extensive development and integration with computer-based instruction. Consequently, videos can be downloaded and played on PCs, Macs, or computers running the Linux operating system. Digital video technologies have higher resolutions resulting in better picture quality than analog video. While analog video resources degrade with use, digital video does not degrade over time. In addition, digital video is easily duplicated so that new file copies are easily obtained directly or by downloading. The new copies have the same quality as the original. Multiple recordings are possible with digital video cameras and which are lighter, smaller, more compact, and readily available to educators. Because of the nature of the digital signal, the images can be transferred and stored over long distances without degrading (see Appendix L for more detail about DVD and VHS tapes).

Video-Based Learning in Online Education

As communication technology has advanced, the methods available for the delivery and viewing of video content have changed considerably. The advanced speed of Internet data transfer has greatly increased the possibilities and relative value of delivering instructional video content in Internet-based online-education applications (Chang, 2004). In addition to direct access through online video Internet sources, video content and text documents can also be provided as standalone educational resources by using delivery formats such as CD, DVD, and flash drives or by pre-downloading resources to the student's computer. Most of the educational resources can be accessed and downloaded through the Internet directly or enhanced by the use of Course Management Systems (CMS). Current video-based learning resources are used in combination with other teaching methods, e.g. integration with online video-based discussions (Warner, 2003) or with video-based learning forums for collaborative learning (Chang, 2004). However, research in this area needs to be conducted to examine the relative benefits of such activity integration alternatives.

Integrating Video Viewing with Learning Activities

Learner interactivity with video -based instruction is classified into three types:

(a) passive watching, (b) interacting with learning resources while watching the instructional video, and (c) learning and practicing with learning resources after watching the instructional video (DeMartino, 2001; Chang, 2004). The first type, passive watching instruction, occurs when students are not engaged in any concurrent discussion or a related activity during or after watching the video content. Passive watching often results in poor learning outcomes (Schluger, Hayes, Turino, Fishman, & Fox, 1987). Televised instruction can be put into this class; the viewers simply access the content and watch it from beginning to end. The second type, interacting while watching, provides the learners with a means to pause, stop, forward, or rewind a video clip in any application that provides more interactive, self-paced learning. This format can be enhanced by including resources that also provide the learners with opportunities to discuss with others, write comments, or criticize any part of the video as a viable part of the learning activity. Such active engagement in the video content promotes learning by shifting from a passive to an active learning mode. Concept mapping in video-based learning can provide another form of this type of interactivity and may enhance the active learning capacity. In the third type, learning and practicing after watching, the learners can engage in activities such as discussions with others, critiques of the video content, and completion of exercises that are related to the video clip content subsequent to viewing the instructional video. Both the second and third types require the learners to participate in planned learning processes that help them engage in active learning, rather than simply listening and watching the instructional video.

Salomon’s classic study (1984) indicated that learners tend to fail to learn from television instruction because they engage only passively in the learning process and do not engage mentally. However, learning from video can be made to be much more effective if learners actively process the messages presented by the content. Cennamo (1993) also concluded that to be more effective, video presentations should be designed and supplemented to increase the learners' mental processes and engage them in meaningful active learning. CMS can be used to improve the effectiveness video-based instruction. Many CMS utilized in online learning programs provide resources such as a Bulletin Board System (BBS), an e-mail list, or a Web Bulletin Board (WBB) to support learning and practicing after viewing an instructional video (Repenning, Ioannidou, & Phillips, 1999; Chang, 2004).

At this time, it is not a common practice for instructors to incorporate such learning resources in conjunction with assigned video materials in spite of the potential learning enhancements that they offer. Since the video materials are easily accessed in the CMS, it would be simple to require students to switch to other resources and engage in application activities such as group discussion of the video content. As a result, students could easily return to the video to review a missed concept, clarify an issue, and expand on a topic, etc. before returning to the discussion. Such activities would blend the formats of active learning both during and after video viewing. There may be a perception that it is very difficult and complex to develop video-based instructional tools that provide such embedded learning and practice activities while learners view the video content, but today's management systems can make this enhancement relatively accessible to most instructional settings. On the other hand, the ability to embed such extended learning activities directly into a video-based instructional tool, or conversely, develop a specific resource that contains a video clip player and relevant integrated learning activities is more difficult to acquire. However, such direct integration of these two components in one instructional resource offers even greater promise for fostering interaction and enhancing learning from video-based resources.

Concept Mapping

There is a growing body of literature focused on the use of concept mapping as a supplementary teaching resource to help learners interpret and acquire knowledge and evaluate what they have learned. Concept maps are graphical tools used for organizing and representing knowledge (Canas, et al., 2003). Novak and Gowin (1984) defined concept maps as “a schematic device for representing a set of concept meaning embedded in a framework of propositions” (p.15); that framework is used to organize the concepts as nodes and provide linking lines (links) to indicate the relationships among them (Novak & Canas, 2008). The combination of two nodes and a labeled link is called a proposition, the basic unit of meaning in a concept map (Ruiz-Primo & Shavelson, 1997; Canas, et al., 2003). The resulting framework is a two-dimensional array (map) that provides a graphical overview of the structure of the body of knowledge represented in its nodes and links. Canas et al. (2003) define some basic characteristics of concept maps as:

1. Circles or boxes are usually used to show concepts and connecting lines that link concepts together indicates the relationship among concepts specify. The

relationships among the concepts are stated using words or sentences on the linking line.

2. The concepts are outlined and placed in a hierarchical order: the most general concepts stay at the top of the map, and the more specific concepts are located below.
3. Cross-links, a link between the concepts defined in the different sublevel or regions on the maps, show explicit relationships between or among concepts. Correctly drawn cross-links within a concept map demonstrate how deeply the concepts are understood from the learners of the content.

A concept map is one of the common tools developed and used in programs to help foster meaningful learning. Concept maps enhance meaningful learning by indicating relationships between concepts and propositions (Novak & Gowin, 1984). Concept maps can be generated by experts and presented to the learners, or the learners can generate the maps as part of their instructional experience, Joseph Novak and his colleagues at Cornell University developed concept mapping in 1972 when they investigated methods of influencing children's acquisition of knowledge of science (Novak, 1998). Their basic approach was based on the learning psychology of David Ausubel. Ausubel's theory focuses exclusively on meaningful learning and makes a functional distinction between meaningful learning and rote learning (Novak & Gowin, 1984; Canas, et al., 2003; Ausubel, 1968; Ausubel, Novak, & Hanesian, 1978). In a description of Ausubel's theory, Novak and Gowin (1984) stated "to learn meaningfully, individuals must choose to relate new knowledge to relevant concepts and propositions they already know” (p. 7). On the other hand, in their definition of rote learning, new knowledge learned simply from verbatim memorization may be arbitrarily incorporated into a cognitive structure of learners without being connected with the knowledge already known.

Ausubel’s Meaningful Learning Theory

Novak and Canas (2008) stated that “The fundamental idea in Ausubel’s cognitive psychology is that learning takes place by the assimilation of new concepts and propositions into existing concept and propositional frameworks held by the learners” (p. 3). The human brain follows logical rules for organizing information into respective categories. Ausubel (1960) asserts, “Cognitive structure is hierarchically organized in terms of highly inclusive concepts under which are subsumed less inclusive subconcepts and informational data" (p. 267). The central idea of Ausubel’s learning theory is the process of subsumption—“incorporation of new knowledge into a specifically relevant existing concept or proposition is a higher state of learning” (Novak, 1998, p. 282)—that allows individuals to absorb new information into their cognitive structures.

Ausubel’s assimilation theory—a learner assimilates the meaning of a new concept using previous knowledge (Daley, Canas, & Stark-Schweitzer, 2007)—as summarized in Figure 1, describes the functional components associated with meaningful learning and clarifies the distinction between rote learning and meaningful learning.

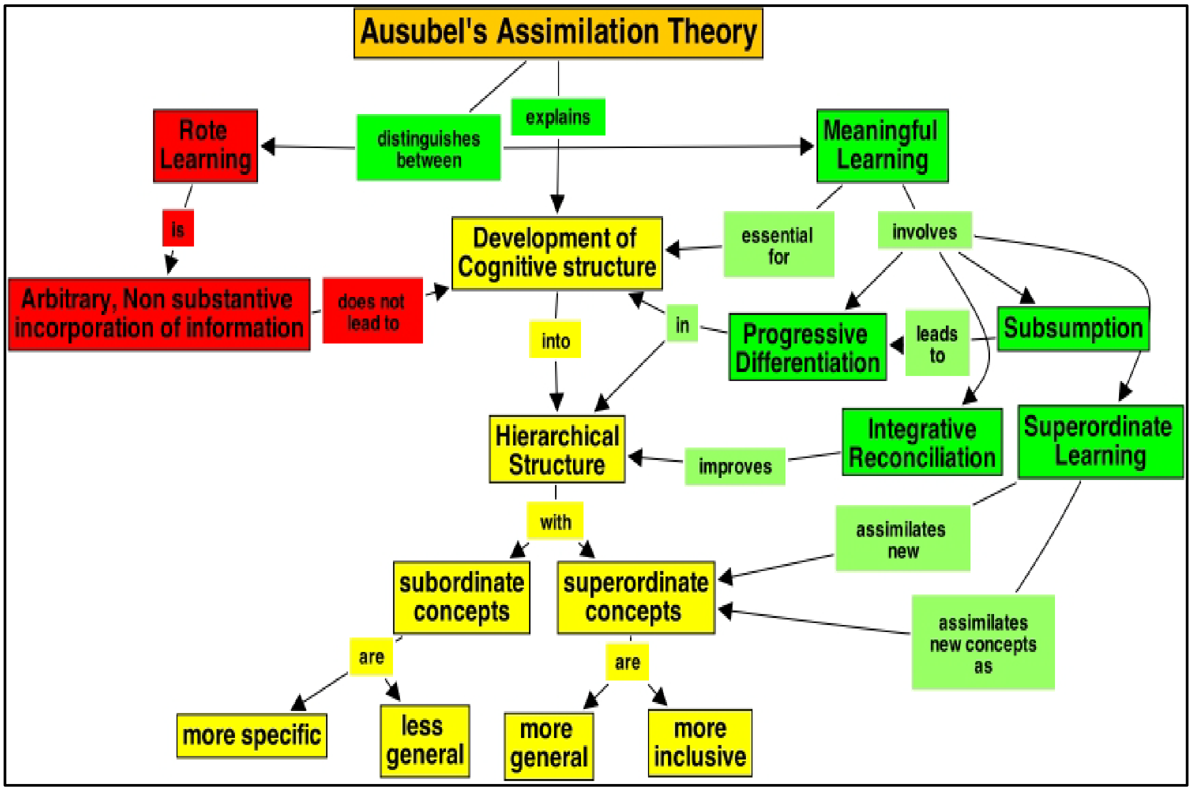

Figure 1. A graphical summary of Ausubel's Assimilation Theory (*IHMC CmapTools*, 2010)

Ausubel described how meaningful learning requires three conditions:

1. "The material presented to the learners be capable of being related in some sensible fashion" (Ausubel & Robinson, 1969, p. 46). The material presented must be clear and related to the learners' prior knowledge.
2. "The learners must possess relevant ideas to which the new idea can be related or anchored" (Ausubel & Robinson, 1969, p. 46). The learners must have some relevant prior knowledge about the domain of subject matter on which to build a concept framework for the present knowledge to be learned. Therefore, conditions (1) and (2) are interrelated (Canas, et al., 2003).

3. "Finally, the learners must actually attempt to relate, in some sensible way, the new ideas to those which they presently possess" (Ausubel & Robinson, 1969, p. 46), i.e. the learners must willingly engage in the relevant meaningful learning activities.

If any of these conditions is missing, any learning that takes place will likely be rote learning. Concept mapping activities can satisfy these three conditions; the characteristic features of concept mapping should be related to the learners' prior knowledge to create links among the concepts that are already known and recently learned. Concept maps are generated from more general concepts to more specific concepts. The more general concepts usually stay at the top, and the more specific concepts are placed below. Concept maps support the sequencing of learning tasks by bridging new and existing knowledge into developing conceptual frameworks (Canas, et al., 2003). Regarding condition three, the teacher or mentor often has no direct control over the students' motivation to choose to learn. The two approaches commonly used to attempt to create such external motivation are instructional strategies and evaluation strategies. The students must decide to learn and attempt to incorporate new meaning into their prior knowledge, instead of preferring to simply memorize concept definitions or propositional statements resulting in rote learning (Canas, et al., 2003). Creating concept maps requires students to engage in complex, intentional learning activities, which increase the intrinsic motivation of the students.

Ausubel presented the concept of advance organizers as a resource for fostering such meaningful learning and worked extensively to establish their ability to facilitate learning. Mayer (2003) defined an advance organizer as information that is presented prior to learning and that can be used by the learners to organize and interpret new incoming information. Ausubel (1963) posited that the learners' cognitive structure should first be strengthened as a means of facilitating the learning of subsequent new material. One of the primary goals of the advance organizer model is to provide a means for this strengthening to take place. According to Ausubel (1960), advance organizers probably facilitate the meaningful learning in two different ways. First, they explicitly draw upon and mobilize whatever relevant subsuming concepts are already established in the learner's cognitive structure and then make them part of the subsuming entity. Second, advance organizers provide optimal anchorage for new information. This promotes both initial incorporation and later resistance to obliterative subsumption. Advance organizers use familiar terms and concepts to link what the students already know to the new information that will be learned in the lesson that aids learners to relate new information with the prior one (Mayer, 2003). There are a number of graphic organizers that provide a visual representation of knowledge that can be used in education as advance organizers, one of them is concept mapping.

Concept mapping is a powerful tool that can be incorporated to support meaningful learning because it requires the learners to relate newly encountered information to their prior knowledge and helps the learners engage in learning processes by interacting with, or constructing concept maps. In order to construct meaningful and explicit concept frameworks learners should possess the prior knowledge to create links among concepts. Moreover, constructing a concept map is an intentional action that requires learners to engage in meaningful learning by requiring them to construct a map of the material to be learned. In support of this, De Simone (2007) stated that concept mapping requires the learners to take an active role in learning by extracting key ideas from the book or lecture, thinking about the relationships and the connections among those ideas, and them organizing the information into a hierarchical ordered concept structure.

Use of Concept Mapping in Education

Concept mapping has been used in education for a number of purposes; teachers and students each use them in different ways. Teachers use them for planning instruction and illustrating relationships in lectures and lessons, while students use them to represent knowledge and information while engaged in learning new material (Milam, Santo, & Heaton, 2000). Examples of uses by teachers are: a) using student created maps as an evaluation tool (Novak & Gowin, 1984; Ruiz-Primo & Shavelson, 1997; Novak, 1998) to assess of what they know, b) an organizational tool to organize and present instructional materials for individual courses or entire school curricula, c) a tool to serve as a navigational aid for hypermedia in order to facilitate information searching and access (provides a scaffold for understanding and integration of educational experiences), and d) an alternative to traditional writing instruction to teach creative writing and critical thinking (Canas, et al., 2003). Concept mapping can be also used in support of group study activities such as brainstorming. In a summary of such techniques Canas et al. (2003) described a number of educational applications of concept mapping including: “a scaffold for understanding, a tool for consolidation of educational experience, a tool for improvement of effective conditions for learning, an aid or alternative to traditional writing assignments, a tool to teach critical thinking, a mediating representation for supporting interaction among learners, and an aid to the process of learning by teaching" (p. 9).

This range of uses of concept mapping will be beneficial if concept mapping is integrated into the full educational experience in the classroom such as teacher demonstration or student laboratory exercises. Canas, et al. (2003) said that when concept mapping is used in a course, it is better that concept mapping be an integral, on-going feature of the learning process instead of some isolated add-on activities at the beginning or end.

Concept Map as an Evaluation Tool

Concept mapping is a very adaptable activity that can be utilized in education in a variety of ways. Since it externalizes the learners's cognitive structure or understanding of a content area it can be used by learners and teachers to identify what the learners know at the beginning of instruction as well as at any point during the process (Novak & Gowin, 1984). Every individual potentially interprets and learns information differently and would, consequently, construct a unique concept map based on that particular perspective. While there often is a particular correct structure for the body of knowledge to be learned, there is no absolute right or wrong way for the individual's map to be arranged. Correct or not, the individual's map presents an external view of the framework that he/she has developed from the instructional activity. Novak and Gowin (1984) mentioned that a concept map is a complete representation of what the learners know, but we can claim that it reflects an approximation of the learners' knowledge that helps both the learners and teachers deliberately move forward. The learners show the hierarchical order of the concepts with the relations among them on the maps that help both the learners and teachers to see what the learners know.

Concept maps created by students have been used to identify students' current understandings, their misconceptions, and the progression of conceptual changes throughout a learning sequence (Canas, et al., 2003). Learners can be encouraged to create their meaningful-mode learning patterns that demonstrate both their valid and invalid interpretations of the instructional topics (Mintzes, Wandersee, & Novak, 2000). Concept maps can have multiple purposes: initially the instructor can use concept maps constructed by the learners to evaluate the knowledge that was acquired during instruction, and then further evaluation of those maps can be subsequently used to improve the instructional tools for future classes. Moreover, maps can be used for identifying what the learners know before and after instruction to explore the changes that resulted from the activities, rather than just the final outcome.

Concept maps, as an assessment tool, are used to measure the structure of a student's declarative knowledge (Ruiz-Primo & Shavelson, 1997). The term assessment instead of test is used to reflect that reaching a judgment about an individual's knowledge and skills require the integration of several pieces of information, and concept maps are considered to be one of them (Ruiz-Primo & Shavelson, 1996). As an assessment tool, the concept maps should have three components:

1. A task in which students provide or display their knowledge structure in a domain,
2. A format for the students' response,
3. Scoring system by which students' concept map can be evaluated accurately and consistently (Ruiz-Primo & Shavelson, 1996).

Evaluating Concept Maps

A scoring system is a systematic method with which students' concept maps can be evaluated correctly and consistently (Ruiz-Primo & Shavelson, 1996). A number of methods have been developed with regard to scoring methods for concept maps; however, they can be grouped into three general scoring strategies:

1. Score the components of the learners' maps, e.g. number of nodes, number of links, complexity,
2. Compare the learners' maps with a criterion map created by experts, i.e. individuals that are professionals in the content area,
3. A combination of both strategies (Ruiz-Primo & Shavelson, 1996, pp. 581, 582).

The traditional method of concept map scoring was developed by Novak and Gowin (1984) and was based on the components and structure included in the concept map. This scoring system gives points for valid propositions (1 point each proposition), level of a hierarchy (5 point each level), number of branching (1 point for each branch), cross-links (10 points for each valid cross-link), and examples (1 point for each example). The number of hierarchical levels shows the degree of subsumption, the number of branchings shows progressive differentiation, and the number of cross-links shows the degree of integration of knowledge (Canas, et al., 2003). Although this scoring technique is time-consuming, it gives a great deal of information about the knowledge acquired by the map's constructor. The second strategy, the use of a criterion map, compares learners' maps with that of an expert's map and scores the overlap between them (Ruiz-Primo & Shavelson, 1997). Different methods have been used to create the expert map and make the comparison. The master expert map can be created by the course instructor, a domain expert, a group of teachers or experts, or an average of top students who previously took the course (Acton, Johnson, & Goldsmith, 1994). Furthermore, different methods have been used to compare the criterion map and the learners' map. The major method is to create a scale of terms and links found in both the expert's concept map and the learner's map using Novak and Gowin's (1984) scoring system. The proportion of terms in the expert's concept map that are included in the learners' map then provides a measure of the accuracy or completeness of the learner's conceptualization.

Acton et al. (1994) evaluated students' concept maps using the different criterion maps to predict the perfomance of the students in college-level computer-programing course. The criterion maps produced by the course instructor, individual experts, an average of experts, and an average of the best students in the class were used to evaluate. It was found that the using criterion map created by individual experts was highly variable in predicting students' performance.

Paper Versus Computer-Based Concept Maps

Many researchers (Novak, 1998; Cicognani, 2000; Canas, et al., 2003; Freeman, 2004; Chiou, 2009) have reported that concept mapping is a useful tool for learning and instruction. Initially paper-and-pencil based concept maps were extensively used for learning and instruction; however, computer-based or online resources are now widely available and now used to construct concept maps. Chang, Sung, and Chen (2001) stated that constructing concept maps using a paper and pencil has some obvious disadvantages that can be eliminated using by computer-based or online system construction. These include:

1) It is inconvenient for a teacher to provide feedback to students during the concept mapping process.
2) The construction of a paper-and-pencil concept maps is complex and difficult for students.
3) Paper-and-pencil based concept maps are difficult to revise.
4) Paper-and-pencil based concept maps are not an efficient tool for evaluation.

Educators often use existing general productivity tools (e.g. graphics software) to create concept maps for teaching purposes (Plotnick, 2001). In addition, a number of specialized computer-based instructional resources or tools have been developed for use throughout the range of educational settings, levels, and content. According to Jonassen (1990), concept mapping computer tools belong to the rare category of computer tools designed purposely for learning. Computer tools designed specifically for the creation and display of concept maps offer a number of advantages over traditional content mapping approaches such as paper/pencil or adapting general computer resources. Plotnick (2001) stated that the advantages of computer-supported concept mapping include:

1. Ease of adaptation and manipulation: Computer assisted concept mapping encourages the users to revise the concept map because deletions, additions, and changes are performed quickly and easily (Anderson-Inman & Zeitz, 1993).
2. Dynamic Linking: Computer assisted concept mapping tools allow the users to modify and drag a concept or group of concepts to another place on the map and update all the links and nodes automatically.
3. Conversion: Computer assisted concept mapping tools allow the users to convert the map to different electronic formats. These can be images, a text outline or graphic, a hypertext structure, or even html web file. These electronic formats can easily be stored, duplicated, modified, revised, sent, used, printed, and deleted like any computer file.
4. Communication: Digital communication provides speed, high fidelity, and reliability to a user.
5. Storage: A computer allows for digital storage. Concept maps created by computer software can be saved as digital files that take less space, make retrieval easier, this is especially important if concept maps are used on a large scale.

A number of software packages such as *Inspiration*, *Mind Mapping*, and *CmapTool* software support the use of computer-generated concept maps and provide valuable tools to both educators and researchers. Some advantages of these resources are the ease of manipulation, dynamic linking, and ease of revision (Anderson-Inman & Ditson, 1999; Zeitz & Anderson-Inman, 1992; Plotnik, 1997).

Royar and Royar (2004), in their research on 9^{th} and 10^{th} grade biology classes, compared group-made paper-and-pencil concept maps created in a traditional manner and computer group-made concept maps using *Inspiration* software. According to their research, they concluded that the group that used a computer to generate concept maps created more complex maps than the group who used paper-and-pencil to create concept maps. They also found that students preferred using a computer rather than paper-and-pencil to create concept maps. Royar and Royer (2004) reported the following results:

1. The computer helped the students develop their concept maps more completely.
2. While the students who used pencil-and-paper to create concept maps opted not to continue to develop or revise their maps, the students who used a computer to create concept maps continued to develop and revise their maps.
3. The students using paper-and-pencil to create maps engaged in several side conversations that did not relate to the topic; whereas, this behavior was not observed the students using the computer to create maps.
4. The computer helped the students organize the many subconcepts, create the larger sized maps, and supported revision.

Dynamics of Map Generation

Learner-Generated Concept Maps

Learner-generated concept maps represent the learners' knowledge, their interpretations of the concepts, and the conceptual frameworks studied. Creating concept maps during learning helps the learners construct their own knowledge by directing them to integrate new knowledge with knowledge they learned previously. While generating concept maps, the learners play an active role in relevant activities that promote their meaningful involvement in the learning process. In general, self-engaging activities, like creating concept maps, enhances learning (Feltovich, Spiro, & Coulson, 1993). This benefit of self-engaging interaction has been posited by other researchers (Horton, McConney, Gallo, Woods, Senn, & Hamelin, 1993). In this view, it is important that learners create their own concept maps because it fosters these interactions and provides the opportunity for learners to display their conceptual framework (Ruiz-Primo, Shavelson, Li, & Schultz, 2001). When the instructional materials are given to learners accomparied by expert-generated concept maps, the maps demonstrate the established relationship among concepts, i.e.the structure of the content is provided at the start. On the other hand, when the instructional materials are given without an existing structure the learners create their own structure, promoting meaningful learning rather than rote learning (Chang, Sung, & Chen, 2002).

According to Novak (1998), the nature of the learners' mental interaction with the instructional content to be learned during the construction of a concept map is a key to the learners' achievement. Learners actively engage in learning by finding concepts in paragraphs, designing hierarchical order of the concepts, creating the links between the concepts, and labeling linking phrases based on the meaningful relation of the concepts. The research shows that learners also learn the relationships among concepts when they create concept maps better than when compared to the use of other intervention tools such as outlining, or defining concepts (Canas, et al., 2003).

Several studies suggest that concept maps may be especially beneficial for lower ability learners, because constructing concept maps requires an active, inquiring, and orderly approach to learning that is a natural approach of higher ability learners (Canas, et al., 2003). Required concept map activities prompt the lower ability learners to behave more like higher ability learners by providing a specified structure for their learning activities. They actively engage in the learning process by creating concepts, defining a relationship among concepts, and ordering hierarchically concepts from more general to more specific. On the other hand, learners who are novice mappers may have problems when trying to learn through the use of concept maps. The cognitive load generated by creating maps may hinder the learning of these individuals (Canas, et al., 2003). Schau and Mattern (1997) argued that asking students to construct a concept map from scratch requires too high a cognitive process to produce an explicit representation of their knowledge. Different methods or resources might be applied to instruction to decrease the negative effects of the cognitive load when creating a concept map that would help learners who are novice mappers. For example, presenting blank content nodes in a concept map that contains pre-labeled relationships of relevant concepts or contains an “expert skeleton” of the concept map that the learners then enhance may be used because these techniques provide guidance and resources that reduce the cognitive load and foster higher-level interactions.

Expert-Generated Concept Mapping

Expert generated concept maps are created when one or more experts develop a concept map according to their knowledge of the content area. This map may then be used as a resource when introducing educational material, as a syllabus showing relationships and a sequence for the introduction (Clark & James, 2004), or may be embedded in an educational tool to enhance conceptual learning. Expert-generated concept maps are used in education to facilitate learning, summarize the contents, visually represent course structure and content (Clark & James, 2004), and to organize program objectives and outcomes (McDaniel, Roth, & Millar, 2005). Some instructors also use an expert-generated concept map to evaluate learner-generated concept mappings. The teaching method using with expert-generated concept maps gives students a different perspective to the presenting of text material using traditional method, which is one-dimensional and often does not illustrate relationships among the concepts (Clark & James, 2004). The concept maps present a two dimensional view (Stewart, Van Kirk & Rowell, 1979) that includes the presentation of the propositional relations between concepts. Furthermore, the concept map not only identifies the major ideas but also shows the relationships among them (Clark & James, 2004).

Expert Versus Learner-Generated Concept Maps

Concept maps created by experts and learners likely have different sematic and structural features. For example, expert maps typically have a greater number of concepts, number of links, number of clusters, number of cross-links, etc. than those of novice, learner maps (Canas, et al., 2003). According to Jonassen et al. (1997), when additional concepts are linked to a given concept, that concept is defined better. According to his study, learners and experts structure their knowledge quite differently. Experts tend to show their ideas in conceptually rich, sophisticated interrelated knowledge structures, while novices tend to show an incomplete and sometimes erroneous knowledge structure. Experts try to describe their thinking through a dense network of connections among concepts while learners tend to draw their thinking in disorganized scratches (Stevens, Lopo, & Wang, 1996). Walker and King (2002) concluded that faculty generated dense networks of higher-order principles and their applications; in contrast, students generated fewer connections among concepts. Therefore, using expert generated concept maps may help learners think more like an expert or an instructor. Furthermore, using expert-generated concept maps in instruction allows learners to quickly engage actively in the learning materials, and to process the knowledge with the view of an expert. On the other hand, some researchers feel that presenting an expert-generated concept map may put the learners in a position which requires too little mental cognitive processing and, consequently, produces little learning (Chang, et al., 2002). Moreover, Brooks & Brooks (1993) said that most students stop thinking about a concept when they see the answer.

Conclusion

Based on the literature review above, we can generalize that video is an effective communication medium (Cartwright, 1990), and it is appropriate for presenting material to be learned. Graphical and audio features maintain learners' attention (Marlow, 1992) and help illustrate and demonstrate difficult concepts (Cartwright). In addition, it is a cost-effective medium. Video programs can be distributed to hundreds, thousands of viewers, and can be used several times without spending extra money or a reduction in quality. Based on the literature we can also generalize that concept maps may be used by instructors and students to represent knowledge and information in learning situations (Milam, Santo, & Heaton, 2000). Concept maps may be used as an evaluation tool to assess what learners know before and after instruction. The learners, while generating concept maps, play an active role in creating, modifying, and editing maps: activities that promote student involvement in the learning process. Therefore, we can posit that the combination of these two resources, integrating concept mapping in computer-based video learning, may help learners engage in meaningful learning of a new topic, and in relating the new information with prior knowledge.

Research Questions

The research questions were defined based on the previous research, and literature. This study using an experimental design, examined the comparative effectiveness of learner-generated and expert-generated concept mapping in video-based learning in an introductory educational psychology class. In the comparison of the use of learner-generated concept maps with expert-generated concept maps, the following questions were addressed:

1. Do undergraduate students who develop and use their own concept maps perform better in embedded evaluations and course evaluations than students who use expert-generated concept maps?
2. With respect to interacting with the instructional resources, i.e., viewing the video and creating or utilizing the content map:
    a. Does time spent interacting with the instructional resources relate to student achievement?
    b. Does the complexity of interaction activity relate to student achievement?
3. In the learner-generated map group, are there discernable patterns of student activities that relate to overall student achievement?
    a. Does time spent on developing concept maps relate to student achievement?
    b. Does the complexity of concept maps created relate to student achievement?
    c. Do temporal and spatial patterns of creating and arranging map nodes relate to student achievement?
4. When they have completed the instruction, what attitudes do students have towards the use of these instructional activities in general? Are there differences between the attitudes of the two groups?

CHAPTER III

METHODOLOGY

This chapter describes the participants, the design, procedures, the data resources, the data collection, and the data analyses implemented in this study. The design and procedures include the administered instruments, a description of the online training, development and application of concept mapping resources in a video-based instructional tool, and the format of the instructional content used in the study for each group.

The study was performed in two phases. Phase I was conducted in the fall semester of 2009 and was performed to evaluate and refine the instructional resources and procedures. Phase II was conducted in the spring semester of 2010. In both phases, the data was collected from undergraduate junior students enrolled in the current Developmental Psychology for Educators class (EPSY 320). The materials developed for this study were based on the existing content of this course. The phase I evaluation results were used to improve the instruments, instructional tools, and procedures that were subsequently used in Phase II. Figure 2 gives more information on the sequence of activities.

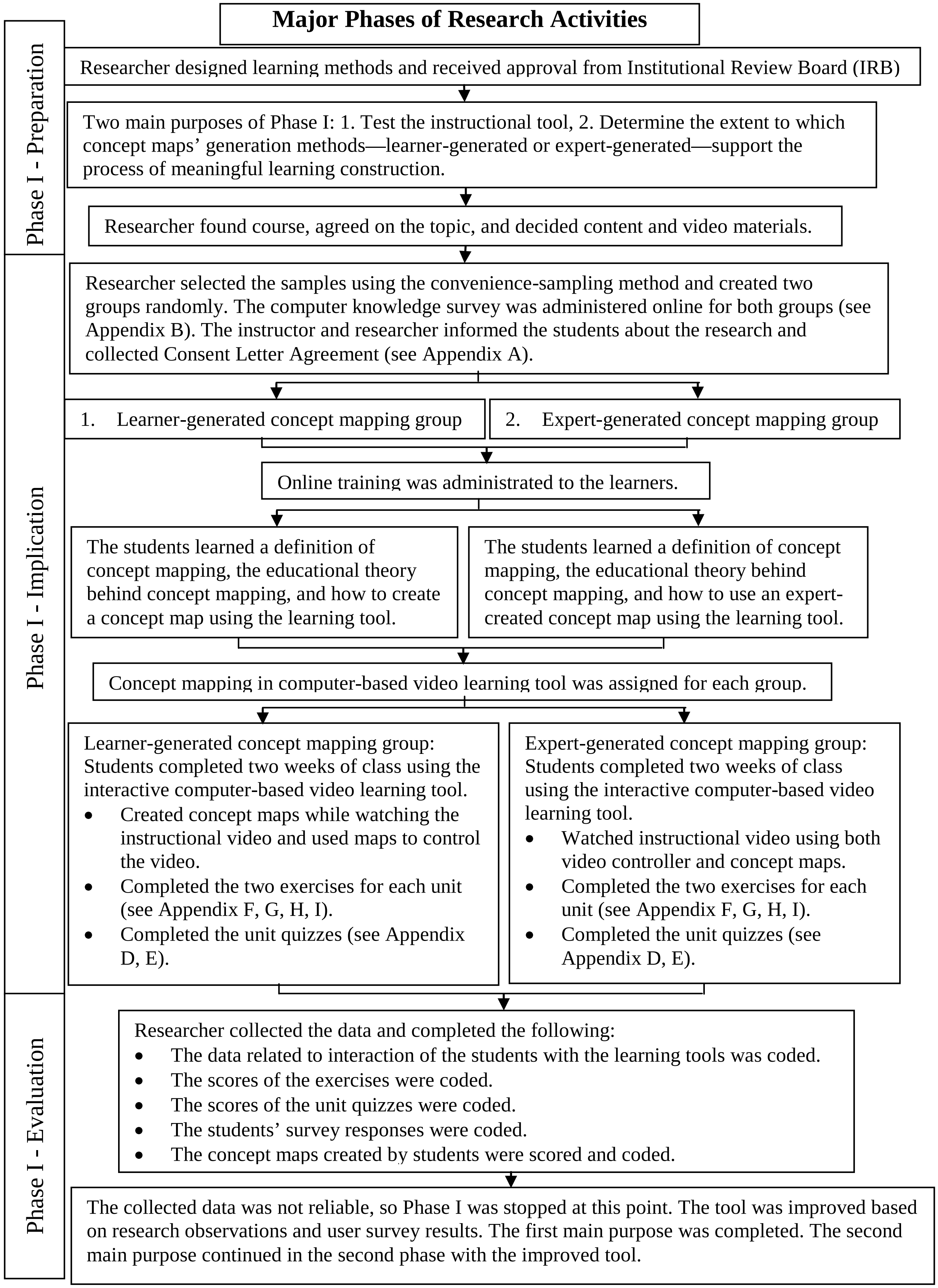

Figure 2. The steps which were implemented in this study

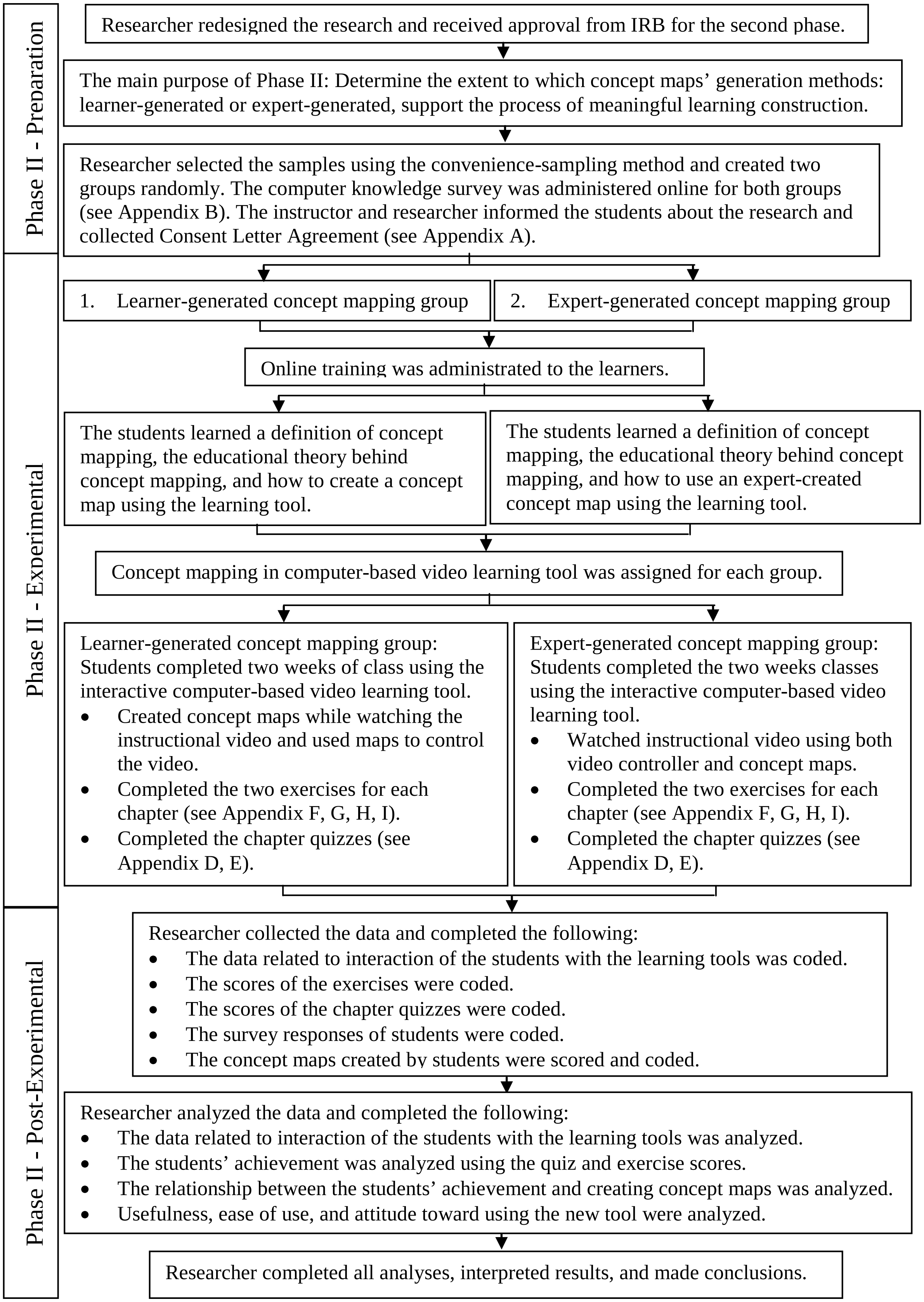

Figure 2. Continued

Participants

Phase II of the study was performed using the entire enrollment of the junior level undergraduate course (n = 65) Developmental Psychology for Educators (EPSY-320) class, the spring semester of 2010 at Texas A&M University. The convenience sampling method was used to randomly assign the students to the two treatment groups. Although all the students turned in consent forms, two students did not complete the treatment, instruction, or survey. One student attended for the treatment and survey but did not complete the exercises and quizzes. Consequently, 62 students (9 males and 53 females) completed the entire study.

Prior the study, the researcher and the course instructor met to clarify the function and the nature of the new instructional materials to be developed for the course. The same content, textbook, and instructional exercises that are normally used in the course were used in developing the research materials; the only difference was the delivery format and the nature of the student interactions with the developed materials. The content of the selected two units of the textbook, the publisher’s PowerPoint slides, and the instructor’s applied exercises were converted into video-based learning materials based on the class curriculum/objectives and the directions of the course instructor. The instructor modified the course syllabus to reflect the fact that this course unit was a part of the course but was to be presented using computer assisted instruction rather than lecture. This inclusion was important to assure the students that this unit was an integral part of the course and not something additional supplied by the researcher. The intent was to help insure the willingness of the students to participate in the study because they were aware that the computer-based video instruction learning was a standard part of the requirements of the course. The following activities were used as credit for the assigned portion of the course grade: viewing training video, four exercises, and two quizzes.

At the beginning of the course the students were informed by the instructor that their participation would neither affect their school grade, nor their current or future relations with Texas A&M University. Although the class syllabus required students to complete the unit using the new instructional method, the students were presented an option to complete them using the normal instructional method with permission of the instructor. All the students who participated in the study completed two surveys, one at the beginning and one at the end; they also completed the instructional resources, which included two exercises and one quiz in each unit. When completed, their products and quiz results were coded by the instructional resource and uploaded to an online database. The identities of the students were kept confidential. Only the researcher and the class instructor had access to the participants' records. The students completed a consent form prior to the study giving the researcher permission to analyze the students' products: i.e. notes, concept maps, quizzes, and survey results. The student consent form is presented in Appendix A. All of the student interactions with the instructional tool, such as accessing and controlling the instructional video or constructing the concept maps, were internally recorded and coded into the database by the software resources. Only the results of the exercises and quizzes were shared with the instructor for grading purposes, the additional performance data was used only for the analyses in the study.

The total class population was 65, 10 (15.4%) male, and 55 (84.6%) female. The learner-generated concept map group consisted of 5 (15.2%) male, 28 (84.8%) female, and a total 33 students. The age range of the learner-generated concept mapping group was 18 to 23, and the mean age was 20.47. The expert-generated concept map group consisted of 5 (15.6%) male, 27 (84.4%) female, total 32 students. The age range of the expert-generated concept mapping group was 18 to 26, and the mean age was 20.44 (see Table 1).

Table 1
Means and Standard Deviations of Students' Age

Group	N	Mean	Std. Dev.	Max Age	Min Age
Learner generated	33	20.47	1.191	23	18
Expert generated	32	20.44	1.664	26	18
Total	65	20.45	1.436	26	18

According to the instructor's report, the students in each group did not differ in their prior knowledge on the content of the two units used for the research. Since *Developmental Psychology for Educators* is the first course that students take in the subject area and the placement into the two groups was random, we can assume that the two groups were equivalent with respect to their prior knowledge of the content.

To determine whether the groups differed in initial computer knowledge that might affect their achievement in the course, the students were asked to complete a *Computer Knowledge Evaluation Survey* form before they started using the computer assisted instruction materials. The survey mainly gathered information about technology and communication resource availability, frequency of use, and purpose of use. The survey also inquired about the students' computer literacy, and their experience with CMS. The full results of the survey are displayed in the "Computer Knowledge Survey Results" (see Appendix K). The results showed that the students in each group did not significantly differ in relation to previous computer knowledge or utilization.

Design and Procedures

A quantitative design method was used in the study to investigate the effect of learner-generated and expert-generated concept mapping in computer-based video learning on students' achievement. The final materials included an instructional video with supporting text content for each of the two units of the text, with two applied exercises and one quiz for each unit. These materials were integrated into each form of the instructional resources: learner-generated maps and expert-generated maps. Online training videos were developed and provided to teach both groups how to use of their respective versions of the instructional tool. At the end of the instructional period, the data were collected from the four exercises, the two quizzes, a pre & post survey, and the interactivity recordings made by the instructional tools. This data set was used to compare the relative effectiveness of the two instructional activities.

Training Students to Use the Instructional Resources

To insure students' ability to perform adequately, two instructional videos were designed and developed by the researcher to train the students in the use of the instructional resources. The students received credit if they watched the entire training video. Each video, one for the expert-generated format and one for the learner-generated format, was embedded on the main course website for the respective group, i.e. when students logged on, they were presented with the appropriate training video for their group. When the video was viewed, the students' name, the video start and stop time, and the viewing date was recorded and automatically stored on the server. The online training video consisted of two parts. The first part, which was the same for both treatment groups, provided general information about the definition of concept maps, the educational theory behind using concept maps, and step-by-step examples of constructing concept maps. The second part provided information about the interactive concept mapping instructional tool used in the study, what the components of the instructional tool are, how it can be used in education, and how the concept maps are constructed using this tool. There were two versions of this part of the video, each providing training specific to that version of the instruction. Consequently, the learner-generated concept map group learned how to create and then use concept maps and the expert-generated group learned how to use existing expert-generated concept maps.

The students could easily return to the training videos through the Internet at any time throughout the full instructional period. Viewing data was automatically collected for the initial and any additional viewing sessions.

Instruments and Resources

The main focus of this study was to investigate the effect of interactive concept mapping activity in video-based learning on students' learning outcome. Five areas were assessed throughout the study: (a) a pre-survey of student computer knowledge, (b) a post-survey of the student attitude towards the computer-based video instruction they used, (c) student performance on two final unit quizzes, (d) an assessment of the degree of student interactions with the interactive instructional tool, and (e) an assessment of the quality of the student generated concept maps (only in the learner-generated concept map group). The surveys were administered separately in the course management web site and the remaining assessments were embedded in the instructional tool.

Course Web Site

Moodle, a course management system, was used to facilitate online training and to distribute the course materials (see Figure 3). Each student had a personal user name and a password to log into the Moodle site which automatically provided resources relative to his/her group membership. The Moodle system also recorded user information about time of login, time of logout, and any activities they completed while logged into Moodle. Before participating in the instructional activities, students had to complete three preliminary activities: a computer knowledge survey, browser JavaScript test, and a video-based learning training video. These three activities were presented on the Moodle site so students could complete them independently according to their individual schedules. The computer knowledge survey was administered to obtain an initial measure of student computer competency. The browser JavaScript test was created to determine that that JavaScript functions were enabled on the student’s computer. JavaScript had to be enabled in order for students to participate in the activities; if this was not set properly then instructions were provided so that the student could make the proper adjustments.

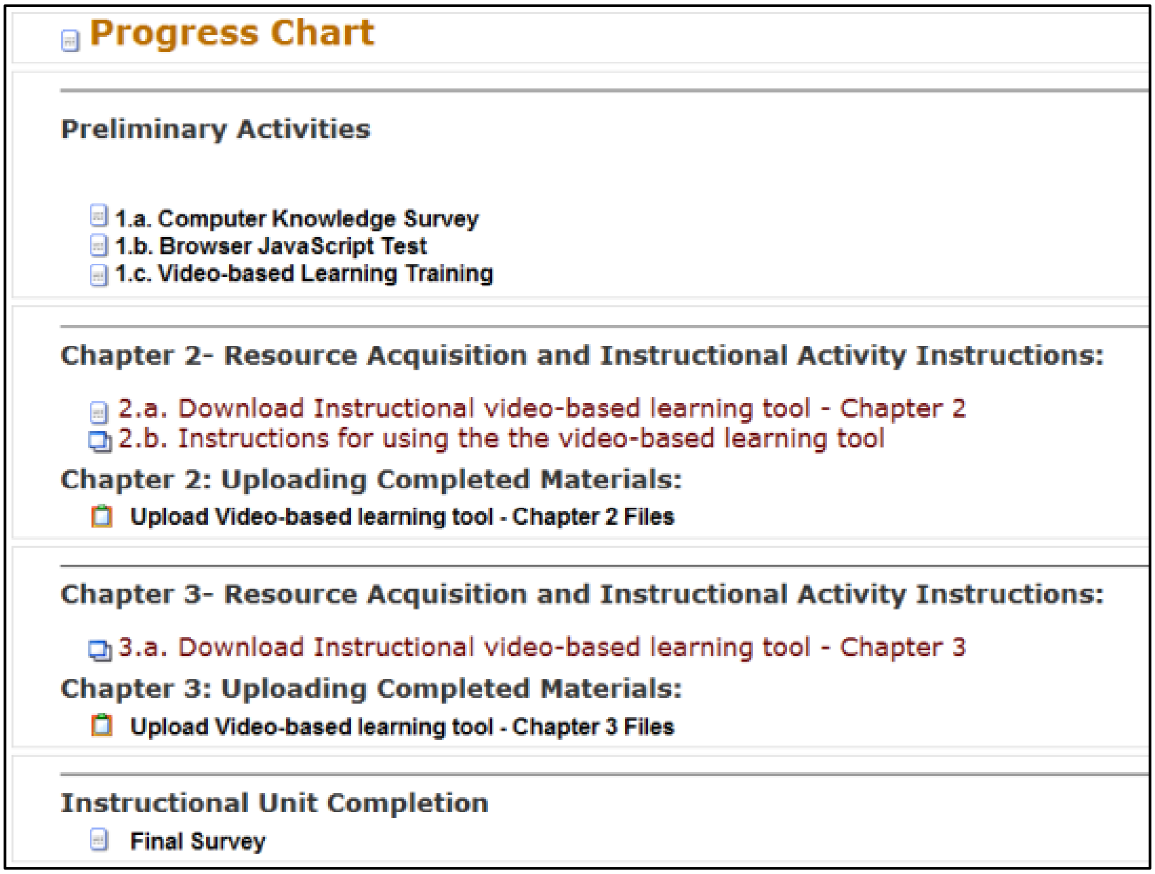

Figure 3. Screenshot of the Moodle course support site showing student menu for accessing functions and resources

The Video-based Learning Training video was accessed on a separate web page that also recorded the student's name, time of the connection, and the amount of time spent watching the training video; this viewing information was automatically stored on the server database as a means of determining the extent of involvement with the training resource. After completing the preliminary activities, each student downloaded the two instructional tools directly from links on the Moodle site. These instructional tools, one for Unit 1 and one for Unit 2, were stand-alone resources that did not require the use of a browser. However, they were still capable of automatically submitting data to the online server via the Internet. After completing all of the instructional and assessment activities, each student uploaded his/her completed learning resources using the Moodle site. These resources were later examined to obtain the data that had been generated during the instructional activities. When this final instructional activity was reflected in the student's progress chart, the final survey was made visible and then completed by the student. Students were required to complete the final survey to get full credit for the assignments.

Progress chart

The progress chart (see Figure 4) on the Moodle site provided a list of activities that students needed to complete, in a particular order. All support and instructional activities were monitored by the software, and completion of an activity was automatically indicated by a changing an arrow to a checkmark, giving a clear picture of the student's progress (or lack of progress). This monitoring was added in response to the lack of timely completion of required tasks in Phase I. Checking the progress chart, students could easily tell which activities they completed, which activities they had partly completed, and which activities they still needed to complete. This chart helped them to complete the activities in a timely, sequential order.

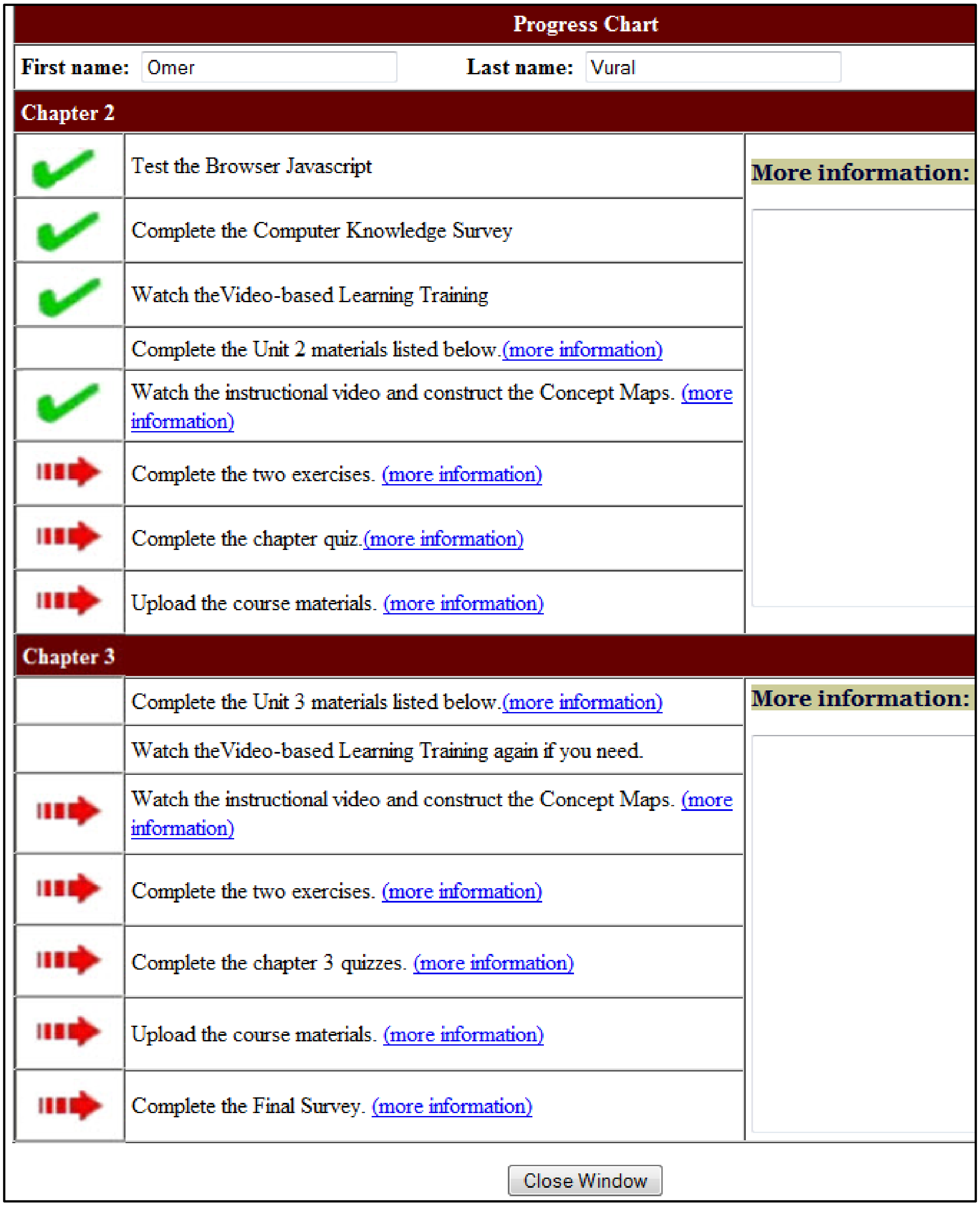

Figure 4. Screenshot of the Moodle course support site showing progress chart of the study

The computer knowledge pre-survey

The computer knowledge survey questions (see Appendix B), designed to assess entry technological skills related to performance in this study, were prepared and administrated by the researcher. The survey questions focused on the computer skills and activities of the students, i.e. the frequency of using computers to do a number of specific tasks at school and at home. The survey results were initially used to identify students who indicated a lack of important computer skills and then provide assistance to these students. The survey results were also used to identify whether the background computer knowledge of the two groups were equivalent. SPSS was used to calculate the Cronbach's Alpha internal consistency to determine the reliability of the test; the results are summarized in Table 2. The standardized item alpha (α) is 0.917, indicating an acceptable reliability value.

Table 2
Reliability Coefficient Alpha for the Computer Knowledge Survey Items

Number of Cases = 17

	Mean	Minimum	Maximum	Range	Max/Min	Variance
Item Means	4.252	2.797	4.847	2.051	1.733	.443

Reliability Coefficients for 17 items

Alpha = .896 Standardized item alpha = .917

Post-instruction attitude survey

A fourteen item post-instruction attitude survey (see Appendix C) was administered to assess the attitudes of the students toward the instructional tool and their recent learning experience. The first eight questions were adapted from the Technology Acceptance Model (TAM), developed by Davis (1989). Gao (2005) stated that TAM can be used for the purpose of predicting users' acceptance and attitudes towards learning activities. The original TAM consisted of 12 items using a 7-point Likert scale (1 = strongly disagree to 7 = strongly agree) to determine students' degree of perceived usefulness, perceived ease of use, and attitude towards using technology in general. (Davis, 1989; Gao, 2005; Davis, Bagozzi, & Warshaw, 1989). The eight questions that were used in this study the same three components in relation to the utilization of the computer-based video instructional tool. The Cronbach's alpha reliability estimated for the whole modified TAM questionnaire was .938. For each construct the Cronbach's alpha reliabilities were as follows: .924 for perceived usefulness, .920 for ease of use, and .879 for attitude towards using. To determine the reliability of the test, SPSS was used to calculate the Cronbach's Alpha internal consistency of the modified TAM test. Table 3 summarizes the results of the calculation.

Table 3

Reliability Coefficient Alpha for Modified TAM Test Items

Number of Items for the Whole Survey = 13						
	Mean	Minimum	Maximum	Range	Max/Min	Variance
Item Means	4.082	3.508	4.949	1.441	1.411	0.188
Reliability Coefficients 13 items						
Alpha = 0.884			Standardized item alpha = 0.878			
Number of Items for the Whole Modified TAM = 8						
	Mean	Minimum	Maximum	Range	Max/Min	Variance
Item Means	3.863	3.484	4.339	0.855	1.245	0.081
Reliability Coefficients 8 items						
Alpha = 0.937			Standardized item alpha = 0.938			
Number of Items for the Perceived Usefulness = 3						
	Mean	Minimum	Maximum	Range	Max/Min	Variance
Item Means	3.957	3.839	4.177	0.339	1.088	0.037
Reliability Coefficients 3 items						
Alpha = 0.924			Standardized item alpha = 0.924			
Number of Items for the Ease of Use = 3						
	Mean	Minimum	Maximum	Range	Max/Min	Variance
Item Means	4.005	3.778	4.349	0.571	1.151	0.092
Reliability Coefficients 3 items						
Alpha = 0.920			Standardized item alpha = 0.920			
Number of Items for the Attitude Toward Using = 2						
	Mean	Minimum	Maximum	Range	Max/Min	Variance
Item Means	3.524	3.492	3.556	0.063	1.018	0.002
Reliability Coefficients 2 items						
Alpha = 0.877			Standardized item alpha = 0.879			

The next six questions in the survey were designed by the researcher for the purpose of assessing users' attitudes about specific features of the computer-based video instructional tool used in the study, i.e. the video content, the textbook content, and the audio content. The question format required the students to rate each content format with respect to its contribution (how sufficient or necessary) to the learning value of the tool.

Concept Mapping Video-Based Instructional Tool

Interactive concept map in computer-based video instructional tool

The computer-based video instructional tool consists of three integrated components: (a) video viewer, (b) supporting expository text, and (c) the interactive concept map. The video viewer contained a linear controller as well as integrated play and pause control buttons. The expository text was below the video viewer and automatically scrolled as the video content progressed to keep the content synchronized. The text could also be scrolled directly by the student to view any specific content area. The interactive concept map provided an alternate means of controlling the video via conceptual nodes that provided instant viewing of the associated video content (see Figure 5).

The computer-based video instructional tool contained programming resources that recorded all student interactions with the controls in each of the three components; the action, the time, and the position of the video player were recorded for each action. Figure 6 contains a sample of the recorded data format.

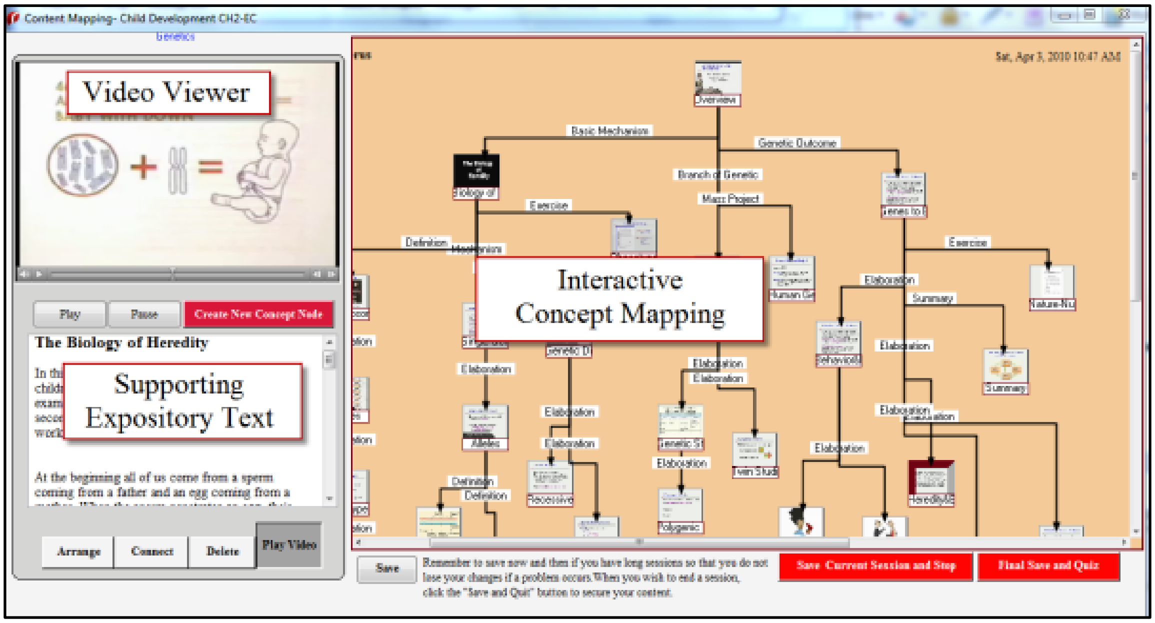

Figure 5. Screenshot of computer-based video instructional tool with the components labeled

The standard feature of the interactive concept map portion created for both groups is to capture of the screen whenever the students clicked on the save button during a session or when finishing a session. For the both groups, the screenshot pictures of the concept maps are stored in a folder and automatically uploaded to the server and stored separately for each user.

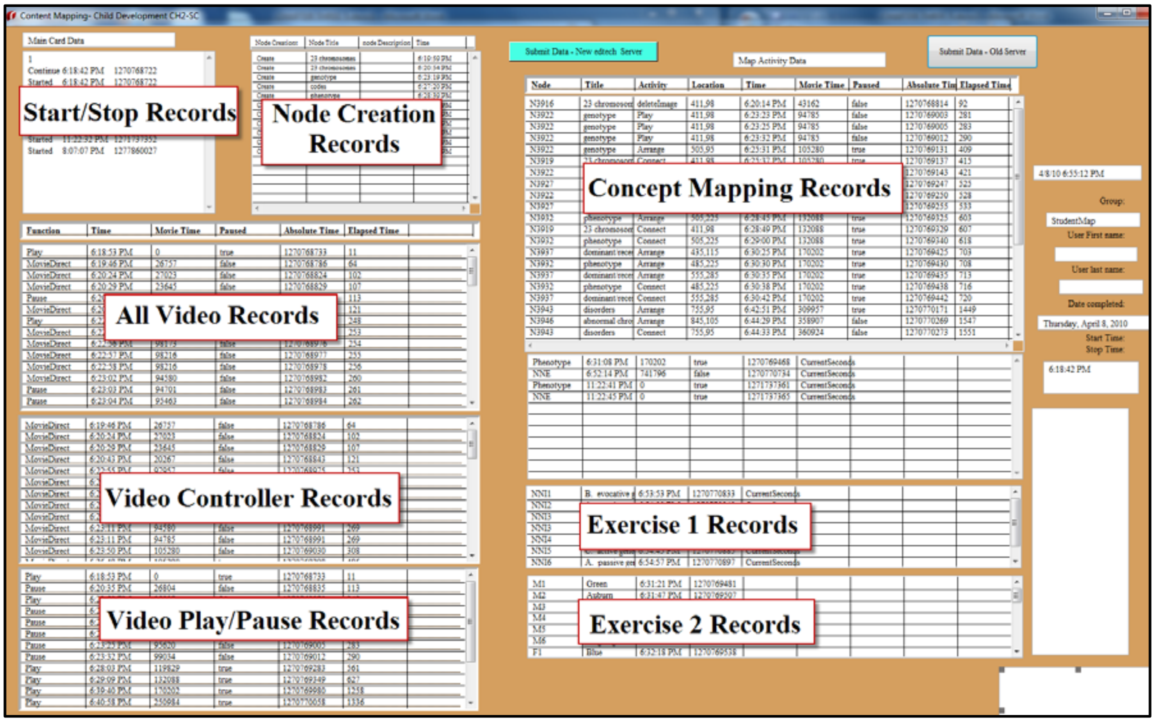

Figure 6. Screenshot of the data storage resource with labels showing the various data categories

The capture of the interactive concept map screen content for the learning-generated group provides a precise record of the students' performances during the process of creating their concept maps. The resulting images portray how the concept maps developed throughout the instruction, providing insight to the students' cognitive learning processes and their understanding of the video content. On the other hand, the capture of the interactive concept map screen for the expert-generated group only shows the maps created by the expert.

Design and development of the computer-based video instructional tool

The interactive concept mapping resource in the computer-based video instructional tool used in this study as adapted from standalone software created by Dr. Ronald Zellner. This software was designed to simultaneously present an instructional video and a text document while allowing for integration with a concept map in an adjoining window. Consequently, it allowed learners to control the viewing of video and text materials from a menu in the form of a concept map. The resource also allowed the viewer to construct or modify the components of interactive concept map. In addition, the standard course exercises and quizzes were converted into interactive computer format and functionally integrated into the instructional tool so students completed the exercises and took the quizzes while watching the video. Two different models of the concept map instructional tool were used for the study. The first model of the tool was designed for the learner-generated map group; this version let learners construct and organize their own concept maps while watching the instructional videos by clicking on the *Create New Concept Node* button found under the video screen (see Figure 7). When students decided that a particular part of the video was conceptually relevant they could click this button to initiate the node creation sequence: first it would freeze the video, then create an interactive thumbnail picture of the video screen, create a new map node, and finally place the thumbnail graphic in the new node to associate it with the current video content. In addition, the students are requested to type a title and a definition for the node they just created. The new node can then be moved to the desired location on the map and connected with other nodes to develop the relationships among them. They can also create a proposition, which identifies the functional relationship represented by the new link, i.e. the resulting concept maps were based on their understanding of the video content. Since the maps are also interactive, whenever the student clicks on one of these nodes in the map, the video jumps to the location in the video that corresponds with the node and continues playing from there.

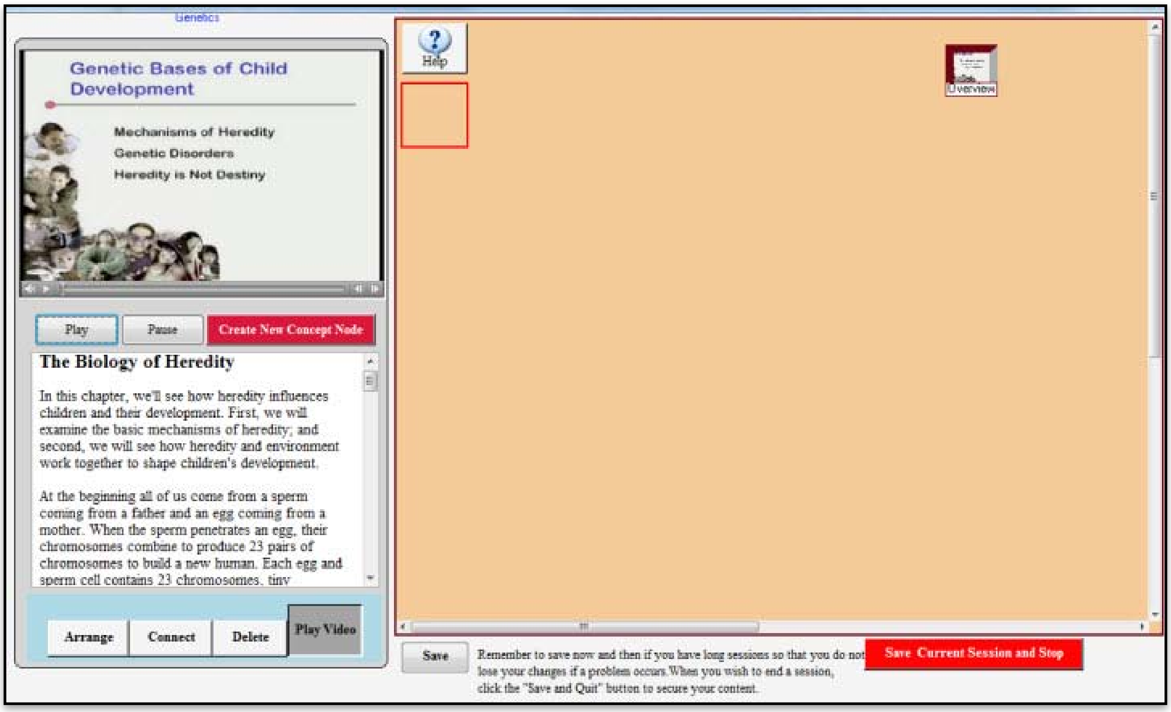

Figure 7. Screenshot of learner-generated concept mapping tool showing the beginning concept map content

The second model of the tool (see Figure 8) was similar to the first, except that there were no tools for creating concept map components. Completed concept maps of the instructional video content, including the nodes and content structure, had already been created by a content expert and were provided to the students. The students could then use the pre-existing map resources to control their exploration of the video and related text content and click on its nodes to jump to the corresponding locations in the video.

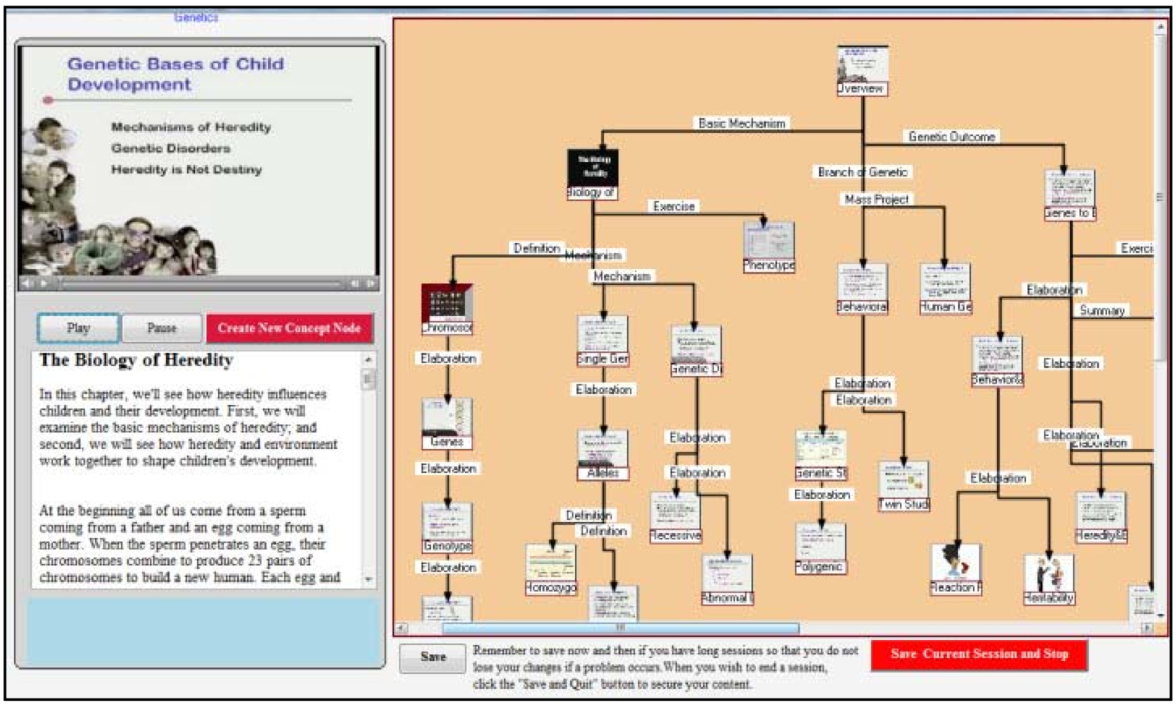

Figure 8. Screenshot of expert-generated concept mapping tool showing the pre-existing map resources

The instructional video

Two instructional videos, which corresponded with units one and two from the EPSY-320 textbook, respectively entitled *The Genetic Bases of Child Development* and *Prenatal Development, Birth, and the Newborn*, were developed and incorporated into the instructional tool. The duration of the two videos was approximately 22 and 23 minutes, respectively. The videos contained audio lectures of the two units with supporting graphics and text. These materials were designed and developed based on the course syllabus, the instructor's advice, the instructor's regular class materials, and the course textbook. In addition, they included materials from a PowerPoint created by the textbook publisher (modified by the course instructor), several pictures from the textbook, and short clips from anonymous animation movies captured from youtube.com. Two different voice formats, human and computer-generated, were used in the instructional videos in order to test different audio types and explore students' voice preference. The human audio files were included both male and female voices. The computer-generated voice was created by the computer audio program *TextAloud*, text-to-speech software that converts your text from MS Word Documents, Emails, Web Pages and PDF Files into natural-sounding speech The video content and the two types of audio files were all merged together to produce the final two unit videos incorporated in the instructional tool.

The unit quiz

Two quizzes (see Appendix D and Appendix E) were administered as part of the instructional activities; one quiz was administered at the end of each unit. Each quiz was compromised of ten-item multiple-choice items, which were adapted from a question item bank provided by the author of textbook, *Essentials of Educational Psychology*. The content validity of the quiz questions was supported by the course instructor who checked each question, compared the content of the test with the course domain, and adjusted them if necessary. She eliminated any question that was not appropriate to the students' knowledge level or the focus of the course. Each quiz was administered as an integral part of the instructional resource for each unit after the student completed the video instruction and had completed the two embedded exercises. The quiz results were automatically recorded by the instructional program and then transferred and stored in the online server database.

To determine the reliability of the test, SPSS was used to calculate the Cronbach's Alpha internal consistency of the test. Table 4 summarizes the results of the calculation. A commonly accepted rule of thumb is that a α of 0.6-0.7 indicates acceptable reliability and 0.8 or higher indicates good reliability (Cronbach, 1951). The standardized item alpha (α) for this measure is 0.659, which is in the acceptable range.

Table 4
Reliability Coefficient Alpha for the Unit Quiz Items

Number of Cases = 20

	Mean	Minimum	Maximum	Range	Max/Min	Variance
Item Means	.804	.467	.990	.524	2.122	.029

Reliability Coefficients 20 items

Alpha = .583 Standardized item alpha = .659

Evaluation/Assessment

Quantifying the interactions with the instructional tool components

The computer-based video instructional tool was constructed to provide instructional support, and record every action of the user, in three functional components: (a) direct video control and viewing, (b) expository text control and display, and (c) video integrated concept mapping access and/or development. The data were recorded unobtrusively and were stored in the background for later access and analyses by the researcher once the learning materials were uploaded by the students at the end of the unit. In the learner-generated version, all actions and clicks made to create nodes and links were monitored and recorded in relation to the current associated position in the video. Accordingly, the following data were recorded: the starting and stopping times for the general use of the instructional resource, the timing and number of clicks on the video player control, the timing of the creation of nodes, the names assigned to the nodes, the names and types of links created, the time and position of any rearrangement of node locations, and the timing and responses of students on the quiz items. Similarly, in the expert-generated version, all clicks on the concept map nodes were monitored and recorded in relation to the current associated position in the video. Accordingly, the following the data were recorded: the starting and stopping time for the general use of the instructional resource, the timing and number of clicks on the nodes, the timing and number of clicks on the video player control, the timing and responses of students on the exercises, and the timing and responses of students on the quiz items.

These data were obtained by having the students upload a copy of their final instructional tool files.

Assessing the quality of concept maps

Students in the learner-generated concept map group created a concept map for each unit as a component of interacting with the instructional tool and viewing the video. The resulting concept maps were obtained from the final files uploaded by the students and then scored using the traditional scoring method developed by Novak and Gowin (1984); a composite score was calculated using the following attributes: (a) valid propositions, (b) valid nodes, (c) valid levels of hierarchy, (d) valid cross-links, and (e) valid examples (see Table 5). The concept map score was used to assess the student cognitive learning organization, and then it was compared with the quiz score that helped to illustrate the relationship between them.

Table 5
Concept Maps Scoring Rubric

1.	Propositions (if valid)	= 1 point for each
2.	Nodes (if valid)	= 1 point for each
3.	Hierarchy (for each level)	= 5 points
4.	Cross-links (for each valid link)	= 10 points
5.	Examples (for each valid example)	= 1 point for each
	Total Score	= Sum of above

(Modified from Novak and Gowin, 1984, p. 36)

Procedure

Phase I: Testing the Instructional Tool and Procedure

Phase I of the study was performed in order to assess the functioning of the instructional learning tool and the associated administration procedures. The study was performed on the entire junior level of undergraduate students (n = 50) enrolled in *Developmental Psychology for Educators* in the fall semester of 2009 at Texas A&M University. All but two students agreed to participate. Due to personal reasons, one student could not complete the study. The students were randomly divided into two equally populated groups, one was assigned to use the expert-generated concept mapping tool, and the other to use the learner-generated concept mapping tool.

Phase I included two surveys, two video-based sets of instructions covering the two units, and two exercises and one quiz for each unit. The Moodle server was used to manage the course activities and materials.

It took approximately four weeks for students to complete three steps of the study: preparation, implementation, and evaluation. In the preparation step, students became familiar with the management system logon procedures and the ways to interact with the various resources available there. All the students completed an online survey related to their computer knowledge and then tested to insure that Javascript was enabled on their browser and that they could participate fully. Students then watched an online training video to learn how to use the learning tool resources. All participants then downloaded the learning tool from the Moodle site and installed it on their own computer. The subsequent learning activities were then completed on that copy of the tool.

In the implementation step, the participants accessed and utilized their copy of the learning tool to view the instructional video and interact with the mapping resource, Members of the learner-generated concept mapping group constructed a concept map while viewing the instructional video, and the expert-generated concept mapping group used the expert-generated concept maps already supplied to control and view the instructional video. After certain portions of the video and text content were viewed, two application exercises were made available in each chapter that required the student to utilize the associated learning content. When the viewing and exercises were completed, the tool revealed a quiz at the end of each chapter. The student responses to the exercises and quizzes were submitted directly to the online database when they were completed.

In the evaluation step, all participants completed the final survey regarding their feelings toward the learning tool as well as their preferences about the text, audio, video, and concept mapping used in the learning tool. The students then uploaded their folder containing the completed learning tool and the data files generated during their interactions. All the data concerning the students’ interaction with the learning tools, exercise scores, quiz scores, survey responses, and learner-generated concept map scores were then aggregated, coded, and stored in the server database to be analyzed by the researcher.

Phase I results were used to evaluate the procedures, functions, and resources in the instructional learning tool for use in the second phase. More specifically, survey results were used to help us better understand the following: (a) how the computer skills of the learner affected the study; (b) the relative components of the design and the use of such instructional resources; and (c) the perceived usefulness, ease of use, and attitude toward concept mapping embedded in video-based instruction. In addition, the relationship between the student achievements and concept mapping provided information about how the use of concept mapping affects students' cognitive learning process in video-based learning.

Observations and data collected during phase I revealed some weaknesses in the procedures that caused some reliability issues with the data used to analyze the relationship between student achievement and the construction of concept maps while viewing the instructional video. These weaknesses were:

- Although they were supposed to watch the training video before starting to use the instructional tool, some of the students did not watch the training video or watched it after they had used the instructional tool.
- Some participants did not follow the outlined procedure while using the instructional tool. For example, before taking the final quiz, they should have watched the instructional video and completed the two exercises. Instead, some students constructed a concept map or took the final quiz before watching the instructional video or completing the exercises.
- Some students did not upload the instructional tool folder back to the Moodle site, which in turn did not allow us to analyze their concept mapping construction.

- Some students complained about the background music of the video that was embedded to improve the motivation of the learner. Some of the students felt that the music was too loud.

The phase I observations were used to modify the procedures, support resources, and the learning tool, making specific changes to eliminate these weaknesses. These modifications were then used in the second phase of the study in the spring semester of 2010 to investigate the extent to which concept maps' generation methods support the process of meaningful learning construction.

Phase II: Reassessing the Instructional Tool

The steps of Phase II were similar to the steps of Phase I. However, the following changes were made based on Phase I study results: (a) the computer-based video instructional tool used was upgraded: the new tool prevented students from taking the final quiz before completing the two exercises and creating concept map; (b) the questions on the computer knowledge survey were revised, and five additional questions were added; (c) a dynamic progress chart was added to the Moodle page that was automatically updated by the data generated from the submission of exercises and quizzes, and (d) the instructional videos were upgraded to add visual transitions and titles between the various topics and subsections; the background music was also removed.

Phase II was conducted with students who took EPSY-320 in the spring 2010 term. After the instructor agreed to use this module in her classroom, she included it in the classroom syllabus. At the beginning of the semester, the instructor and the researcher explained the purpose of this study and asked students to volunteer to participate. All the students who wanted to participate in the study filled out and returned a consent letter (see Appendix A) one week before the study began. The phase II study took over four weeks and included the following components: (a) online training; (b) two online course modules; (c) one pre-survey (see Appendix B) used to identify students' computer knowledge; (d) two exercises in each unit (see Appendix F, G, H, and I); (e) one short quiz at the end of each unit (see Appendix D and E); and (f) one post-survey (see Appendix C) that was conducted to evaluate perceptions of usefulness, ease of use, and attitude of students toward the instructional tool.

The same Moodle website was used (see Figure 2) to facilitate the online training and distribute the course materials. The students followed the same steps in Phase II as they did in Phase I. The Progress Chart (see Figure 3) helped to show students the sequential order of the activities, indicating which were completed and which still needed to be done. The researcher also helped the students by answering their email questions as soon as possible.

The preliminary activities took approximately one week and consisted of the online training, the pre-survey, and the Browser Javascript test. After the preliminary activities were completed, Unit 1 was activated on the Moodle course site. After all the data from the instructional tool and the online surveys were collected, the data were coded and stored in the server database and then were analyzed by the researcher.

Data Sources

To determine the effect of using concept mapping in computer-based video instructional materials, the following data sources were collected: (a) students' responses to the Computer Knowledge Survey, (b) students' responses to the post-instruction attitude survey, (c) students' exercise scores, (d) students' quiz scores, (e) rubric scores for assessing students' concept maps, and (f) recorded data about the interaction of the students with the instructional tool.

Data Analysis

The data analysis was guided by the research questions. Each research question was interpreted and analyzed as described below:

- *Research Question 1: Do undergraduate students who develop and use their own concept maps perform better in embedded evaluations and course evaluations than students who use expert-generated concept maps?* A Multivariate Analysis of Variance (MANOVA) analysis method was used to compare the mean of the scores of the two quizzes completed by the two groups. The scores were collected from the short quizzes given at the end of each unit. The comparison of the scores gave us two possible results: either both instructional methods are effective, or one is superior to the other.
- *Research Question 2: With respect to interacting with the instructional resources, i.e., viewing the video and creating or utilizing the content map:*
  a. *Does time spent interacting with the instructional resources relate to student achievement?* A regression analysis was conducted between the

dependent variable—student achievement—and the independent variables—time spent interacting with the instructional textbook and time spent interacting with the instructional video. The regression analysis was used to determine if differences in student achievement were related to the differences in the time spent interacting with the instructional video and interactive concept maps, and time spent interacting with the instructional textbook. A MANOVA using “group” as the fixed factor and “time spent interacting with the instructional textbook” and “time spent interacting with the instructional video” as the dependent variables was administrated to determine differences in the time spent by each group while completing the instructional tool activities. “Time spent interacting” was recorded by the computer-based video instructional tool.

b. *Does the complexity of interaction activity relate to student achievement?* A regression analysis was conducted between the dependent variable—student achievement—and the independent variable—complexity of interaction activity. The data related to interaction of the students with the instructional video and interactive concept maps was collected and scored based on amount of use. In other words, the number of clicks on pause button and play button while watching the video and the number of clicks on the concept map links were recorded. The regression analysis was used to determine if differences in student achievement were related to the differences in the complexity of interaction.

- *Research Question 3: In the learner-generated map group, are there discernable patterns of student activities that relate to overall student achievement?*
    a. *Does time spent on developing concept maps relate to student achievement?* A regression analysis was conducted between the dependent variable—student achievement—and the independent variable—time spent on developing concept maps. The data for "time spent on developing concept maps" was recorded by the instructional tool. The regression analysis was used to determine the differences in the student achievement related to the differences in the times spent on developing concept maps.
    b. *Does the complexity of concept maps created relate to student achievement?* A regression analysis was conducted between the dependent variable—student achievement—and the independent variables—complexity of the concept maps. The concept maps constructed by the students were scored based on the Novak and Gowin (1984) traditional scoring method. The regression analysis was used to determine the differences in student achievement related to the differences in the complexity of the concept maps.
    c. *Do temporal and spatial patterns of creating and arranging map nodes relate to student achievement?* A regression analysis was conducted between the dependent variable—student achievement—and the

independent variable—temporal and spatial patterns of creating and arranging map nodes. The concept maps created by the students were analyzed and graded based on the pattern and nodes on the maps. A number of the nodes on the maps, the propositions among nodes, and the links between nodes were used to score the independent variable. The regression analysis was used to determine the differences in student achievement related to the relationship among the nodes, the propositions, and the links.

- *Research Question 4: When they have completed the instruction, what attitude do students have toward the use of these instructional activities in general? Are there differences between the attitudes of the two groups?* Descriptive statistical analysis with 95% confidence intervals (CIs) was employed to investigate how the use of the instructional tool affected the students' attitude toward the instructional tool. The students' attribute levels were identified using 95% CIs and bar graphs. A MANOVA statistical analysis was conducted to analyze the dependent variables — perceived usefulness, ease of use, and attitude toward using. Modified technology acceptance model (TAM) questionnaires (see Appendix C) were administrated to determine the students' perspectives about usefulness, ease of use, and attitude toward using the instructional tool.

CHAPTER IV

RESULTS

This study was designed to investigate the comparative effectiveness of learner-generated and expert-generated concept mapping methods on learning using computer-based instructional video resources created for the junior-level undergraduate *Developmental Psychology for Educators* (EPSY-320) class at Texas A&M University. The effectiveness of learner-generated and expert-generated concept mapping methods in video-based learning was measured with the following instruments: (a) students' responses to the Computer Knowledge Survey, (b) students' responses to the unit quizzes, (c) students' responses to the post-instruction attitude survey, (d) analysis of the number of interactions with the instructional tool components, (e) analysis of the student created concept maps, and (f) rubric scores for assessing the quality of those concept maps. This chapter presents the results of this data collection and its analyses in relation to the research questions.

Research Question 1

Do Undergraduate Students Who Develop and Use Their Own Concept Maps Perform Better in Embedded Evaluations and Course Evaluations Than Students Who Use Expert-Generated Concept Maps?

A MANOVA was applied to answer this question. The assumption of a MANOVA was tested by checking the results of homogeneity of variance-covariance, known as homoscedasticity. It was examined by interpreting the results of Box's Test of Equality of Covariance Matrices. The observed covariance matrices of the dependent variables were equal across groups because the test was not significant (Box's M = 3.237, F = 1.039, p = .374 > .05). Therefore, homogeneity of variance-covariance across groups can be assumed.

A MANOVA analysis was conducted to determine the effects of the two independent variables—the learner-generated concept map and the expert-generated concept map—on the two dependent variables—the Unit 1 quiz scores and the Unit 2 quiz scores. The mean quiz score summary statistical analysis with 95% confidence intervals (CIs) for unit one and two are given in Table 6.

Table 6
Summary Statistics of Unit Quiz Scores

	Unit 1 Quiz Scores	
Summary Indications	Learner-Generated Concept Map Group	Expert-Generated Concept Map Group
Minimum	4	6
Quartile 1	6	7
Median	8	8
Quartile 3	9	9
Maximum	10	10
Mean	7.61	8.16
Standard Deviation	1.542	1.167
Std. Error Mean	.277	.206
Sample Size	31	32

Table 6
Continued

Unit 2 Quiz Scores		
Summary Indications	Learner- Generated Concept Map Group	Expert- Generated Concept Map Group
Minimum	6	5
Quartile 1	8	7
Median	8.5	8
Quartile 3	9	9
Maximum	10	10
Mean	8.33	8.12
Standard Deviation	1.155	1.408
Std. Error Mean	.211	.249
Sample Size	30	32

According to the MANOVA analysis results, the two video-based instruction methods were not significantly different: Wilks' $\Lambda = .924$, $F = 2.427$, $p = .097 > .05$ (see Table 7 and Table 8). Therefore, the null hypothesis—the learner-generated concept map group performs better in embedded evaluations and course evaluations than the expert-generated concept map group—was rejected. The two instructional methods did not differ.

Table 7
Multivariate Test Results of the Effects of the Two Instructional Methods

Effect	Value	df	F	Sig	Eta Squared
Intercept Wilks' Lambda	.017	2	1744.71	.000	.983
Group Wilks' Lambda	.924	2	2.427	.097	.076

Table 8
ANOVA Between-Subjects Test Results of the Learner-Generated and Expert-Generated Concept Mapping Video-Based Learning

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig	Eta Squared
Intercept	Unit 1 Quiz	3811.557	1	3811.557	2123.717	.000	.973
	Unit 2 Quiz	4194.220	1	4194.220	2512.345	.000	.977
Group	Unit 1 Quiz	6.008	1	6.008	3.348	.072	.053
	Unit 2 Quiz	.672	1	.672	.403	.528	.007

Research Question 2

With Respect to Interacting with the Instructional Resources, i.e., Viewing the Video and Creating or Utilizing the Content Map: Does Time Spent Interacting with the Instructional Resources Relate to Student Achievement?

Descriptive statistical analysis with 95% CIs was constructed around the means of the variables (see Table 9). This descriptive statistical analysis was used to determine the effect of the amount of time spent with the instructional tool on student achievement.

Table 9

Descriptive Statistics of the Time Spent Interacting with the Instructional Resources

Summary Indication	N	Mean	Mean SE	SD	Min	Max
Hours spent interacting with textbook	63	2.714	.3789	3.01	0	20
Hours spent on video-based learning	63	2.87	.225	1.786	.8	8
Number of times connecting to Moodle	65	7.06	.419	3.381	1	21
Number of clicks within Moodle	65	71.97	4.934	39.78	3	215
Number of clicks on video player control in unit one	63	58.19	7.241	57.479	8	343
Number of clicks on concept map in unit one	63	15.325	2.04	16.162	0	70
Minutes spent creating a concept map for unit one	32	47.38	5.075	28.71	8	118
Minutes spent using all interaction tools in unit one	63	51.44	5.321	42.234	1	164
Number of clicks on video player control in unit two	59	53.24	8.267	63.501	3	323
Number of clicks on concept map in unit two	59	9.34	1.332	10.229	0	36
Minutes spent creating a concept map for unit two	30	46.70	5.649	30.942	5	142
Minutes spent using all interaction tools in unit two	59	38.8	4.524	34.746	12	187

Note. Mean SE = mean standard error; SD = standard deviation.

A MANOVA analysis was applied. The dependent variables identified were the time spent interacting with the instructional textbook and the time spent interacting with the instructional video; the fixed variables identified were the two groups (the learner-generated concept map group and the expert-generated concept map group). The assumption of the MANOVA was tested by checking the results of homogeneity of variance-covariance by interpreting the results of Box's Test of Equality of Covariance Matrices. The observed covariance matrices of the dependent variables were equal across groups because the test was not significant (Box's M = 9.254, F = 2.975, p = .030 > .001). Therefore, homogeneity of variance-covariance across groups can be assumed.

According to the MANOVA analysis results, the times spent interacting with the instructional textbook and with the instructional video were not significantly different: Wilks' Λ = .963, F = 1.143, p = .326 > .05 (see Table 10 and Table 11).

Table 10
Multivariate Test Results of the Time Spent with Textbook and the Time Spent with Video-Based Learning

Effect	Value	Df	F	Sig	Eta Squared
Intercept Wilks' Lambda	.243	2	93.492	.000	.757
Group Wilks' Lambda	.963	2	1.143	.326	.037

Table 11
ANOVA Between-Subjects Test Results for the Time Spent with Textbook and the Time Spent with Video-Based Learning

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig	Eta Squared
Intercept	Time spent with textbook	465.640	1	465.640	51.151	.000	.456
	Time spent with video-based learning	520.567	1	520.567	165.926	.000	.731
Group	Time spent with textbook	5.561	1	5.561	.611	.437	.010
	Time spent with video-based learning	6.395	1	6.395	2.038	.158	.032

To determine the differences in the time spent by each group while using the instructional tools to complete each unit, a MANOVA analysis was conducted. The dependent variables identified were the time spent on all interaction in unit one and the time spent on all interaction in unit two. The fixed variables identified were the two groups: the learner-generated concept map group and the expert-generated concept map group. Descriptive statistical analysis with 95% CIs was constructed around the means of the time spent interacting with all tools in unit one and unit two (see Table 12).

Table 12

Descriptive Statistics of the Time Spent on All Interaction While Completing the Units

Source	Group	N	Mean	Mean SE	SD
Interaction in unit one	Learner created	32	61.41	7.758	43.883
	Expert created	31	41.16	6.912	38.486
Interaction in unit two	Learner created	30	54.30	7.016	38.428
	Expert created	29	22.76	3.928	21.152

The assumption of the MANOVA was tested by checking the results of homogeneity of variance-covariance. The observed covariance matrices of the dependent variables were equal across groups because the results of Box's Test of Equality of Covariance Matrices was not significant (Box's M = 12.743, F = 4.083, p = .007 > .001). Therefore, homogeneity of variance-covariance across groups can be assumed.

According to the MANOVA analysis results, the times spent on all interaction in unit one and unit two were significantly different: Wilks' Λ = .785, F = 7.547, p = .001 < .05 (see Tables 13 and 14). The ANOVA results showed that the expert-generated concept mapping group spent significantly less time than the learner-generated concept mapping group (F = 3.868, p = 025 < .05 for unit 1; F = 15.150, p < .001 for unit 2) in the both units.

Table 13

Multivariate Test Results of the Time Spent on All Interaction in Units One and Two

Effect	Value	df	F	Sig	Eta Squared
Intercept Wilks' Lambda	.311	2	60.888	.000	.689
Group Wilks' Lambda	.785	2	7.547	.001	.215

Table 14

ANOVA Between-Subjects Test Results for the Time Spent on All Interaction in Units One and Two

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig	Eta Squared
Intercept	Time spent on unit one interaction	155107.243	1	155107.243	86.800	.000	.608
	Time spent on unit two interaction	84788.382	1	84788.382	86.156	.000	.606
Group	Time spent on unit one interaction	6911.381	1	6911.381	3.868	.027	.065
	Time spent on unit two interaction	14909.900	1	14909.900	15.150	.000	.213

Note. One direction, one tail $\alpha = .05$ ANOVA test results

A regression analysis was conducted to determine the relative effects of the time spent on all interactions with the instructional tools during the completion of unit one and unit two, the time spent interacting with the instructional textbook, and the time spent interacting with the instructional video on student achievement. The dependent variable was student achievement, and the independent variables were time spent interacting with the instructional textbook, time spent interacting with the instructional video, and time spent on all interaction with the instructional tool. The regression analysis results were not statistically significant ($F(3, 60) = .610$, $p = .611$), so we cannot assume any relation between student achievement and the time spent interacting with the instructional materials (see Table 15).

Table 15
Summary of Regression Analysis of the Effect of Time Spent Interacting with the Instructional Resources on Student Achievement

Predictors	B	SE	β	*p*	r_s
Time Spent Interacting with Instructional Textbook → Student Achievement	-.026	.055	-.062	.640	-.043
Time Spent Interacting with Instructional Video → Student Achievement	.192	.112	.276	.093	.217
Time Spent on all Interaction with Instructional Tool → Student Achievement	.205	.213	.182	.344	.182

Note. SE = standard error (R square = .090 and adjusted R square = .039)

Does the Complexity of Interaction Activity Relate to Student Achievement?

A regression analysis was conducted, using student achievement as the dependent variable and interactions with the video content (i.e. the number of clicks on the concept map and on the video player control) as the independent variables, to determine the relation between complexity of interaction activity and student achievement. The regression analysis showed that the number of clicks on the concept map (β = -.004, *p* = .978) and the number of clicks on the video player control (β = .113, *p* = .415) during the interaction with the instructional tools was not directly related to student achievement (see Table 16).

Table 16
Summary of Regression Analysis of the Effect of the Complexity of Interaction Activity on Student Achievement

Predictors	B	SE	β	*p*	r_s
Click on Video Player Control → Student Achievement	-.004	.137	-.004	.978	.113
Click on Concept Map → Student Achievement	.118	.144	.113	.415	-.022

Note. SE = standard error (R square = .013, *p* = .706; adjusted R square = -.024)

Research Question 3

In the Learner-Generated Map Group, Are There Discernable Patterns of Student Activities That Relate to Overall Student Achievement? Does Time Spent on Developing Concept Maps Relate to Student Achievement?

Descriptive statistical analysis with 95% CIs was constructed (see Table 17) around the means of the time spent creating concept maps in the instructional tool to determine the effect of spending time on developing concept maps as it was related to student achievement.

Table 17
Descriptive Statistics of the Time Spent Creating Concept Maps in the Instructional Tool

Summary Indication	N	Mean	Mean SE	SD	Min	Max
Minutes spent creating concept map in unit one	32	47.38	5.075	28.710	8	118
Minutes spent creating concept map in unit two	30	46.70	5.649	30.942	5	142

Note. N = sample size; Mean SE = mean standard error; SD = standard deviation

A regression analysis was conducted using student achievement as the dependent variable and time spent creating concept maps as the independent variable in order to determine the effect of time spent creating concept maps on student achievement. The regression analysis (β = .231, p = .227) showed that the time spent creating concept maps was not directly related to student achievement (see Table 18).

Table 18
Summary of Regression Analysis of the Effect of the Time Spent Creating Concept Maps on Student Achievement

Predictors	B	SE	β	*p*	r_s
Time Spent Creating Concept Maps → Student Achievement	.263	.213	.231	.227	.231

Note. R square = .054 (p =.227, adjusted R square = .018)

Does the Complexity of Concept Maps Created Relate to Student Achievement?

To determine the differences in student achievement in relation to the differences in the complexity of the concept maps they created, a regression analysis was conducted using student achievement as the dependent variable and the complexity of the concept maps as the independent variable. The complexity of the concept map was calculated using the Novak and Gowin (1984) traditional scoring method. The regression analysis was statistically significant (β = .451, p = .012 < .05), showing that student achievement was related to the complexity of the concept map (see Table 19).

Table 19
Summary of Regression Analysis of the Complexity of Concept Maps in Relation to Student Achievement

Predictors	B	SE	β	*p*	r_s
Concept Map Score → Student Achievement	.488	.182	.451	.012	.451

Note. R square = .203 (p = .012; adjusted R square = .175)

Several interaction measures were recorded during the creation of the maps (i.e. the number of clicks on the concept map, the number of clicks on the video player control, and the time spent creating the concept map) and several map components (nodes, propositions, and branching) were used to score the resulting concept maps. A Pearson correlation analysis was conducted with these variables to determine the status and relationships among them (see Table 20). According to the results, student achievement had a positive correlation with the first set of variables: concept map total score (r = .451, p = .012), nodes (r = .458, p = .011), propositions (r = .450, p = .014), and branching (r = .459, p = .011). Concept map total scores were calculated by adding nodes, propositions, and branching. Therefore, it was reasonable that these variables had a high correlation among them. Concept map total scores also had a positive correlation

Table 20

Pearson Correlation Results: Student Achievement, Number of Clicks on Video Player Control, Number of Clicks on Concept Map, Time Spent Creating Concept Map, Concept Maps Total Score, and Time Spent on All Interaction

Variables	SA	Nodes	Propositions	Branchings	# of Clicks on VPC	# of Clicks on CM	Time Spent Creating CM	CM Total Score	Time Spent on All Interaction
S Achievement	1	.458*	.450*	.459*	.113	-.022	.231	.451*	.182
Sig (2-tailed)		.011	.014	.011	.402	.872	.227	.012	.344
N	62	30	30	30	57	57	29	30	29
Nodes		1	.983**	.950**	.266	-.031	.744**	.978**	.616**
Sig (2-tailed)			.000	.000	.156	.871	.000	.000	.000
N		32	30	31	30	30	30	31	30
Propositions			1	.963**	.340	.098	.803**	.994**	.677**
Sig (2-tailed)				.000	.071	.612	.000	.000	.000
N			30	30	29	29	29	30	29
Branchings				1	.358	.016	.792**	.961**	.693**
Sig (2-tailed)					.052	.933	.000	.000	.000
N				31	30	30	30	31	30
# of Clicks VPC					1	-.161	.605**	.409*	.581**
Sig (2-tailed)						.228	.000	.025	.001
N					58	58	30	30	30
# of Clicks CM						1	.218	-.004	.179
Sig (2-tailed)							.247	.983	.345
N						58	30	30	30
Time Spent Creating CM							1	.744**	.874**
Sig (2-tailed)								.000	.000
N							30	30	30
CM Total Score								1	.665**
Sig (2-tailed)									.000
N								31	30
Time Spent on All Interaction									1
Sig (2-tailed)									
N									30

Note. SA = student achievement; # of Click VPC = number of clicks on video player control; # of Click CM = number of clicks on concept maps; CM Total Score = Concept maps total score

* Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01 level (2-tailed) with the interaction variables examined: the number of clicks on the video player control (r = .409, p = .25), time spent creating concept maps (r = .744, p < .001), and time spent on all interaction (r = .665, p < .001).

A regression analysis was performed using the concept map scores as the dependent variable and the number of clicks on the video player control, time spent creating the concept maps, and time spent on all interaction as the independent variables. The regression analysis for each variable was statistically significant. As illustrated in Table 21, the number of clicks on the video player control (β = .409, p= .025 < .05), time spent creating concept maps (β = .803, p < .001), and time spent on all interaction (β = .665, p < .001) within the instructional tool had a direct impact on the concept map total scores.

Table 21
Summary of Regression Analysis of the Effect of the Number of Clicks on the Video Player Control, the Time Spent Creating a Concept Map, and the Time Spent on All Interaction on Concept Map Total Scores

Predictors	B	SE	β	*p*	*rs*
Number of Clicks on VPC → Concept Map Scores	.325	.137	.409	.025	.409
Time Spent Creating CM → Concept Map Scores	.804	.133	.803	.001<	.803
Time Spent on Interaction → Concept Map Scores	.666	.141	.665	.001<	.665

Note. VPC = video player control; CM = concept maps

Do Temporal and Spatial Patterns of Creating and Arranging Map Nodes Relate to Student Achievement?

A regression analysis was performed using student achievement as the dependent variable and temporal and spatial patterns of creating and arranging map nodes as the independent variable. These patterns were defined as the number of nodes on the concept maps, the number of propositions among the nodes, and the number of branchings on the concept maps. The regression analysis for each variable was statistically significant: the number of nodes in relation to student achievement (β = .458, p = .011 < .05), the number of propositions in relation to student achievement (β = .450, p = .014 < .05), and the number of branchings in relation to student achievement (β = .459, p = .011 < .05) (see Table 22).

Table 22
Summary of Regression Analysis of the Number of Nodes, Propositions, and Branchings on Student Achievement

Predictors	B	SE	β	*p*	r_s
Number of Nodes → Student Achievement	.498	.181	.458	.011	.458
Number of Propositions → Student Achievement	.434	.166	.450	.014	.450
Number of Branchings → Student Achievement	.497	.182	.459	.011	.459

The regression analysis showed that the number of nodes, the number of propositions, and the number of branchings created by the students during the construction of concept maps were related to student achievement. As expected, these three variables had very high correlations with each other (see Table 23).

Table 23
Summary of Correlations of the Variables: Nodes, Propositions, and Branchings

Predictors	N	*p*	r_s
Nodes ↔ Propositions	30	<.001	.983
Nodes ↔ Branchings	30	<.001	.950
Propositions ↔ Branchings	30	<.001	.963

Research Question 4

When They Have Completed the Instruction, What Attitudes do Students Have Toward the Use of These Instructional Activities in General? Are There Differences Between the Attitudes of the Two Groups?

The post-instruction attitude survey scores were used to examine the students' attitudes toward the instructional activities and tools. The survey itself consisted of 12 items. A total of eight items, adapted from TAM developed by Davis (1989), were examined here: three that indicated perceived usefulness, three that indicated ease of use, and two that indicated attitude toward using the instructional tool. Factor analysis reduced the items for each dependent variable, and a MANOVA was conducted to determine the differences of each group in the perceived usefulness, ease of use, and attitude toward using the instructional tool.

A descriptive statistical analysis with 95% CIs was conducted on the means for the dependent variables: perceived usefulness, ease of use, and attitude toward using. The mean scores of the students for the dependent variables using the learner-generated concept mapping in video-based instructional tool were given in Table 24. A 7-point Likert scale (1 = strongly disagree to 7 = strongly agree) was used to assess the participants' views.

Table 24
Descriptive Statistics of Ease of Use, Perceived Usefulness, and Attitude Toward Using

Variable	Group	N	Mean	Std. Deviation	Std. Error Mean
Ease of Use	Learner created	31	3.72	2.077	.215
	Expert created	32	4.28	1.739	.178
Perceived Usefulness	Learner created	31	3.40	1.786	.186
	Expert created	32	4.49	1.667	.170
Attitude toward Using	Learner created	31	2.90	1.647	.209
	Expert created	32	4.13	1.686	.211

The assumption of the MANOVA was tested by checking the results of the homogeneity of variance-covariance. The observed covariance matrices of the dependent variables were equal across groups since the results of Box's Test of Equality of Covariance Matrices was not significant (Box's M = 6.804, $F = 1.072$, $p = .376 > .001$). Therefore, homogeneity of variance-covariance across group can be assumed.

According to the MANOVA analysis results, the perceived usefulness and the attitude toward using the instructional tool were significantly different from one group to the other: Wilks' Λ = .854, F = 3.299, p = .027 < .05 (see Tables 25 and 26); however, ease of use of the instructional tool was not significantly different. As seen in Table 24, the three variables' mean scores for the expert-generated concept map group were higher than for the learner-generated concept map group. As Table 26 shows, perceived usefulness (F = 7.261, p = .009) and attitude toward using the instructional tool (F = 8.505, p = .003) were significantly different from one group to the other group, but ease of use of the instructional tool (F = 1.687, p = .1992) was not.

Therefore, we can conclude that the group of students in the expert-generated concept map group tended to use the educational tool more than the students in the learner-generated concept map group. Both groups felt that the instructional tool was not easy to use.

Table 25
Multivariate Test Results of the Students' Behavior Toward the Instructional Tool

Effect	Value	Df	F	Sig	Eta Squared
Intercept Wilks' Lambda	1.000	3	.004	1.000	.000
Group Wilks' Lambda	.8544	3	3.299	.027	.146

Table 26
ANOVA Between Subjects Test Results of the Students' Behavior Toward the Instructional Tool

Source	Type III Sum of Squares	Df	Mean Square	F	Sig	Eta Squared
Ease of Use	1.692	1	1.692	1.687	.1992	.027
Perceived Usefulness	6.585	1	6.585	7.261	.009	.108
Attitude toward Using	8.505	1	8.505	9.539	.003	.137

In the study, the students' preferences toward the presentation methods of the instructional tool were also investigated. The presentation methods were classified into three categories: (1) presenting video instruction without a text document, (2) presenting video instruction without a content map, and (3) using the textbook alone without video materials. Moreover, the students' preferences concerning the audio components, audio format, and animation portions of the instructional video were investigated. A descriptive statistical analysis with 95% CIs and a bar chart were constructed. The mean score of video instruction attributes are given in Table 27.

Table 27
Descriptive Statistics of the Video Instruction Attributes

Source	N	Mean	SD	Variance
Video, No Text	63	3.48	1.874	3.512
Video, No Concept Map	63	4.59	1.837	3.375
Textbook, No Video	62	4.40	1.624	2.638
Audio Components of Video	63	4.27	1.658	2.749
Animation Portions of Video	61	4.93	1.352	1.829
Audio Preference of Video	62	.32	.621	.386

Note. N = sample population; SD = standard deviation of the mean.

As illustrated in Table 27 and Figure 9, students preferred video instruction with text documents. However, the students thought that the content mapping component in the instructional tool was not necessary and that the video instruction would be just as effective without content mapping (see Figure 10). Almost half of the students believed that the textbook alone would be sufficient to teach the content (see Figure 11). The students found that the most useful parts of the video were the audio components (see Figure 12) and the animation portions (see Figure 13). The audio portion consisted of both a human voice and a computer-generated voice, and most students preferred hearing the human voice (see Figure 14) in the video.

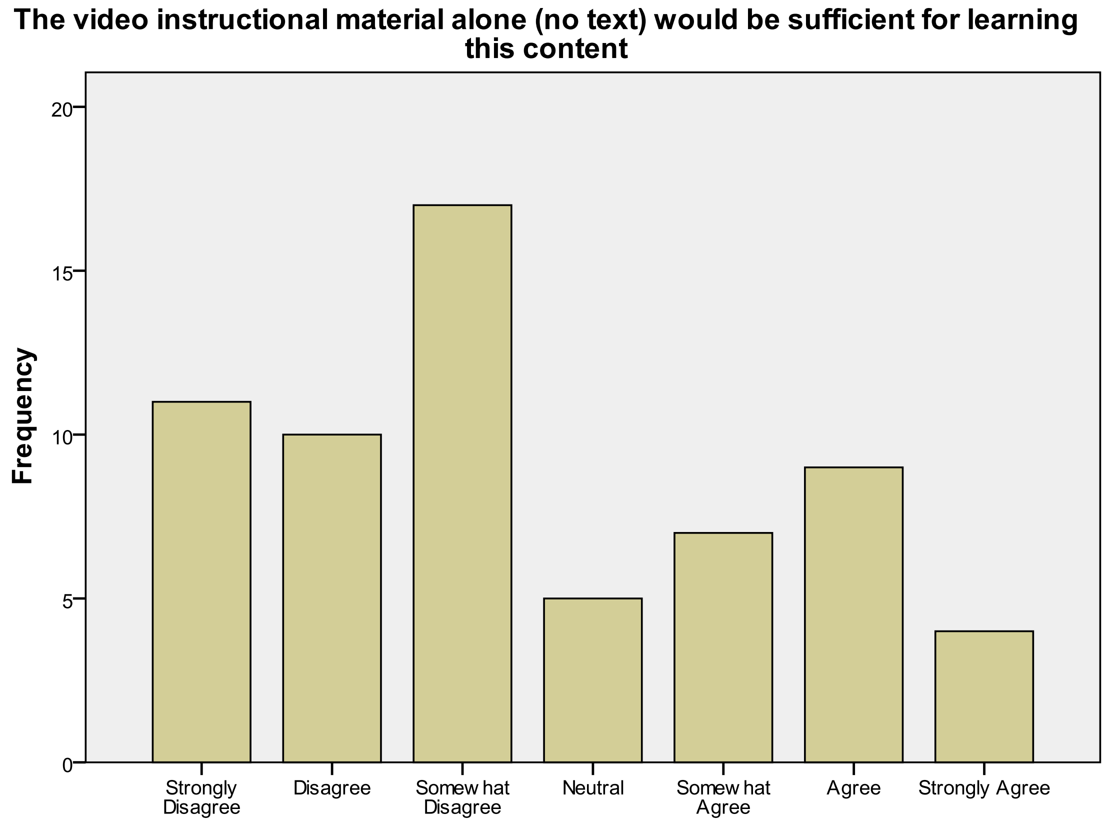

Figure 9. Bar graph showing the students' preference for using video instruction without the text document

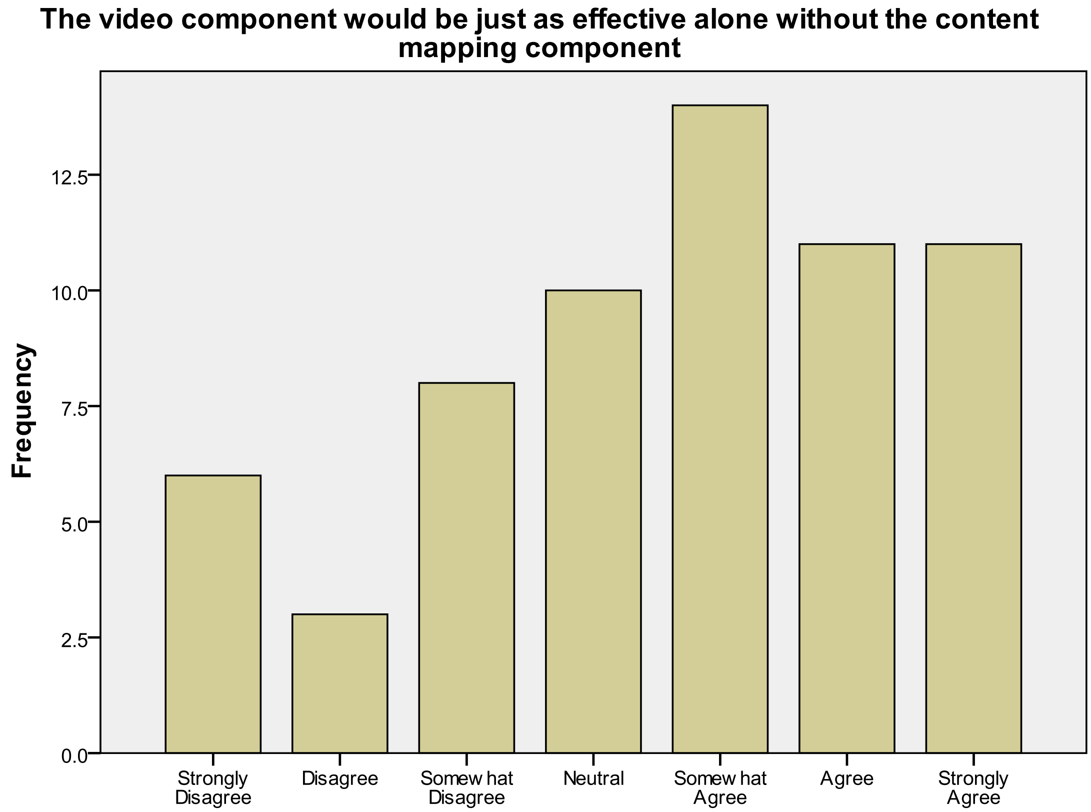

Figure 10. Bar graph showing the students' preference for using the video instruction without the content mapping component

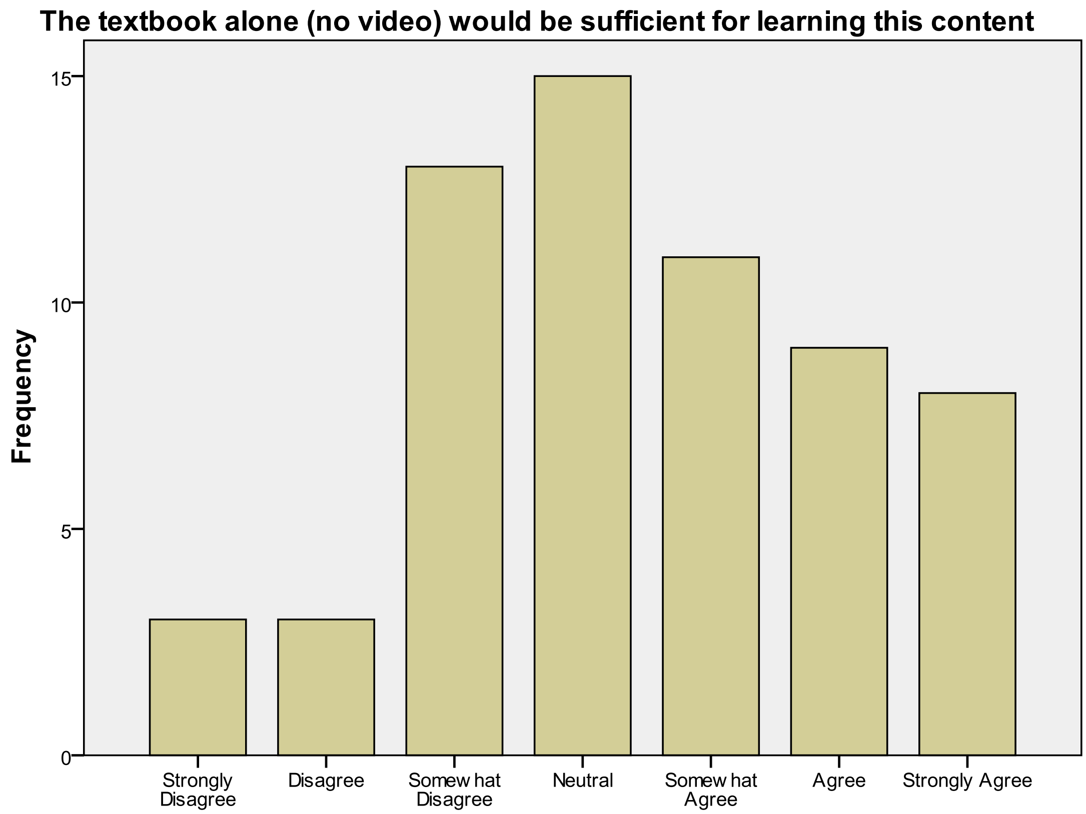

Figure 11. Bar graph showing the students' preference for learning content via the textbook alone, without video support

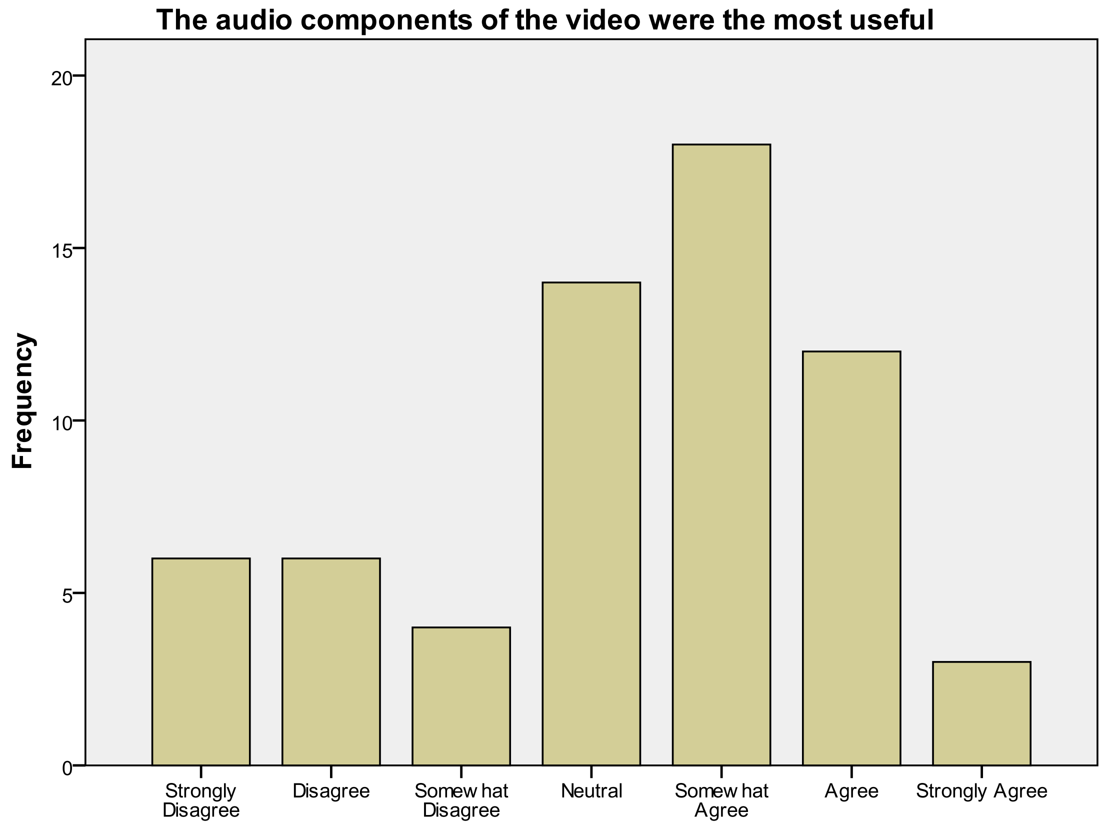

Figure 12. Bar graph showing the students' thoughts about the audio components of the video being the most useful

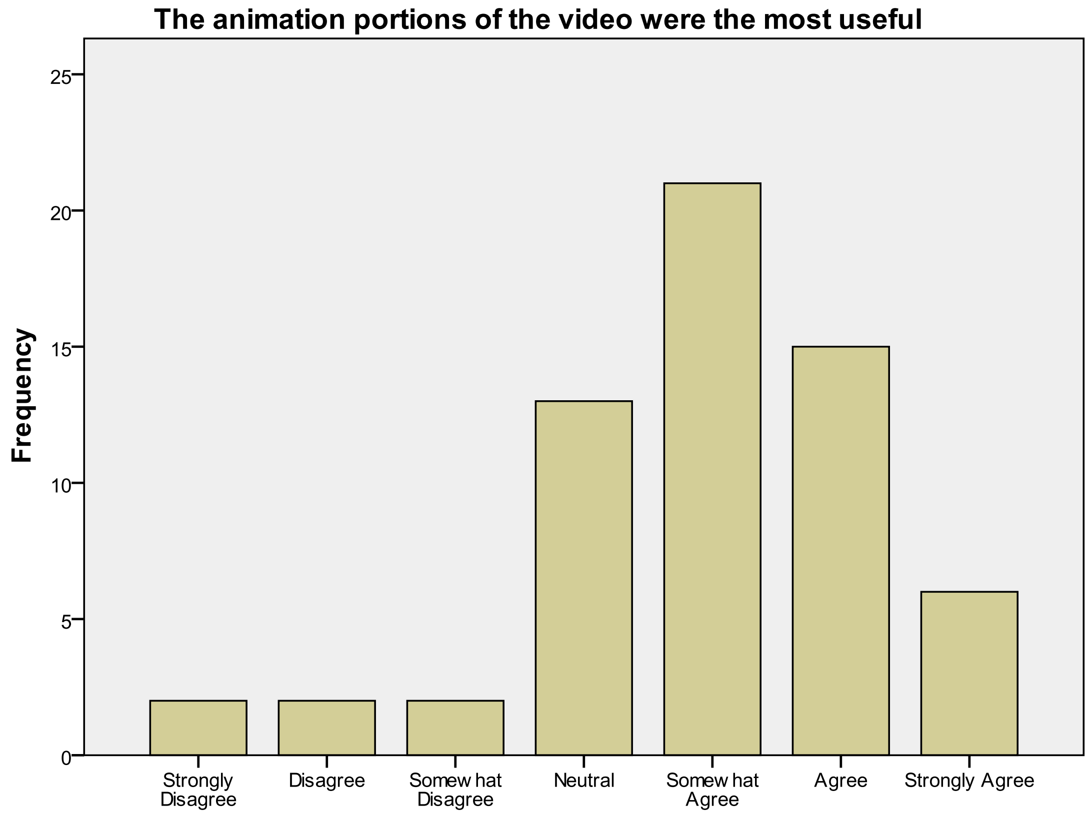

Figure 13. Bar graph showing the students' thoughts about the animation portions of the video being the most useful

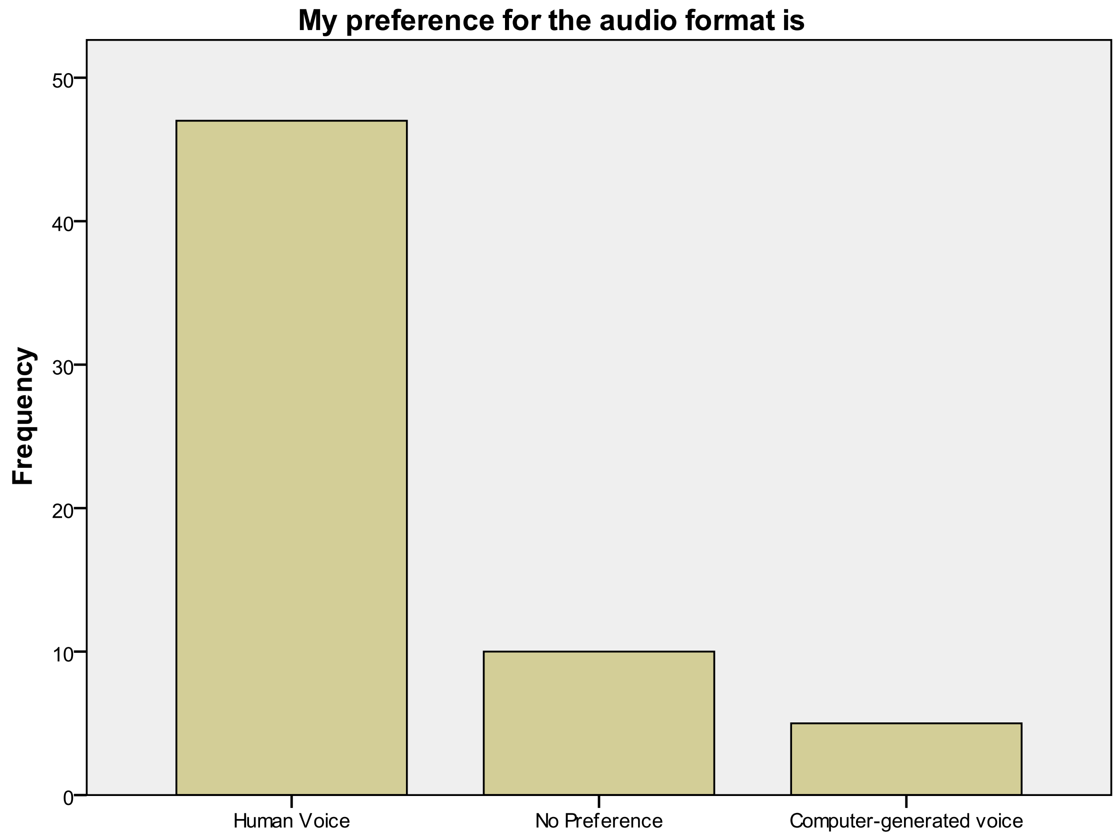

Figure 14. Bar graph showing the students' preference for the audio format

CHAPTER V

DISCUSSION AND CONCLUSION

Background Information

Advancing Internet technology provides expanded opportunities to incorporate video materials in distance learning education. Simply watching video materials generally results in poor learning outcomes (Schluger, Hayes, Turino, Fishman, & Fox, 1987). Cennamo (1993) revealed that video materials can be more effective if they are designed to increase learners' mental processes and engage them in meaningful active learning. Concept mapping can be used for this purpose by embedding exercises into a computer-based video instructional tool to allow learners to interact more with learning resources while watching instructional video. Furthermore, concept mapping requires learners to relate newly encountered information to their prior knowledge; learners are more engaged in the learning process as they construct concept maps. In addition, concept mapping helps learners to take an active role in learning by requiring them to organize the information into a hierarchical-ordered concept structure (De Simone, 2007).

In this study, an instructional tool was used to evaluate the instructional effectiveness of concept mapping activities in computer-based video. Two concept mapping methods—learner-generated and expert-generated—were compared to compare their relative effectiveness. In the learner-generated concept mapping method, students created a concept map based upon their understanding from the video content. In contrast, in the expert-generated concept mapping method, students interacted with a concept map that had been previously created by an expert of the video content. The two methods were used with 65 students in the junior-level undergraduate EPSY-320 class in the spring semester of 2010.

Results

Question 1: Do undergraduate students who develop and use their own concept maps perform better in embedded evaluations and course evaluations than students who use expert-generated concept maps?

The findings of this study revealed that the achievement performances of students in the two groups, the expert-generated concept mapping group and the learner-generated concept mapping group, were not significantly different (see Tables 6 and 7). Specifically, the combined quiz scores (quiz 1 + quiz 2) of the two groups were not significantly different indicating that using one concept mapping method over the other did not affect student achievement. Although the combined quiz scores of the two groups were not statistically different, the expert-generated concept mapping group scored higher on the first quiz (unit one M = 8.16) than the learner-generated concept mapping group (M = 7.61). However, the expert-generated concept mapping group scored lower on the second quiz (unit two M = 8.12) than the learner-generated concept mapping group (M = 8.33) (see Figure 15).

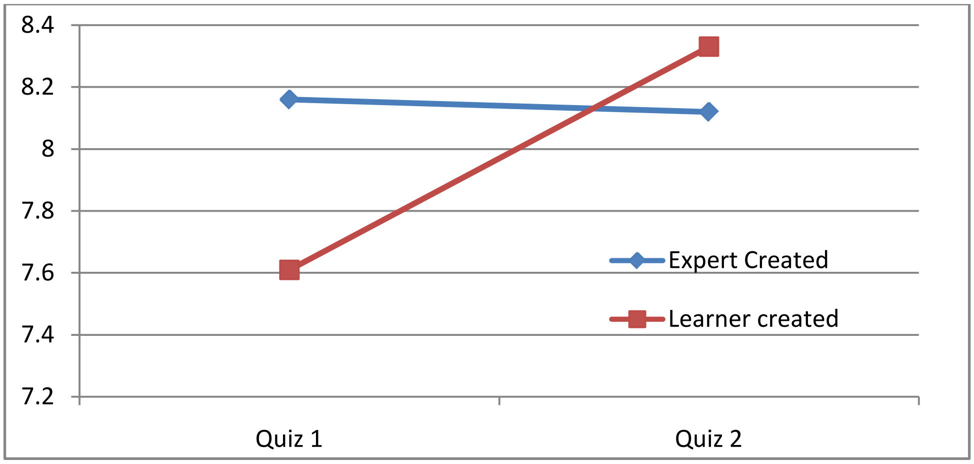

Figure 15. The line graph of two quizzes mean scores of the two groups

According to Canas et al. (2003), when students are novice mappers, the cognitive load of creating concept maps from scratch may hinder learning. Therefore, these results might be interpreted that the learner-generated concept mapping group might have scored lower on the first quiz because of the effect of cognitive load associated with initially learning to create concept maps. However, once they had gained experience and knowledge about creating concept maps during the first unit they were less distracted during the second unit exercise, allowing them to score higher on the second quiz. This change would support the main hypothesis that learner generation of content maps produces greater learning, but the relative scores on quiz 2 do not fully support this. Future research related to this topic might reveal that long-term use of concept mapping in video-based learning has a greater effect on student achievement. In addition, the introductory nature of the unit contents and the quizzes' focus on knowledge and basic understanding may be a limiting factor; research on more complex content and more in depth assessment might reveal a greater advantage to learner-generated formats.

Discussion of Finding in Question 1

When the effectiveness of learner-generated versus expert-generated concept mapping methods was compared, no difference in overall student achievement was found. While the learner-generated group received a lower score on the first quiz, they increased their score on the second quiz. As mentioned previously, when a novice learner constructs a concept map from scratch as part of an instructional activity, cognitive load from the construction process may actually hinder learning. When students in this study constructed concept maps for the first time in Unit 1, cognitive load may have hindered their learning of that content; however, subsequent interaction in Unit 2 may have affected their learning process in a more positive way. Students commented, “They were complicated at first, but got easier as they went through the lessons.” As illustrated in Figure 15, the learner-generated group improved their quiz results in Unit 2 while the expert-generated group scores actually decreased slightly. This finding suggests that concept mapping might enhance cognitive learning after the basic skills are acquired and the learners become competent concept mappers. Further research is needed to determine the factors that led to the increase in student quiz scores for Unit 2.

Question 2a: Does time spent interacting with the instructional resources relate to student achievement?

A MANOVA statistical analysis was conducted to determine the differences in time spent on the instructional materials and how it related to student achievement. The results showed that the student reported time spent interacting with the instructional textbook and the instructional video was not significantly different (see Tables 9 and 10). However, the students spent more time reading the textbook (M = 3.60 hrs) than they did interacting with the video-based instructional tool (M = 2.91 hrs).

The MANOVA statistical analysis was also conducted to determine the differences in time spent by each group completing each unit using the instructional tools. The results showed that time spent on all interactions in unit one and unit two was significantly different (see Tables 12 and 13).

These results indicate that although both groups had similar quiz results, the students who were in the expert-generated concept mapping group spent less time interacting with the instructional tools than the students who were in the learner-generated concept mapping group. In fact, the learner-generated concept mapping group (Mean = 54.30 min) spent significantly more time than the expert-generated concept mapping group (Mean = 22.76 min) interacting with the instructional tool. This finding suggests that using the expert-generated concept mapping in video-based instructional might be more beneficial since the users spent less time and had similar quiz scores; indicating that it was a more efficient form of instructional activity.

Question 2b: Does the complexity of interaction activity relate to student achievement?

A regression analysis was performed to determine the relationship between student achievement and the number of clicks on the concept map and the number of clicks on the video player control (interactions with the instructional resource). The results showed that there was no significant relationship between this interactivity and student achievement. Therefore, we can conclude that the degree of interacting with the video controls did not improve the cognitive process of individuals while viewing the instructional video.

Discussion of Finding in Question 2

There was no relationship found between student achievement and time spent interacting with the instructional resources. This finding was unexpected. Student time spent interacting with the instructional resources was anticipated to have a positive effect on student achievement. Closer examination of the relationship between student achievement and time spent interacting with instructional resources revealed that each group spent time on different learning activities. For instance, the learner-generated group spent more time creating concept maps and less time watching the video and interacting with the maps. On the other hand, the expert-generated group spent more time watching the video and interacting with the expert maps. Here again, during the creation of concept maps, cognitive load might hinder student learning, so the time spent creating concept maps could not affect student cognitive learning related to student achievement, which might explain why the statistical analysis did not find any relationship between the two variables

Question 3a: In the learner-generated map group, does time spent on developing concept maps relate to student achievement?

A regression analysis was performed to determine the effect of time spent creating concept maps on student achievement. The results showed that the time spent creating concept maps did not have a direct relation with student achievement.

Question 3b: In the learner-generated map group, does the complexity of concept maps created relate to student achievement?

A regression analysis was conducted to determine student achievement in relation to the differences in the complexity of concept maps. The concept map scores were used to estimate the complexity of concept maps. The results showed that concept map scores related to student achievement ($\beta = .451$, $p = .012 < .05$), more complex maps were associated with higher scores. In addition, concept map scores had very high correlations with nodes, propositions, and branchings. The number of clicks on the video player control, time spent creating concept maps, and time spent on all interaction also related to the concept map scores (see Table 21). These findings reveal that concept map scores mediated the relationships between the numbers of clicks on the video player control, time spent creating concept maps, and time spent on all interaction and student achievement. Although the variables—the number of clicks on the video player control, time spent creating concept maps, and time spent on all interaction—did not have a direct effect on student achievement, they affected the concept map scores, which in turn affected student achievement.

Question 3c: In the learner-generated map group, do temporal and spatial patterns of creating and arranging map nodes relate to student achievement?

A regression analysis was performed to determine student achievement in relation to temporal and spatial patterns of creating and arranging map nodes. The number of nodes, the number of propositions, and the number of branchings were used to estimate temporal and spatial patterns of creating and arranging map nodes (see Table 23). The results showed that the number of nodes, the number of propositions, and the number of branchings all related to student achievement. These findings support the existing literature on the benefits of concept mapping. The information about number of nodes, propositions, and branchings shows how much information the students' concept maps include. The more information contained in the concept map, the higher the student achievement score. We know from the results of the previous question that the number of clicks on the video player control, time spent creating concept maps, and time spent on all interaction all related to the concept map scores. This finding suggested temporal patterns: spending more time creating concept maps and interacting with the instructional video do have the cognitive learning of students indirectly, most likely because students played an active role in creating and modifying the concept map and interacting with the video, which promoted active learning. This finding is parallel with general agreement with literature.

Discussion of Finding in Question 3

Concept maps were scored based on the number of nodes, propositions, and branchings. Each node, proposition, and branching was graded using the traditional scoring method (illustrated in Table 5). The analysis showed that concept map scores related to student achievement. This finding supported Ruiz-Primo and Shavelson (1997), who found that concept maps have the potential to assess the structure of a student's declarative knowledge. The result suggests that concept maps created by students might be scored to illustrate students' understanding gained from video instruction, and concept map scores might be used as student grades. Moreover, the researcher tried to find out whether the three variables—nodes, propositions, and branchings—related to student achievement. The statistical analysis showed that nodes, propositions, branchings, and concept mapping scores had very high correlations. Because of the high correlations, it was not possible to conduct a path analysis to show the relationship between the variables and student achievement on a graph.

Question 4: When they have completed the instruction, what attitude do students have toward the use of these instructional activities in general? Are there differences between the attitudes of the two groups?

A MANOVA was conducted to determine the differences in the attitudes of the students toward the instructional tool. The three variables: perceived usefulness, ease of use, and attitude toward using were used to define the attitude of the students toward the instructional tool. The results showed the feeling toward the instructional tool of the expert-generated concept mapping group was significantly different from the learner-generated concept mapping group (see Table 26). The attitude of the expert-generated group toward the instructional tool (Mean = 4.13) was significantly higher than the learner-generated group (Mean = 2.90) indicating that they felt more positive about the use of these resources for learning. Also, the expert-generated concept mapping group (M = 4.49) indicated neutral feeling that using the instructional tool would improve their learning performance, while the learner-generated group (M = 3.40) did not feel about this value. Both groups reported neutral views about the ease of use of the instructional tool. The expert-generated group's (M = 4.28) attitude regarding ease of use was slightly higher than the learner-generated group (M = 3.72), but the difference was not significant (see Figure 16). Three variables: ease of use, perceived usefulness, and attitude toward using help us determine the actual usage of the instructional tool.

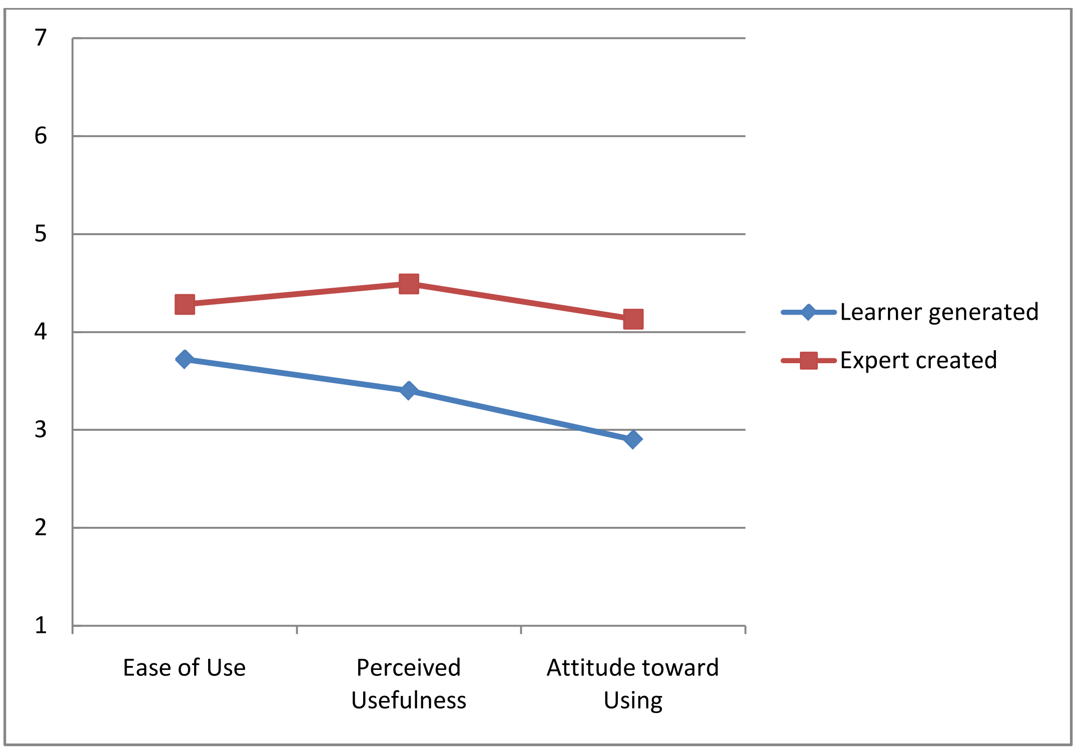

Figure 16. The line graph of the two groups about attitude towards using the instructional tool

The six questions in the post-survey were used to identify the students' preferences for the various content presentation modes (see Table 27). Students preferred video instruction with the text document. They reported that the video instruction without the text document would be insufficient for learning content (see Figure 9). Moreover, they thought that the concept mapping component was not essential for the video-based learning (see Figure 10). Students also revealed that they thought the audio components (see Figure 12) and the animation portions (see Figure 13) were the most useful elements of the video, and most students preferred the human voice to computer voice in the video (see Figure 14). The most interesting result was that the students thought that simply reading the textbook alone would be sufficient for learning the content (see Figure 11).

Limitations of the Study

The first limitation was that the study was conducted in an undergraduate junior class setting, and the convenience sampling method was used to select the sample students; therefore, generalizability of the results to a different population is not recommended. Second is partially related to the disproportionate number of females in the sample. Third, the sample population was small, so the two research groups might not have been equal background knowledge of class content and technology. Fourth, the training materials and instructional materials used for the study were initial use of the resources and that additional refinement of the materials and procedures may be necessary to make a definitive comparison of the two methods. The design and delivery method of the materials and the quality of the instruction might differ from other researchers. Finally, the behavior of the participants might have been influenced as a result of knowing that they were part of a study. Therefore, generalization to actual performance with such materials in a course may be limited.

The content used in the study was introductory and general in nature. Similarly, the assessment quizzes were focused on knowledge items rather than the assessment of deep understanding and had a relative high difficulty index; this can limit the ability to determine true group differences in levels of learning and efficiency. In addition, the video resource paralleled the content of the textbook. Reading the textbook may have erased any differences between the two groups that resulted from the video instructional tool. A more stringent test would to present content that is not available from another source such as the textbook, or include assessment items that pertain to content that was only in the instructional tool resources.

Implications for Educational Practice

This study has three major implications for course designers and instructors who want to use video instruction or concept mapping in video instruction: 1) determining which concept mapping method is more beneficial, 2) determining the necessary technology training prior to using such computer-based instruction resources, and 3) establishing student preferences for the video attributes that are incorporated.

Learner-Generated Versus Expert-Generated Concept Mapping

The lack of significant differences between the two learning methods—learner-generated concept mapping and expert-generated concept mapping—suggested that, under these conditions, one method is not superior to the other method. This means that either method may have the potential to be used effectively as part of a computer-based video instructional tool. The expert-generated concept mapping method may be preferred when taking into account the effort spent by the students when using the instructional tool. According to the findings, students spent more time and effort with the learner-generated concept mapping method than with the expert-generated concept mapping method. As existing literature has stated, constructing a concept map from scratch requires too high a cognitive process to produce a representation of students' knowledge (Schau & Mattern, 1997). One student commented that "when doing the content map I was not very focused on what I was typing," which supports the literature. Consequently, it is suggested that educators use the expert-generated concept mapping method in video-based learning.

Technology Training Before Online Course

Based on students' exit survey comments about the instructional tool, inadequate knowledge of technology or computers might be the biggest obstacle to using a computer-based instructional tool. The students complained about the difficulties of using the instructional tool, saving and submitting learning materials, downloading and uploading the tool and materials, and other problems. They did not know how to deal with a problem, even a simple one, while completing exercises. They spent a lot of time connecting and logging into the course site, downloading the course materials to their computers, and working on the computer program designed for the course. Many students who participated in the study had not taken an online course before. Thus, it is better to train students when they take an online course for the first time. Doing so might help students spend less time dealing with technology problems and more time learning the topic.

Attributes of the Instructional Video

This study gave an idea of students' preferences for the various attributes of a video used in video-based learning. The attributes were classified in the study as "video alone," "video with text document," "audio components of video: human voice and computer voice," and "animation components of video." The findings showed that students preferred an instructional video with integrated text resources. The reason might be that students want to see and hear at the same time. They also liked the animation portion of the video, which was used to illustrate circumstances that could not be easily observed naturally. As for the audio component, they preferred listening to the human voice. Based on these findings, an instructional video should include a text document supporting resources and should be narrated by a human voice. Complex content, for example human metabolism, climate changes, animal life, etc., should be presented and explained using animation. Finally, the course textbook should be included since some students still feel more comfortable learning a new subject from a textbook.

Implications for Future Research

Based on the results of this study, the following recommendations are made:

- Further research should be conducted to compare three groups: control, learner-generated, and expert-generated concept mapping groups. Students in the control group attend in traditional face-to-face teaching with textbook, and the results are used to compare the effectiveness of concept mapping. The similar research can be conducted but in this case learner-generated and expert-generated groups use the instructional tool without textbook, and the results are used to compare.

- Further research should investigate whether concept mapping in computer-based video learning affects female and male students' achievement scores differently.
- Further research can be conducted using more sample sizes, dealing more complex topic, embedding animation video, and using higher level assessment tool to get more accurate and reliable research results.
- Further research can be conducted to compare training methods delivered through online and face-to-face for concept mapping. A researcher investigates the effect of different concept mapping training whether facilitate to generate concept maps relevant to content areas. The training session, where the students actually develop maps of trial content should be completed before interacting with the formal learning content,
- In the study, the unit two quiz scores of the learner-generated concept mapping group were significantly higher than the unit one quiz scores; however, the unit one and two quiz scores of the expert-generated concept mapping group were not significantly different. Therefore, the better training session, where participants actually develop maps of trial content before interacting with the formal learning content, should be designed to train

participants to become advanced concept mappers before conducting the research. Further research should be conducted over a longer time range to determine how student achievement changes based on using concept mapping during a longer time range.

- Students may learn better using the computer-based video instructional tool in different content areas. In order to find this out, more complex instructional videos in different content areas should be developed and embedded in the instructional tool. The instructional tool was used in introductory classes with undergraduate students in the study. The same instructional tool with the new instructional videos should be used with different grade level students i.e. high school, to investigate the effectiveness of the use of the instructional tool in different courses.
- The instructional tool consisted of three components: video, text, and concept mapping. Further research should be conducted to test a new component embedded in the instructional tool such as, group discussion, collaborative concept mapping, or chatting.
- The negative effects of cognitive load presented the main problem when doing research with novice students using concept mapping. Future studies using different concept mapping methods such as expert skeleton can be conducted to reduce the negative effects of cognitive load. Canas et al. (2003) stated that “scaffolded” ways of interacting with concept maps, such as filling

in the blank content nodes of a concept map the already includes the labeled links of a completed map, may be helpful.

REFERENCES

Acton, W., Johnson, P., & Goldsmith, T. (1994). Structural knowledge assessment: Comparison of referent structures. *Journal of Educational Psychology*, *86*, 303-311.

Adequecy news for grown-ups. (2003). Retrieved July 14, 2010, from http://www.adequacy.org/stories/2001.8.24.112921.289.html

Alpert, S. R. (2003). Abstraction in concept map and coupled outline knowledge. *Journal of Interactive Learning Research*, *14*(1), 31-49.

Anderson-Inman, L., & Ditson, L. (1999). Computer based concept mapping: A tool for negotiating meaning. *Learning and Leading with Technology*, *26*(8), 6-13.

Anderson-Inman, L., & Zeitz, L. (1993). Computer-based concept mapping: Active studying for active learners. *The Computer Teacher*, *21*(1), 6-11.

Atkin, C., & Wallack, L. (1990). *Mass communication and public health: Complexities and conflicts.* Newbury Park, CA: Sage.

Ausubel, D. P. (1960). The use of advance organizers in the learning and retention of meaningful verbal materials. *Journal of Educational Psychology, 51*(5), 267-272.

Ausubel, D. P. (1963). *The psychology of meaningful verbal learning.* New York: Grune and Stratton Inc.

Ausubel, D. P. (1968). *Educational pschology: A cognitive view*. New York: Holt, Rinehart and Winston.

Ausubel, D., Novak, J., & Hanesian, H. (1978). *Educational psychology: A cognitive view* (2nd ed.). New York: Holt, Rinehart & Winston.

Ausubel, D. P., & Robinson, F. G. (1969). *School learning: An introduction to educational psychology.* New York: Holt, Rinehart & Winston.

Baggett, P. (1984). Role of temporal overlap of visual and auditory material in forming dual media associations. *Journal of Educational Psychology, 76*(3), 408–417.

Brooks, J.G. & Brooks, M.G. (1993). *In search of understanding: The case for constructivist classrooms.* Alexandria, VA: Association for Supervision and Curriculum Development.

Camcorder basics: Digital video vs analog. (2002). Retrieved June 12, 2010, from http://www.essortment.com/hobbies/camcorderbasics_slpi.htm

Canas, A. J., Coffey, J. W., Carnot, M. J., Feltovich, P., Hoffman, R. R., Feltovich, J., et al. (2003). *A summary of literature pertaining to the use of concept mapping techniques and technologies for education and performance support.* (Report to The Chief of Naval Education and Training). Pensacola, FL: Institute for Human and Machine Cognition.

Cartwright, S. (1990). *Secrets of successful video training: The training with video casebook.* White Plains, NY: Knowledge Industry Publications.

Cennamo, K. (1993). Learning from video: Factors influencing learners' preconceptions and invested mental effort. *Educational Technology Research and Development, 41*(3), 33-45.

Chang, C. (2004). Constructing a streaming video-based learning forum for collaborative learning. *Journal of Educational Multimedia and Hypermedia, 13*(3), 245-263.

Chang, K., Sung, Y., & Chen, S. (2001). Learning through computer-based concept mapping with scaffolding aid. *Journal of Computer Assisted Learning*, *17*(1), 21-33.

Chang, K. E., Sung, Y. T., & Chen, I. D. (2002). The effect of concept mapping to enhance text comprehension and summarization. *Journal of Experimental Education*, *71*(1), 5-19.

Chang, S., & Chang, Y. (2008). Using online concept mapping with peer learning to enhance concept application. *The Quarterly Review of Distance Education*, *9*(1), 17-27.

Chiou, C. C. (2009). The effect of concept mapping on students' learning achievements and interests. *Innovations in Education and Teaching International, 45*(4), 375–387.

Choi, H. J., & Johnson, S. D. (2005). The effect of context-based video instruction on learning and motivation in online courses. *The American Jorunal of Distance Education*, *19*(4), 215-227.

Cicognani, A. (2000). Concept mapping as a collaborative tool for enhanced online learning. *Educational Technology and Society*, *3*(3), 150-158.

Clark, I., & James, P. (2004). Using concept maps to plan an introductory structural geology course. *Journal of Geoscience Education, 52*(3), 224-230.

CmapTools. (2010). Retrieved April 22, 2010, from http://www.ihmc.us/cmaptools.html

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16*(3), 297-334.

Daley, B. J., Canas, A. J., & Stark-Schweitzer, T. (2007). CmapTools: Integrating teaching, learning, and evaluation in online courses. *New Directions for Adults and Continuing Education, 113*, 37-47.

Davis, F. D. (1989). Perceived usefulness, perceived ease-of-use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319-338.

Davis, F., Bagozzi, R., & Warshaw, P. (1989). User acceptance of computer technology: Comparison of two theoretical models. *Management Science, 35*(8), 982-1003.

De Simone, C. (2007). Application of concept mapping. *College Teaching*, *55*(1), 33-36.

DeMartino, D. (2001). Use of video mediated instruction in teaching American Heart Association emergency cardiac care training courses. *Proceeding of ED-MEDIA 2001 (World Conference on Educational Multimedia, Hypermedia & Telecommunications)*, (pp. 388-392). Tampere, Finland.

Derry, S. J. (1990). *Flexible cognitive tools for problem solving instruction.* Paper presented at the annual meeting of the American Educational Research Association, Boston, MA.

Feltovich, P. J., Spiro, R. R., & Coulson, R. L. (1993). Learning, teaching and testing for complex conceptual understanding. In N. Fredericksen, R. Mislevy, & I. Bejar (Eds.), *Test theory for a new generation of tests* (pp. 187-217). Hillsdale, NJ: Lawrance Erlbaum Associates.

Fencel, T. (1994). *Efficacy, application, design, development, and execution of prosocial/educational video. Volume II. TELEDVISOR: A resource guide for developers of prosocial/ educational video.* Ann Arbor, MI: The Union Institute.

Freeman, L. (2004). The power and benefits of concept mapping: Measuring use, usefulness, ease of use, and satisfaction. *International Journal of Science Education, 26*(2), 151-169.

Gao, Y. (2005). Applying the technology acceptance model (TAM) to educational hypermedia: A field study. *Journal of Educational Multimedia and Hypermedia, 14*(3), 237-247.

Heinze-Fry, J. A., & Novak, J. D. (1990). Concept mapping brings long-term movement toward meaningful learning. *Science Education, 74*(4), 461-472.

Herron, C. A., Cole, S. P., & Corrie, C. (1999). The effectiveness of a video-based curriculum in teaching culture. *The Modern Language Journal, 83*(4), 518-533.

Horton, P. B., McConney, A. A., Gallo, M., Woods, A. L., Senn, G. J., & Hamelin, D. (1993). An investigation of the effectiveness of concept mapping as an instructional tool. *Science Education, 77*(1), 95-111.

IHMC. (2010). Retrieved April 22, 2010, from http://www.ihmc.us/about.html

IHMC CmapTools. (2010). Retrieved April 22, 2010, from http://cursa.ihmc.us/rid=1094487285248_442176581_5443/Ausubel%27s%20theory.cmap

Jack, K. (2008). *Digital video and DSP*. Boston, MA: Elsevier Inc.

Jonassen, D. H. (1990). What are cognitive tools? In P. A. Kommers, D. H. Jonassen, & J. T. Mayes (Eds.), *Proceedings of the NATA advanced research workshop: Cognitive tools for learning* (pp. 1-6). Enschede, The Netherlands: University of Twente.

Jonassen, D. H., & Reeves, T. (1996). Learning with technology: Using computers as cognitive tools. In D. H. Jonassen (Ed.), *Handbook of research on educational communications and technology* (pp. 693-719). New York: Macmillan.

Jonassen, D., Reeves, T., Hong, N., Harvey, D., & Peters, K. (1997). Concept mapping as cognitive learning and assessment tools. *Journal of Interactive Learning Research, 8*(3-4), 289-308.

Kommers, P., Jonassen, D. H., & Mayes, T. (1992). *Cognitive tools for learning*. Heidelberg, Germany: Springer-Verlag.

Marlow, E. (1992). *Corporate television programming: Applications and techniques.* White Plains, NY: Knowledge Industry Publications.

Mayer, R. (2003). *Learning and instruction.* Upper Saddle River, NJ: Pearson Education, Inc.

McDaniel, E., Roth, B., & Millar, M. (2005). Concept mapping as a tool for currículum design. *Proceeding of Informing Science and Information Technology Education Joint Conference*, (pp. 505-513). Flagstaff, AZ.

Meyen, E., Vergason, G. A., & Whelan, R. J. (1996). *Strategies for teaching.* Denver, CO: Love.

Milam, J. H., Santo, S. A., & Heaton, L. A. (2000). *Concept maps for web-based applications*. (ERIC technical report). Washington, DC: ERIC Clearinghouse on Higher Education.

MindMapper. (2010). Retrieved April 22, 2010, from http://www.mindmapper.com/mind/mind.asp

Mintzes, J. J., Wandersee, J. H., & Novak, J. D. (2000). *Assessing science understanding.* Orlando, FL: Academic Press.

Novak, J. D. (1998). *Learning, creating, and using knowledge: Concept maps as facilitative tools in schools and corporations.* Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Novak, J. D., & Canas, A. J. (2008). *The theory underlying concept maps and how to construct and use them.* (Technical report IHMC CmapTools 2006-01 Rev 01-2008). Pensacola, Fl: Institute for Human and Machine Cognition.

Novak, J. D., & Gowin, B. (1984). *Learning how to learn.* New York: Cambridge University Press.

Plotnick, E. (2001). A graphical system for understanding the relationship between concepts. *Teacher Librarian, 28*(4), 42-44.

Reader, W., & Hammond, N. (1994). Computer-based tools to support learning from hypertext: Concept mapping tools and beyond. *Computers and Education, 12*(1-2), 99-106.

Reese, D. D. (2004). *Assessment and concept map structure: The interaction between subscores and well-formed mental models.* Paper presented at the annual the American Educational Research Association, San Diego, CA.

Repenning, A., Ioannidou, A., & Phillips, J. (1999). Collaborative use and design of interactive simulations. *Proceedings of the 1999 conference on Computer Supported Cooperative Learning, article no: 59, December 12-15, 1999.* Palo Alto, CA.

Royar, R., & Royar, J. (2004). Comparing hand drawn and computer generated concept mapping. *Journal of Computers in Mathematics and Science Teaching, 23*(1), 67-81.

Ruiz-Primo, M. A., & Shavelson, R. J. (1996). Problems and issues in the use of concept maps in science assessment. *Journal of Research in Science Teaching, 33*(6), 569-600.

Ruiz-Primo, M., & Shavelson, R. (1997). *Concept-map based assessment: On possible sources of sampling variability.* Los Angeles, CA: Office of Educational Research and Improvement.

Ruiz-Primo, M., Shavelson, R., Li, M., & Schultz, S. (2001). On the validity of cognitive interpretations of scores from alternative concept-mapping techniques. *Educational Assessment, 7*(2), 99-141.

Salomon, G. (1984). Television is "easy" and print is "tough": The differential investment of mental effort in learning as a function of perceptions and attributions. *Journal of Educational Psychology, 76*(4), 647-658.

Scarr, S. (1987). Personality and experience: Individual encounters with the world. In J. Aronoff, A. I. Rabin, & R. A. Zucker (Eds.), *The emergence of personality* (pp. 67-68). New York: Springer.

Schau, C., & Mattern, N. (1997). Use of map techniques in teaching applied statistics courses. *The American Statistician, 51*(2), 171-175.

Schluger, J.,Hayes, J., Turino, G., Fishman, S., & Fox. A. (1987). The effectiveness of film and videotape in teaching cardiopulmonary resuscitation to the lay public. *New York State Journal of Medicine, 87*(7), 382-385.

Sowa, J. F. (2000). *Knowledge representation: Logical, philosophical, and computational foundation.* Pacific Grove, CA: Brooks Cole.

Stevens, R. H., Lopo, A. C., & Wang, P. (1996). Artificial neural networks can distinguish novice and expert strategies during complex problem-solving. *Journal of the American Medical Informatics Association, 3*(2), 131-138.

Stewart, J., Van Kirk, J., & Rowell, R. (1979). Concept maps: A tool for use in biology teaching. *The American Biology Teacher, 41*(3), 171-175.

Sweller, J. (1994). Cognitive load theory, learning difficulty, and instructional design. *Learning and Instruction, 4*(4), 295-312.

VHS or DVD - Which should I buy? (2010). Retrieved July 14, 2010, from http://www.libraryvideo.com/articles/article19.asp

Visual understanding environment. (2010). Retrieved April 22, 2010, from http://vue.tufts.edu/

Walker, J., & King, P. (2002). Concept mapping as a form of student assessment and instruction in the domain of bioengineering. *Journal of Engineering Education, 19*(2), 167-179.

Wandersee, J. H., Mintzes, J. J., & Novak, J. D. (1994). Learning: Alternative conceptions. In D. L. Gabel (Ed.), *Handbook on research in science teaching* (pp. 177-210). New York: Macmillan.

Warner, D. (2003). *Student recommendations for discussions boards: Conclusions of student problems*. Retrieved October 18, 2010, from Middle Tennessee State University Web site: http://frank.mtsu.edu/~itconf/proceed03/142.html/

Wetzel, C. D., Radtke, P. H., & Stern, H. W. (1994). *Instructional effectiveness of video media.* Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Zeitz, L., & Anderson-Inman, L. (1992). *The effects of computer-based formative concept mapping on learning high school science.* Paper presented at the annual conference of the American Educational Research Association, San Francisco, CA.

Zhang, D., Zhou, L., Briggs, R. O., & Nunamaker, J. F. (2006). Instructional video in e-learning: Assessing the impact of interactive video on learning effectiveness. *Information and Management*, *43*(1), 15-27.

APPENDIX A

STUDENT CONSENT FORM

Effectiveness of Concept Maps in Video-based Learning Tool Introduction

The purpose of this form is to provide you information that may affect your decision as to whether or not to participate in this research study. If you decide to participate in this study, this form will also be used to record your consent.

You have been asked to participate in a research project study examining the role of interactive concept maps in a video-based learning tool. The purpose of this study is to determine how concept maps affect students' cognitive learning process in video-based learning tool. You were selected to be a possible participant because you are students taking EPSY 320 – "Child Development for Educators" course at Texas A&M University. All of the students in the class have been asked to participate.

What will I be asked to do?

If you agree to participate in this study, you will be asked to complete a survey related to technology knowledge prior to the instructional units. Any necessary training in the use of the technology and instructional resources will be provided to insure that everyone is capable of successfully completing the units. You will receive brief online instruction about the use and function of concept maps in instruction; The Instructional resources for the two units will be provided for you to use. You will download these resources and use them on your own computer. You will need to use the same computer to complete the learning modules and must be connected to the Internet. If you prefer, you may choose to complete the materials in the computer lab. At the end of the each learning unit you will take a short quiz over the content presented. Once you complete the units, you will get the second survey related your views of the learning resources you have used. All your interactions with the learning tool will be recorded and stored online in the Educational Technology department. Anonoymous IDs will be assigned to the data for final analysis of the learning resources outcome. This study will take the same amount of time normally spent in the lecture and homework in the traditional course format. The study is designed for two lessons of the course. The first lesson will be released on April 1st, and the second lesson will be released on April 6th. You will have four days to complete each module. Each portion of the courses is required four to six hours to complete. The first survey will be given one week prior the first lesson and the final survey will be given at the end of the lesson.

What are the risks involved in this study?

The risks associated in this study are minimal, and are not greater than risks ordinarily encountered in daily life. There are no known risks associated with this study and no costs. The material to be learned is a standard part of the course and considered to be valued informational content.

What are the possible benefits of this study?

The possible benefits of participation are to get course credit based on the results of the two unit quizzes. The research study may impact the design of future video-based online learning resources to be used in subsequent offerings of this course as well as instruction in general.

Do I have to participate?

No. Your participation is voluntary. You may decide not to participate or to withdraw at any time without your current or future relations with Texas A&M University being affected. If you decide to participate, you are free to refuse to answer any of the questions that may make you uncomfortable. You can withdraw at any time simple by telling the researcher that you wish to without your relations with the University, job, benefits, etc., being affected.

Who will know about my participation in this research study?

This study is confidential. The records of this study will be kept private. No identifiers linking you to this study will be included in any sort of report that might be published. Research records will be stored securely and only Omer Faruk Vural and Dr. Ronald Zellner will have access to the records.

Whom do I contact with questions about the research?

If you have questions regarding this study, you may contact Omer Faruk Vural at 979-845-3018, alternative phone number 979-255-9034, or ofarukvural@yahoo.com with any questions about this study.

Whom do I contact about my rights as a research participant?

This research study has been reviewed by the Human Subjects' Protection Program and/or the Institutional Review Board at Texas A&M University. For research-related problems or questions regarding your rights as a research participant, you can contact these offices at (979)458-4067 or irb@tamu.edu.

Signature

Please be sure you have read the above information, asked questions and received answers to your satisfaction. You will be given a copy of the consent form for your records. By signing this document, you consent to participate in this study.

Signature of Participant: ____________________________ Date: ______________

Printed Name: _______________________________

Signature of Student: _______________________________ Date: ______________

Printed Name: _______________________________

APPENDIX B

COMPUTER KNOWLEDGE EVALUATION SURVEY

This survey does not affect your grade in the course but it helps us understand your computer skills. The results will help to decide whether you need any additional training to feel comfortable during the course. Please complete the following survey based on your current use of computer skills.

General Information:

First Name: Last Name:

Gender: Male Female

Age:

Do you have a computer where you live? Yes No

Do you have internet access where you live? Yes No

Please check each of the following activities for which you typically use your computer? (Check all that apply)

☐ Class Assignment, ☐ Social Networking, ☐ Work or job productivity, ☐ Reading News, ☐ Games, ☐ Others

Approximately how many years have you been using a computer?

How many hours a week, on average, do you spend on the Internet?

How many hours a week, on average, do you spend on the computer?

Please mark X in the box that correspond the appropriate answer.

Answer each of the following in relation to your general computer knowledge - Do you know how to					
Computer Use	No experience	A little experience	Some experience	Moderate user	I am proficient
Install a new program and comprehend how to use it	1	2	3	4	5
Compress and uncompress (zip and unzip) electronic files (pdf, jpeg or doc files)	1	2	3	4	5
Use Word, Excel, Power Point and similar	1	2	3	4	5

software					
Manage files and folders (find, copy, save, rename, delete, move a file or folder)	1	2	3	4	5
Use a graphic editing program	1	2	3	4	5
Internet Use	No experience	A little experience	Some experience	Moderate user	I am proficient
Use browsers to navigate the web (forward and back)	1	2	3	4	5
Enter a web address, follow a link from one web page to another	1	2	3	4	5
Create a bookmark or save a favorite web page	1	2	3	4	5
Print a web page, download or upload files	1	2	3	4	5
Access search engines i.e. Yahoo, Google, widen and narrow searches	1	2	3	4	5
Access educational web sites	1	2	3	4	5
Log in a social site and discuss with others i.e. Facebook	1	2	3	4	5
Answer the following with respect to your experience with Learning Management Systems i.e. Blackboard Vista, e-learning	No experience	A little experience	Some experience	Moderate user	I am proficient
Log in, log out a Learning Management System site	1	2	3	4	5
Participate in class discussion forums, e.g. read, post, and edit comments.	1	2	3	4	5
Engage in live chats with others	1	2	3	4	5
Engage in online instructional activities and tests	1	2	3	4	5
Download class resources or upload assignments	1	2	3	4	5

Comments about the use of computers in your educational activities that you would like to add:	

APPENDIX C

POST-INSTRUCTION ATTITUDE SURVEY OF INTERACTIVE CONCEPT MAPS IN VIDEO-BASED LEARNING TOOL

This questionnaire gives you an opportunity to express your response to the interactive learning tool that you used. Your response will help us understand more about the relative components of design and use of such instructional resources. Please consider all the tasks you have done with the learning tool while you answer these questions.

Please circle the number that best indicates your agreement or disagreement with each statement. (Items will be separated and mixed on actual survey.)

General Information:

First Name: Last Name:

Please estimate a number of hours spending for the textbook:

Please estimate a number of hours spending for the video-based learning tool:

Did you use a concept mapping in your learning before this course? Yes No

Concept Maps in Video-based Learning tool in Child Development Course	**Strongly Disagree**						**Strongly Agree**
1. Using this learning tool would enhance my effectiveness in learning. (PU)	1	2	3	4	5	6	7
2. I have a generally favorable attitude toward using this learning tool. (AU)	1	2	3	4	5	6	7
3. Learning to use this learning tool would be easy for me. (EU)	1	2	3	4	5	6	7

			1	2	3	4	5	6	7
4.	I found this learning tool easy to use. (EU)		1	2	3	4	5	6	7
5.	Using this learning tool would improve my course performance. (PU)		1	2	3	4	5	6	7
6.	My interaction with this learning tool was clear and understandable. (EU)		1	2	3	4	5	6	7
7.	I found this learning tool useful. (PU)		1	2	3	4	5	6	7
8.	I believe it would be a good idea to use this learning tool for my coursework. (AU)		1	2	3	4	5	6	7
9.	The video instructional material alone (no text) would be sufficient for learning this content.		1	2	3	4	5	6	7
10.	The video component would be just as effective alone without the content mapping component.		1	2	3	4	5	6	7
11.	The textbook alone (no video) would be sufficient for learning this content.		1	2	3	4	5	6	7
12.	The audio components of the video were the most useful.		1	2	3	4	5	6	7
13.	The animation portions of the video were the most useful.		1	2	3	4	5	6	7
			Human Voice Preferred			No Preference			Computer-generated voice Preferred
14	In general, my preference for the audio format is:		1			2			3
15	Comments about the use of concept maps in video-based learning tool in the Child Development course:								

Note. PU = Perceived usefulness, EU = Ease of use, and AU = Attitude toward using

APPENDIX D

UNIT 1 QUIZ

Please carefully choose the right answer. Only one answer is true among the choices.

1. Intelligence is [b]

a. determined by a single gene.
b. a polygenic trait.
c. determined by the sex chromosomes
d. not influenced by genetic factors.

2. All of a person's genes make up a __________. [a]

a. genotype
b. mectotype
c. phenotype
d. introtype

3. A ___________ refers to the physical, behavioral, and psychological characteristics that develop when the genotype is exposed to a specific environment. [c]

a. penvotype
b. lectotype
c. phenotype
d. microtype

4. Cognitive skills, school achievement, ______, personality, and substance abuse are among the psychological characteristics known to be influenced by heredity. [d]

a. physiological disorders
b. genetic disorders
c. autoimmune disorders
d. psychological disorders

5. Bright parents are often likely to provide intellectually stimulating environments to their children, a relation called ______. [c]

a. active gene-environment
b. evocative gene-environment
c. passive gene-environment
d. invocative gene-environment

6. The fact that behavioral consequences of genetic instruction depend on the environment in which those instructions develop is best illustrated by the concept of [a]

a. reaction range.
b. niche-picking.
c. non-shared environmental influences.
d. polygenic inheritance.

7. Deliberately seeking environments that compliment one’s heredity is called [b]

a. reaction range.
b. niche-picking.
c. non-shared environmental influences.
d. polygenic inheritance.

8. When alleles in a chromosome pair are identical, they are said to be [d]

a. recessive.
b. dominant.
c. heterozygous.
d. homozygous.

9. The chemical instructions of a __________ allele in an allele pair will be followed while those of a __________ allele will be ignored. [d]

a. heterozygous; homozygous
b. homozygous; heterozygous
c. recessive; dominant
d. dominant; recessive

10. Inherited disorders [b]

a. are most often caused by dominant alleles.
b. are relatively rare.
c. do not run in families.
d. are more common than disorders caused by the wrong number of chromosomes.

APPENDIX E

UNIT 2 QUIZ

Please carefully choose the right answer. Only one answer is true among the choices.

1. The period from conception to birth normally lasts __________ weeks. [c]

   a. 30
   b. 34
   c. 38
   d. 42

2. The final and longest stage of prenatal development is the period of the ______ [d]

   a. zygote
   b. blastocyst
   c. embryo
   d. fetus

3. Most of the body structures and internal organs develop during the period of the _____ [a]

   a. embryo
   b. fetus
   c. zygote
   d. ectoderm

4. The heart begins to beat at ______________ weeks. [c]

   a. 2 weeks
   b. 3 weeks
   c. 4 weeks
   d. 5weeks

5. The age of viability refers to the ______________ [d]

   a. time since conception.
   b. age at which a baby is expected to be born.
   c. age at which a fetus can hear sounds.
   d. age at which a fetus has a chance to survive if born.

6. Stress during pregnancy __________________ [c]

   a. is harmful even when it is relatively mild.
   b. increases the mother's resistance to illness during pregnancy.
   c. is associated with premature birth and low birth-weight babies.
   d. does not appear to have any harmful effects on the developing child.

7. Which is more serious? [b]

a. being a premature infant or
b. being a small-for-date infant

8. The APGAR score evaluates a broad range of newborn abilities and behaviors including reflexes, hearing, vision, alertness, irritability, and consolability. [False]

True
False

9. If Carlie is a typical newborn, she will sleep ___________ hours a day. [c]

a. eight to 10
b. 12 to 14
c. 16 to 18
d. 20 to 22

10. To help prevent sudden infant death syndrome, babies should be placed on their backs to sleep. [True]

True
False

APPENDIX F

UNIT 1 - YOUR GENETIC PROFILE EXERCISE

Complete the following table by listing the characteristics of your parents and yourself.

Characteristic	Mother's Trait (her phenotype)	Father's Trait (his phenotype)	Your Trait (your phenotype)	Your Genotype *
Eye color				
Hair color				
Height (*tall, average, short*)				
Body weight (*overweight, average, underweight*)				
Blood type				
Personality (*shy or outgoing; passive or aggressive, etc*.)				

*Homozygous, heterozygous, or incomplete dominance

APPENDIX G

UNIT 1 - NATURE/NURTURE INTERACTIONS EXERCISE

Sandra Scarr (1987) illustrated several ways in which one's environment and one's genetics interact to shape one's personality. For each of the numbered examples below, label the type of nature/nurture interaction by using one of the following types of interactions:

A. passive gene-environment relation

B. evocative gene-environment relation

C. active gene-environment relation (niche picking)

______ 1. Smiling, active babies receive more social stimulation than fussy, difficult infants.

______ 2. Parents who are sociable will expose their children to more social situations than parents who are socially inept and isolated.

______ 3. Cooperative, attentive preschoolers receive more pleasant and instructional interactions from the adults around them than uncooperative, distractible children.

______ 4. Children who are quick, strong, and agile will likely become involved in athletic activities.

______ 5. Preschoolers with long attention spans and good spatial skills often seek games and puzzles to play.

______ 6. Parents, who are assertive, faced with a child who is passive, may exert more pressure and do more assertiveness training than they would with a more assertive offspring.

Source: Scarr, S. (1987). Personality and experience: Individual encounters with the world. In J. Aronoff, A. I. Rabin, & R. A. Zucker (Eds.), *The emergence of personality* (pp. 67-68). New York: Springer.

APPENDIX H

UNIT 2 - APGAR EXERCISE

Please evaluate the health status of each of the newborn infants described below using the APGAR Scale.

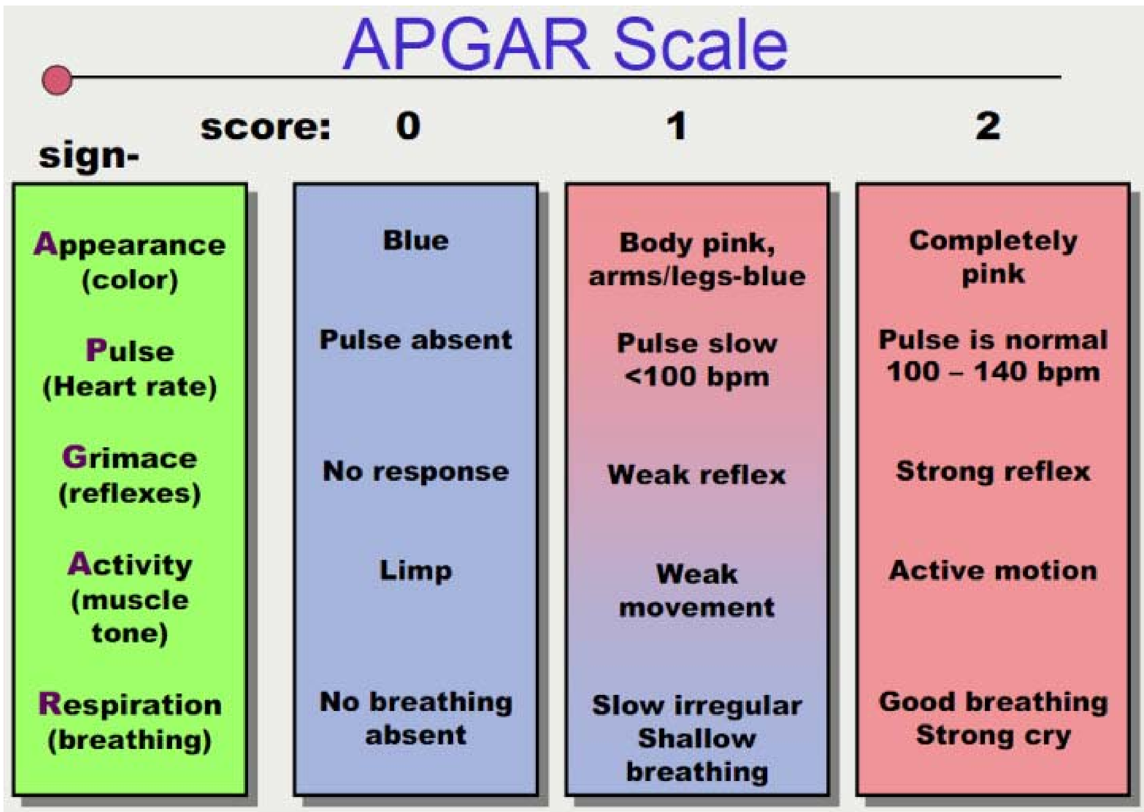

Figure 17. Screenshot of Unit 2 APGAR Exercise

1. Josh is 1 minute old. He is not breathing; he appears blue; his heart rate is 50 bpm; he is completely limp; and exhibits no response to a pinprick on the heel. Josh's APGAR score would be __________.

2. Maria is 1 minute old. She is crying loudly; she appears completely pink; her heart rate is 125 bpm; she is actively moving; and exhibits a weak response to a pinprick on the heel. Maria's APGAR score would be __________.
3. Caleb is 1 minute old. His breathing is shallow; his body is pink but his arms and legs are tinged blue; his heart rate is 130 bpm; he is showing weak movement; and he exhibits a weak response to a pinprick on the heel. Caleb's APGAR score would be __________.
4. Keiko's APGAR score was a 7 at 1 minute of age. At 5 minutes, she is retested with the following results: she is crying loudly; she appears completely pink; her heart rate is 140 bpm; she is actively moving; and she exhibits a strong reflex in response to a pinprick on the heel. Keiko's APGAR score taken at 5 minutes would be _________.
5. DeShawn's APGAR score was a 3 at 1 minute of age. At 5 minutes, he is retested with the following results: his breathing is irregular; his body is "pink" but his arms and legs are grayish-blue; his heart rate is 90 bpm; he exhibits weak movement and a weak reflex in response to a pinprick on the heel. DeShawn's APGAR score taken at 5 minutes would be __________.

APPENDIX I

UNIT 2 – DISCUSSION EXERCISE

Please write your opinion about the following questions:

1. Is parenthood a right or a privilege? Why do you feel that way?
2. What are the consequences of your view?
3. Should Mothers who abuse alcohol or drugs while pregnant be prevented from having more children?
4. How would you deal with the consequences of your view?

APPENDIX J

COMPUTER PROGRAMS TO CONSTRUCT CONCEPT MAPS

IHMC CmapTools – CmapTools was developed at Institute for Human and Machine Cognition (IHMC). IHMC is a research institute with scientists and engineers that investigate the topics related to understanding cognition in both humans and machines. The current active research areas of the institute include: knowledge modeling and sharing, adjustable autonomy, robotics, advanced interfaces and displays, communication and collaboration, computer-mediated learning systems, intelligent data understanding, software agents, biologically-inspired network security, expertise studies, work practice simulation, knowledge representation, and other related areas (*IHMC*, 2010). CmapTools is software developed to facilitate the collaborative construction, sharing and publishing of knowledge models represented as concept maps. It is used by all ages, and different background people, from elementary school children to scientists. It allows users to build synchronous and asynchronous collaboration during the construction of concept maps through CmapServers and allows users to publish the concept maps as Web pages. The software runs on all hardware/software platforms (Windows, Mac OS X, Linux, etc.) and is available for free download (*CmapTools*, 2010).

Inspiration – It is graphic organizer software used mostly by educators and students to build concept maps, webs, mind maps and idea maps and diagrams. Inspiration Software, first started to be used in 1987, was designed to develop products for brainstorming, thinking, planning, outlining, organizing, and presenting ideas (Inspiration, 2010).

MindMapper – It is visual mapping software developed by Sim Tech Systems. It only supports Microsoft Windows Operating Systems. MindMapper allows users to create mind maps, concept maps, flow charts, process maps, organizational charts, and diagrams. MindMapper can be used for Project Management, planning, ideation, brainstorming, and more. It is an image-centered diagram that represents semantic or other connections among segments of information It allows two or more users to collaborate through online to share and contribute to the same file that reduces time, space, and expenses. Also, two or more people or organization can work together for the same goal (*MindMapper*, 2010).

MS Office Visio – it is developed and marketed by Microsoft Office. Visio is a diagramming program used with Microsoft Windows that uses vector graphics to create diagrams. It has two editions: Standard and Professional. They both have the same interface. The Professional has more advanced diagrams, layouts, and functionality that make it easy for users to connect their diagrams to related data sources and allow displaying the information graphically. The Visio can be used as a graphic organizer and diagram designer (*Microsoft visio*, 2010).

VUE (Visual Understanding Environment) – it is a free, open source concept mapping application developed by the Academic Technology group at Tufts University. The VUE was funded by the Andrew W. Mellon Foundation as a grant. The VUE project is focused on creating flexible tools to provide faculty and students to successfully manage and integrate digital resources into their teaching and learning. The VUE provides a flexible visual environment for structuring, presenting, and sharing digital information. The faculty and students use a visual, concept mapping interface through the VUE to construct customized, resource-linked semantic networks that can be edited, viewed and shared online (*Visual understanding environment*, 2010).

APPENDIX K

COMPUTER KNOWLEDGE SURVEY RESULTS

Survey Questions	Learner-generated concept map group	Expert-generated concept map group	Significance (.05 < P)
Have a computer where you live	100%	100%	NA
Have internet access where you live	97%	100%	.325
Use your computer for Class Assignment	100%	100%	NA
Use your computer for Social Networking	100%	97%	.325
Use your computer for Work or Job Productivity	38%	41%	.802
Use your computer for Reading News	84%	50%	.003
Use your computer for Games	44%	31%	.309
Use your computer for Others	44%	44%	1
How many years using a computer	11.28	11.13	.815
How many hours a week, on average, spend on the Internet	19.28	18	.637
How many hours a week, on average, spend on the computer	22.13	21.94	.951
Computer Use			
install a new program and know how to use it	3.47	3.97	.052
compress and uncompress electronic files	2.41	3.25	.012
use Word, Excel, PowerPoint and similar software	4.53	4.44	.487
manage files and folders	4.59	4.68	.549
use a graphics editing program	2.78	2.84	.863
Internet Use			
use browsers to navigate the web	4.81	4.78	.796
enter a web address, follow a link from one web page to another	4.81	4.84	.729

create a bookmark or save a favorite web page	4.59	4.75	.370
print a web page, download or upload files	4.66	4.61	.795
access search engines i.e. Yahoo, Google, widen and narrow searches	4.84	4.88	.753
access educational web sites	4.47	4.53	.737
log in a social site and discuss with others i.e. Facebook	4.81	4.81	1
Answer the following with respect to your experience with Learning Management Systems (LMS)			
log in, log out a LMS site	4.69	4.53	.433
participate in class discussion forums	4.09	4.39	.250
engage in live chats with others	3.16	3.55	.247
engage in online instructional activities and tests	3.77	4.25	.100
download class resources or upload assignments	4.38	4.56	.350

APPENDIX L

Comparison of Digital Video Disk (DVD) and VHS tapes in educational perspective, the following conclusions can be made:

- Over 95% of the nation's classrooms have VHS player but many classrooms do not have DVD player (*VHS or DVD - Which should I buy?*, 2010).
- Library Video Company carries more than 12,000 educational VHS titles over 3,500 educational DVD titles (*VHS or DVD - Which should I buy?*, 2010).
- Although DVD picture quality is better, the research showed that the students thought that there was no difference (*Adequecy news for grown-ups,* 2003).
- Although DVD sound quality is better, scientists demonstrated that human brain is not capable of separating out more than four simultaneous sound channels at once and VHS tapes support four simultaneous sound channels as well (*Adequecy news for grown-ups*, 2003).
- Although it was said that DVD preserves better than VHS tapes, the small scratch may affect and destroy a DVD forever. VHS tapes are virtually impossible to destroy (*Adequecy news for grown-ups*, 2003)
- Duplicating DVDs are easier and faster than duplicating VHSs.
- DVD player has menu with interactive "buttons". You can choose play, scene selections, or other special features whereas VHS player is linear. You cannot select scene to start from at that point.

According comparison of DVD and VHS types, the both of them can be used to present an instructional video in the classroom. However, DVD becomes more popular in education due to better features.

VITA

Name: Ömer Faruk Vural

Address: 714A Harrington Tower, 4225 TAMU
College Station, TX, 77843-4225

Email Address: ofarukvural@yahoo.com

Education: B.S., Mathematics Education, Orta Dogu Teknik University, Turkey, 2001
M.S., Instructional Design, Development and Evaluation, Syracuse University, 2006
Ph.D., Educational Psychology, Texas A&M University, 2010

Refereed Publications

Cifuentes, L., Merchant, Z., & Vural, O. (Accepted). Harnessing web 2.0 for global citizenship. *Learning and Leading with Technology*.

Vural, O., & Zellner, R. (2010). Using concept mapping in video-based learning. *Gaziantep University Journal of Social Sciences*, *9*(3), 747-757.