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Using Concept Mapping in Video-Based Learning

Video Temelli Öğrenmede Kavram Haritalarının Kullanımı

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Abstract

Video-based learning has been extensively incorporated to enhance instruction. The advanced communication technology has greatly increased the possibilities and relative value of delivering instructional video content in online-education applications. Simple watching instructional video often results in poor learning outcomes. Therefore, current video-based learning resources are used in combination with other teaching methods. Concept mapping, one of teaching methods, can provide another form of this type of interactivity and may enhance the active learning capacity. The new learning tool, which consisted of video viewer, supporting text, and interactive concept map, was developed to investigate the effect of time spent interacting with the learning tool by creating concept maps relate to student achievement. The study results showed that there was no relationship found between student achievement and time spent interacting with the learning tool.

Keywords: Concept Mapping, Content Mapping, Video-Based Learning

Özet

Video tabanlı eğitim, eğitimi geliştirmek için yaygın bir şekilde kullanılmaktadır. Gelişmiş iletişim teknolojisi eğitim videolarının içeriğinin göreceli değerini online eğitim uygulamalarında artırmıştır. Sadece eğitim videolarını izlemek zayıf öğrenme ile sonuçlanır. Bundan dolayı, mevcut video tabanlı eğitim kaynakları diğer eğitim metodları ile birlikte kullanılmaktadır. Bu eğitim metodlarından biri olan kavram haritası, sağladığı etkileşim ile aktif öğrenme kapasitesini artırabilir. Video görüntüleyici, metin sağlayıcı, ve etkileşimli kavram haritasından oluşan yeni eğitim araçı,kavram haritası oluştururken zaman ile etkileşimini öğrenci başarısı ile olan ilişkiyi incelemek için geliştirilmiştir. Araştırma sonuçları, eğitim aracının zaman ile etkileşiminin öğrenci başarısına herhangi bir etkide bulunmadığını göstermiştir.

Anahtar Kelimeler: Kavram Haritası, İçerik Haritası, Video-Tabanlı Eğitim

I. INTRODUCTION

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.

I.I. Concept Mapping

Concept maps, graphical tools used for organizing and representing knowledge (Canas, A. J., Coffey, J. W., Carnot, M. J., Feltovich, P., Hoffman, R. R., Feltovich, J., et al., 2003), 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). 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). 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).

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. Creating concept maps requires students to engage in complex, intentional learning activities, which increase the intrinsic motivation of the students.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, CMap Tool, Mind Mapping, Visio, and VUE (Virtual Understanding Environment). 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, 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.

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.

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.

I.2. Video-based Instruction

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.

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. Baggett (1984) concluded 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.

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 learning 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.

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). Most of the educational resources can be accessed and downloaded through the Internet directly or enhanced by the use of Content Management Systems (CMS). 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). 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 this article, we tried to find an answer for the question: does time spent interacting with the learning tool by creating concept maps in computer-based video learning relate to student achievement ?

II. METHODOLOGY

Research was conducted in the spring of 2010. Concept mapping in computer-based video learning tool was used to teach the junior level undergraduate course (n = 65; 10 males and 55 females) 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 into the treatment groups.

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 chapters 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 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 Course Management Systems (CMS). The results showed that the students in each group did not significantly differ in relation to previous computer knowledge or utilization.

A quantitative design method was used in the study to investigate the effect of concept mapping in computer-based video learning on students' achievement. Two applied exercises and one quiz for each of the two chapters were integrated into the each form of the instructional resources. Online training videos were developed and provided to teach students how to use of the learning tool. At the end of the instructional period, the data were collected from the four exercises, the two quizzes, the pre & post surveys, and the interactivity recorded by the learning tools, and used to analyze the relative effectiveness of the two instructional activities.

II.I. Interactive Concept Map in Computer-Based Video Learning Tool

The interactive concept mapping in computer-based video learning tool, used mainly in the stuyd, consists of three integrated components: (a) video viewer, (b) supporting expository text, and (c) the interactive concept map. The video viewer contained integrated play and pause controls. 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 content area. The interactive concept map provided a means of controlling the video via conceptual nodes associated with specific locations of video content (see Figure 1).

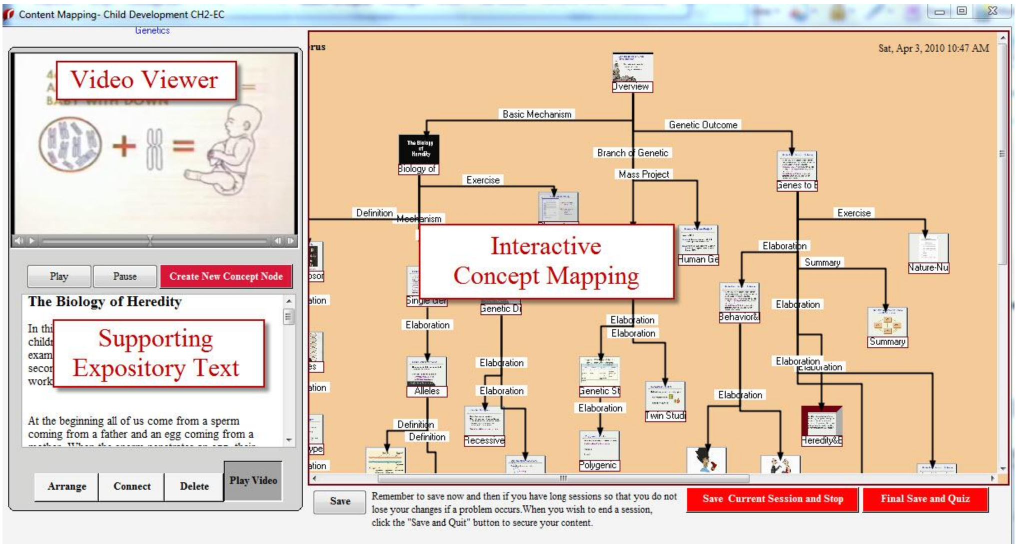

Figure 1. Screenshoot of computer-based video learning tool with the components labeled

The 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. The content of the interactive concept map portion of the screen is captured whenever the students paused and clicked on the save button. The screenshot pictures of the concept maps are stored in a folder and automatically uploaded to the server and stored separately for each user.

II.2. The Instructional Video

The videos contained audio lectures of the two chapters 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.

II.3. Data Analysis

The following data sources were collected: (a) students' exercise scores, (b) students' quiz scores, (c) recorded data about the interaction of the students with the learning tool. These data was used to find out how time spent interacting with the learning tool by creating concept maps in computer-based video learning relates to student achievement.

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 ($\beta = .231$, $p = .227$) showed that the time spent creating concept maps was not directly related to student achievement.

A regression analysis was conducted using student achievement as the dependent variable and the the concept map scores as the independent variable to determine the differences in student achievement in relation to concept map scores created by students. The concept map scores were calculated using the Novak and Gowin (1984) traditional scoring method (see Table 1). The regression analysis was statistically significant ($\beta = .451$, $p = .012 < .05$), showing that student achievement was related to the concept map scores.

Table 1

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)

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. According to Pearson correlation analysis, 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 also had a positive correlation with the interaction variables examined: the number of clicks on the video player control ($r = .409$, $p = .25$), time spent creating concept maps ($r = .744$, $p < .000$), and time spent on all interaction ($r = .665$, $p < .000$).

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. The number of clicks on the video player control ($\beta = .409$, $p = .025 < .05$), time spent creating concept maps ($\beta = .803$, $p < .001$), and time spent on all interaction ($\beta = .665$, $p < .001$) within the learning tool had a direct impact on the concept map total scores.

III. DISCUSSION AND CONCLUSION

In this study, the researcher investigated time spent interacting with the learning relate to student achievement. The study results showed that concept map scores related to student achievement, and 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. These findings reveal that concept map scores mediated the relationships between the number 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.

There was no relationship found between student achievement and time spent interacting with the instructional resources. This finding was unexpected. Time spent interacting with the instructional resources should have increased student achievement. When the relationship between student achievement and time spent interacting with instructional resources was investigated, I realized that the students spent more time creating concept maps and less time watching the instructional video and interacting with the maps. 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. It is possible that during creating concept maps, cognitive load might hinder student learning (Canas, et al., 2003). Therefore, 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. However, further research is needed to find out for sure whether student achievement relates to time spent interacting with instructional resources.

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