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Editorial

Knowledge Ownership and Access

Donald G. Perrin

History: In the ancient world, cave paintings, stone tablets, pottery, and papyrus scrolls communicated through images and the beginnings of written language. More advanced cultures produced art and architecture, sculpture and pottery, and artifacts with symbols, hieroglyphics and writings as expressions of their culture and knowledge. Control of knowledge by privileged groups and individuals has manifested itself throughout history, usually for power and profit. Censorship inhibits access for military and political purposes.

In the Middle Ages, monks and scholars hand copied illuminated manuscripts. These rare and important documents were protected by the Church, which interpreted them to the people. The printing press opened a new era for written communications, open dialog, and a thirst for knowledge, by replicating large numbers of affordable copies. The resulting explosion of knowledge moved us from the Dark Ages to the Renaissance.

Property rights existed since biblical times. By the time of the Industrial Revolution, lawyers and politicians were deeply involved in settling ownership disputes. By the time of the Industrial Revolution, intellectual property law gave legal protection to artists, inventors, and creators of original works for a defined period in order to profit from their inventions or creative works.

A **Patent** is a set of exclusive rights granted by a government or state to an inventor or assignee in exchange for a public disclosure of an invention. The term for patents may be limited to 20 years, after which the invention becomes part of the public domain.

Copyright is more complex. It is a set of exclusive rights granted to the author or creator of an original work, including the right to copy, distribute and adapt the work. These rights can be licensed, transferred and/or assigned. Copyright applies to a wide range of works that are substantive and fixed in a medium. When the copyright expires, the work is said to enter the public domain which makes it available to everyone.

Advent of **mass media** such as books, newspapers, radio, film, and television have made copyright law more complex, partly because of the huge sums of money involved. Copy machines, computers and the digital revolution made all media easy to copy. Creators and vendors claim substantial losses due to “pirating”.

The **Digital Millennium Copyright Act** (DMCA) redefined owner and user rights. It criminalized reproduction and dissemination of technology, devices, or services intended to circumvent access controls to copyrighted works and increased penalties for copyright infringement on the Internet. This law was oppressive to teachers, who feared that the loosely defined “fair use” provision did not protect them from prosecution if they copied or used copyrighted materials in their classes. DMCA also gave impetus to privatization of knowledge.

Privatization results when organizations limit access to information for purpose of profit. This is actually happening with library materials and books, films and recordings including those in the public domain. **Digital Locks** can limit the use of purchased materials for a set time period and legislation has been proposed to add momentum to this movement. This raises serious questions about user rights for legitimate purchasers of these products, especially if vendors can lock items in the public domain and render them accessible only to paying customers.

Freedom of information is an extension of freedom of speech, a fundamental human right recognized in international law. It also applies to freedom of expression in any medium, be it orally, in writing, print, through the Internet or through art forms. This means that the protection of **freedom of speech** as a right includes not only the content, but also the means of expression. Freedom of information also considers the right to privacy in the context of the Internet and information technology.

Creative Commons (CC) was invented to create a more flexible copyright model. The Copyright is issued by a non-profit organization devoted to expanding the range of creative works available for others to build upon legally and to share. A Creative Commons license allows the creator to communicate which rights they reserve, and which rights they waive for the benefit of recipients or other creators. An easy to understand one-page explanation of rights, with associated visual symbols, explains the specifics of each Creative Commons license. This simplicity distinguishes Creative Commons from an all rights reserved copyright. In 2008, there were an estimated 130 million works licensed under Creative Commons. Wikipedia is one notable web-based project protected by a Creative Commons license.

Open Source describes open access to the knowledge required to create an end product. It describes a development environment that redefines copyright, licensing, domain, and consumer issues. **Open Source Computer Software** allows users to share, adapt, develop and extend source code to meet their specific needs. In return, they contribute code to the collaborative for the benefit of other users. The open source model embraces the concept of concurrent yet different agendas. It differs from more centralized models of development used in commercial software companies. Moodle is an excellent example of "free" open source software that can be adapted by individual users.

Innovative communication technologies offer new opportunities for their creators and users. In the process, legal and business models need adjustment so that controls are neither oppressive nor unfair. Traditional controls involving legal actions are unpopular and unenforceable. Litigation against extreme violations has done little to curb pirating for personal use. Intellectual property must be respected, but in the digital age the playing field has changed and must be continually redefined.

The collaborative model (creative commons) and shared resources (open source) have led to successful companies such as Google. Those whose success was based on tolls and locks, like Microsoft, are diminishing in power under pressure from open source and free Internet. Companies that make significant gains by privatizing knowledge are in direct competition with open access via the Internet. The marketplace will make its statement as the public is better informed.

Education is being crippled by oppressive laws (DMCA), excessive costs, and privatization of knowledge. Business and industry must recognize that a free society requires free and easy access to knowledge. That is what we need for our schools to be competitive. That is what the Internet represents. Keep it that way!

Note: This article was prepared in a few hours by searching and modifying parts of a dozen articles in the Wikipedia. This is a legitimate use of a Creative Commons document as a starting point for discussion. It is not intended to represent good research based on primary resources or original writing. It was done out of a sense of urgency because a proposed law in Canada may further restrict the availability of resources for education. Read more in Rory McGreal's article in the Calgary Herald.
http://www.calgaryherald.com/technology/Copyright+bill+could+digitally+lock/3148130/story.html
You can also Google "*Oldaily copyright"*.

Editor's Note: This article provides interesting and evocative research. The principle is well researched and the practice was very broad. The findings in Research Question 2 have considerable significance for design of learning. and the research findings from Research Question 4 provide considerable direction for optimal design of effective of learning materials.

The Impact of Multiple Representations of Content using Multimedia on Learning Outcomes

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Australia

Abstract

Innovative educational technologies provide valuable opportunities for educators to design an enhanced, interactive, more inclusive and engaging curriculum. Key pedagogical motivations for utilising educational technologies include the desire to improve learning performance and engagement. Educational technology and access to multimedia have provided opportunities to present multiple representations of key content areas using multimedia (text-based, video, aural, interactive elements) to cater more effectively to different learning styles and model preferences. This paper presents the findings of an experiment to measure the impact of multiple representations of content on learning outcomes including learning performance and engagement. While, in this study, multiple representations of content did not lead to actual improvements in learning performance, students reported favourably on multimodal learning elements and perceived that they had assisted comprehension and retention of the material. Implications for educators, limitations of the experimental methodology and directions for future research are presented.

Keywords: multiple representations; multimodal; multimedia; educational technology; interactive; learning styles; modal preferences; learning outcomes; learning performance; engagement

Introduction

In the field of distance education, traditional print-based materials are being converted to more interactive, multimodal, technology-mediated e-learning formats. Multimedia enhancements include, for example, video and audio elements, recorded lecture presentations, interactive audio-enhanced diagrams and simulations, interactive quizzes and crosswords, and graphics. Multimedia can be used to represent the content knowledge in ways that mesh with different learning styles and appeal to different modal preferences (Birch & Sankey, 2008; Moreno & Mayer, 2007). The concept of learning styles proposes that "different people learn information in different ways" (Pashler, McDaniel, Rohrer & Bjork, 2008, p. 106). Modal preferences refers to the existence of study preferences; that is, "the fact that people will, if asked, volunteer preferences about their preferred mode of taking in new information and studying" (Pashler et al., 2008, p. 106).

Multimodal learning

In recent years, multimedia in conjunction with hypermedia have been successfully applied to many e-learning environments in order to cater to a wider variety of student learning styles and modal preferences (Birch & Gardiner, 2005; Sankey & St Hill, 2009; Sprague & Dahl 2010). Fleming (2001) proposed that learners have a preferred learning style, namely, visual, aural, read/write or kinaesthetic, with many learners (about 40 percent) presenting as multimodal. As such, multimedia can be used to develop a more inclusive and engaging curriculum, appealing to visual, aural and kinaesthetic learners, thereby counteracting some differences in student performance (Birch & Burnett, 2009; St Hill, 2000). To further support this concept, neuroscience research has revealed that "significant increases in learning can be accomplished through the informed use of visual and verbal multimodal learning" (Fadel, 2008, p. 12). Students have been found to feel more comfortable and perform better when learning in environments that cater for their predominant learning style (Cronin, 2009, Omrod, 2008). This is known as the "meshing hypothesis" (Pashler et al. 2008, p. 109). Presenting material in a variety of modes may also encourage students to develop a more versatile approach to their learning (Hazari, 2004). Within the field of cognitive science, recent findings suggest that,

> Multiple intelligences and mental abilities do not exist as yes-no entities but within a continua which the mind blends into the manner in which it responds to and learns from the external environment and instructional stimuli. Conceptually, this suggests a framework for a multimodal instructional design that relies on a variety of pedagogical techniques, deliveries, and media (Picciano, 2009, p. 11).

Multimodal e-learning environments allow instructional elements to be presented in more than one sensory mode (Mayer, 2003). Therefore, material presented in a variety of presentation modes may lead learners to perceive that it is easier to learn and improve attention rates, thus leading to improved learning performance, in particular for lower-achieving students (Chen & Fu, 2003; Moreno & Mayer, 2007; Zywno 2003). Mayer (2003) contends that students learn more deeply from a combination of words and pictures than from words alone; known as the "multimedia effect". Shah and Freedman (2003) discuss a number of benefits of using visualisations in learning environments, including: (1) promoting learning by providing an external representation of the information; (2) deeper processing of information; and (3) maintaining learner attention by making the information more attractive and motivating, hence making complex information easier to comprehend. Fadel (2008) states that, "students engaged in learning that incorporates multimodal designs, on average, outperform students who learn using traditional approaches with single modes" (p. 13).

A major benefit to multimodal design, as identified by Picciano (2009), is that it "allows students to experience learning in ways in which they are most comfortable, while challenging them to experience and learn in other ways as well" (p. 13). The non-linear design of the multimodal learning environment has been found to increase learners' control over the way that they progress through their materials (Karagiorgi & Symeou, 2005). Thus, students may become more self-directed, interacting with the various elements housed in these environments. Therefore, depending upon their predominant learning style, students may self-select the learning object or representation that best suits their modal preference (Doolittle, McNeill, Terry, & Scheer, 2005).

Different approaches to suit different learning styles and modal preferences

Integral to the design of the multimodal learning environments is the premise that students learn in different ways and that each student has a preferred learning modality (Sarasin, 1999). In other words, "different modes of instruction might be optimal for different people because different modes of presentation exploit the specific perceptual and cognitive strengths of different individuals" (Pashler, McDaniel, Rohrer, & Bjork, 2008, p. 109). This being the case, when learning environments are designed to cater to multiple sensory channels, information processing can become more effective (Kearnsley, 2000).

Fundamental to the design of learning environments are the principles of multimodal design in which "information (is) presented in multiple modes such as visual and auditory" (Chen & Fu, 2003, p.350). Although visual images are proven to be an integral part of human cognition, they have tended to be marginalised and undervalued in contemporary higher education (McLoughlin & Krakowski, 2001). If material such as verbal texts (audio), diagrams, drawings, photographs, and videos are all regarded as texts to be read, they can be applied to the development of new inclusive curricula (Roth, 2002). It is necessary to develop strategies for the multiple representation of a whole range of instructional concepts to cater to the diversity of learners we have today.

The use of multiple representations, particularly in computer-based learning environments is recognised as a very powerful way to facilitate understanding (Moreno, 2002). For example, when the written word fails to fully communicate a concept, a visual representation can often remedy the communication problem (Ainsworth & Van Labeke, 2002). Some simple examples of multiple representations include, using point-form text or images with audio enhancement in the form of mini-lectures for various topics (Figure 1), interactive diagrams with accompanying transcripts and voiceovers (Figure 2), video presentations, interactive graphs and forms, audio explanations of concepts, and still images.

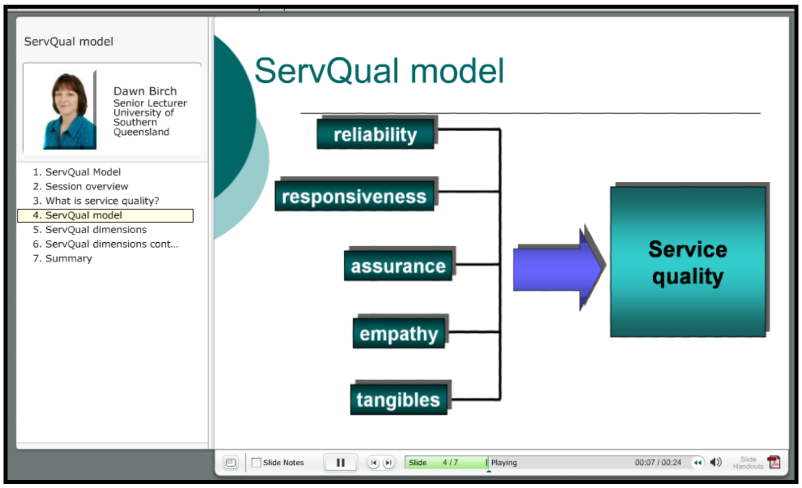

Figure 1: Audio-enhanced PowerPoint presentation

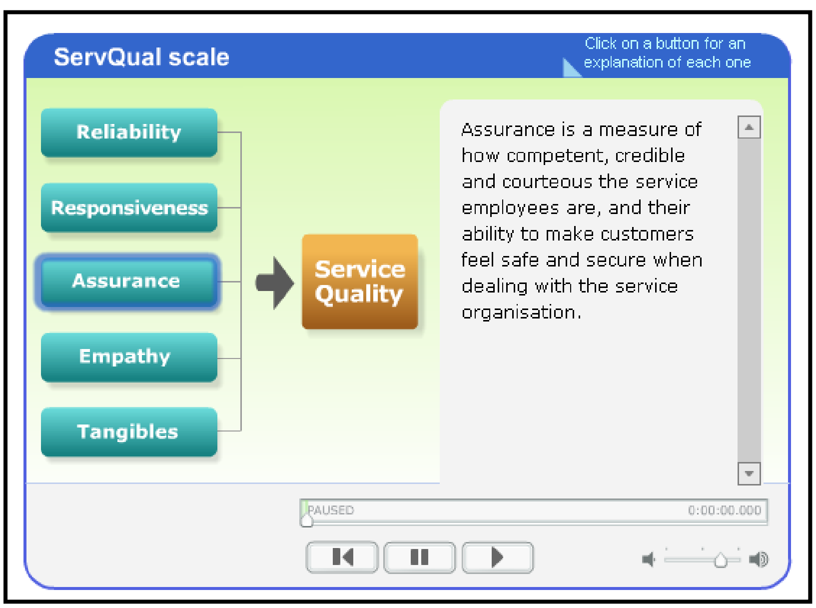

Figure 2: Interactive narrated diagram with a text-based transcript

In the examples provided above (Figures 1 and 2), the multimedia elements (visual, aural, and interactive elements) present additional representations of the information traditionally provided in text-based explanations. This approach caters for a range of different learning styles and modal preferences. It gives students choice in how they can access course content, and thus may be considered a more ethical and inclusive response to the needs non-traditional learners.

Facilitating Metacognition

Educators may try to design for all the different learning styles, however limitations exist arise because many students "don't even realise they are favouring one way or the other, because nothing external tells them they're any different from anyone else" (DePorter, 1992, p.114). Therefore, although it has been seen that there is a real need to design learning environments to cater for a range of different learning styles and modal preferences to aid student cognition, consideration of students' metacognition is equally necessary. Therefore, a further aspect needs to be considered, namely, helping individual students become aware of their own preferred approach to learning.

It has been suggested that when students are aware of their individual strengths and weaknesses as learners they become more motivated to learn (Coffield, Moseley, Hall, & Ecclestone, 2004). The potential of this awareness is that students can then question their long-held beliefs or behaviours and be taught to monitor their selection and use of a range of strategies to aid their learning (Sadler-Smith, 2001). This strategy has also been shown to increase the confidence and the grades of students by helping them to make the most of the learning opportunities that match their preferred style (Coffield, et al., 2004). To determine their predominant learning style, students can be encouraged to complete some form of learning styles inventory. McLoughlin (1999) emphasises that "teaching students how to learn and how to monitor and manage their own learning styles is crucial to academic success" (p.231).

The need for evidence of the learning styles hypothesis

Despite the ongoing call for evidence-based practice, difficulties in assessing the impact of educational technologies on learning outcomes have been reported due to the need to provide all students with the same opportunities (Cronin 2009; Forte & Bruckman 2007; Mayer, 2009). This study sought to address the dearth of experimental studies to test the "meshing hypothesis"; that is, the claim that instructional resources should mesh with the student's learning style (Pashler et al. 2008, p. 108). The problem investigated in this research was to determine the impact of multiple representations of content on learning outcomes across learning styles and modal preferences. Four research questions were developed to investigate the research problem.

1. Do multiple representations of content lead to improved learning outcomes and does this vary across learning styles and modal preferences?
2. What types of representations of content (visual/aural/text/kinesthetic elements) lead to improved learning outcomes and does this vary across learning styles and modal preferences?
3. Do multiple representations of content lead to cognitive overload, thus reducing learning outcomes and does this vary across learning styles and modal preferences?
4. What is the optimal combination of representations of content for improving learning outcomes and does this vary across learning styles and modal preferences?

Methodology

The main purpose of the research was to establish a cause-and-effect relationship between the ways in which content is presented to students and learning outcomes. Differences across predominant learning styles (visual, aural, read/write, kinaesthetic, multimodal) and modal preferences were also investigated. An experimental design was selected to allow for the manipulation of the ways content was presented and the measurement of students' learning performance. A post-experiment survey was conducted to identify modal preferences by investigating which learning elements were considered to be most helpful in assisting learning.

Undergraduate and post-graduate students studying at the University of Southern Queensland, Australia were emailed to seek their participation in the experiment. An incentive of an AUD$30 university bookshop voucher was used to encourage participation. To determine students' predominant learning style, students were requested to complete the VARK learning styles inventory online (http://www.vark-learn.com/english/page.asp?p=questionnaire) and to email their VARK scores and result (predominant learning style) to the researchers.

The experiment itself involved the development of two learning concepts, both drawn from services marketing theory. The first concept concerned customer satisfaction and addressed the 'expectancy disconfirmation model'. The second concept concerned the measurement of service quality and focussed on the ServQual model. Neither concept is particularly difficult to understand. Students who had previously studied services marketing were excluded from the experiment to control for prior learning. The learning material was presented in six different ways (conditions) with an additional representation of the content being added for each subsequent condition, with Condition 6 representing the highest number of representations of content used in this experiment. (see Table 1).

Table 1

Learning Conditions Used in the Experiment

Representations of Content					
Condition 1	**Condition 2**	**Condition 3**	**Condition 4**	**Condition 5**	**Condition 6**
• Text	• Text	• Text	• Text	• Text	• Text
• Study guide	• Study guide	• Study guide	• Study guide	• Study guide	• Study guide
	• Printed PowerPoint	• Printed PowerPoint	• Printed PowerPoint	• Printed PowerPoint	• Printed PowerPoint
		• Recorded PowerPoint with audio	• Recorded PowerPoint with audio	• Recorded PowerPoint with audio	• Recorded PowerPoint with audio
			• Interactive diagram with script only	• Interactive diagram with audio only	• Interactive diagram with script and audio

Sixty students were recruited, allowing for ten students in each of experimental groups (each student was exposed to two learning concepts across two different learning conditions), with the aim being to include two students from each of the five learning styles (visual, aural, read/write, kinaesthetic, and multimodal) in each group. However, only four of the students who agreed to participate in the experiment had a predominant aural learning style. The most common learning style from the students agreeing to participate in the experiment were multimodal learners, so where a shortage of students with one of the predominant learning styles existed, a multimodal learner was included to make up the number for each group.

The experiment was conducted in two computer laboratories at the University. As students needed to access the multimodal presentations via computer, the learning conditions and the post-experiment survey were housed on a separate website. When the students entered the website, they were instructed to select their assigned group and then follow the instructions in working through the learning conditions. To measure learning and assess prior knowledge or understanding, all students were asked to complete an identical pre-test comprising multiple choice questions for each concept and then to complete a post-test (identical in content to the pre-test) once they had been exposed to each learning concept.

To control for confounding factors, a standardised set of instructions, format and setting were used for every group. Students were told that the purpose of the experiment was to measure the impact of various learning resources on learning outcomes and to determine if these varied across learning styles and modal preferences. Students were instructed to carefully work through each learning concept to ensure that they did all of the required reading, listening and interacting with all of learning elements within each condition. Before the commencement of the experiment, students were provided with information about the experiment and asked to sign an informed consent form. Students were assured of anonymity and confidentiality.

Demographic data for each participant was gathered from university records including gender, age, program and grade point average. A post-experimental survey was developed to gather students' perceptions of the learning elements they were exposed to during the experiment. Students were asked which of the two learning concepts they found to be: (a) easiest; and (b) most enjoyable to learn. Six open-ended questions provided all students with an opportunity to express what they felt had been the most helpful resource/s they had been exposed to during their interactions with the two allocated learning conditions and why. These qualitative measures were administered to provide students with the opportunity to give a more in-depth account of their encounter with the multimodal learning environment (Barker, Pistrang, & Elliott, 2002).

Findings and Discussion

Of the sixty students participating in the experiment, approximately two thirds (68.4%) were females and one third (31.6%) were males. Students across a broad age range participated in the experiment with the youngest students being 17 years and the eldest student being 60 years. The majority of students were under 30 years of age (70.0%).

The proportion of students with each learning style is presented in Table 2. The majority of students in the study had a predominant multimodal learning style (35.0%), with equal numbers of kinaesthetic (21.7%) and read/write (21.7%) learners. Visual (16.7%) and aural (6.7%) learners were under represented in the sample. There were differences in learning styles across gender. The males in the sample predominantly had a multimodal (52.6%) learning style with no visual learners, while females were more evenly distributed across multimodal (26.8%), visual (24.4%), kinaesthetic (22.0%) read/write (19.5%) learning styles. There were very few aural learners in the sample with only 7.3 percent of females having an aural learning style and only 5.3 percent of males.

The majority of the students in the sample (60%) had a grade point average of 5.0 or above (out of 7.0) with only 8.0 percent of students with a grade point average of less than 4.0, indicating that very few lower-achieving students elected to undertake the experiment. There were no significant differences across the six experimental groups with respect to gender, age or grade point average.

The research problem investigated in this study sought to determine the impact of multiple representations of content on learning outcomes across learning styles and modal preferences.

Table 2
Learning styles of participants

Predominant learning style	Female	Male	Total
Visual	10 (24.4%)	0 (0%)	10 (16.7%)
Aural	3 (7.3%)	1 (5.3%)	4 (6.7%)
Read/write	8 (19.5%)	4 (21.1%)	12 (20.0%)
Kinaesthetic	9 (22.0%)	4 (21.1%)	13 (21.7%)
Multimodal	11 (26.8%)	10 (52.6%)	21 (35.0%)
TOTAL	41 (68.4%)	19 (31.6%)	60 (100.0%)

In addition to the experimental data, a thematic analysis of the qualitative data was conducted on students' responses to the six open-ended questions. An initial scan of the 333 comments made to the open-ended questions was performed using the qualitative analysis tool, Leximancer, to provide an initial feel for the potential themes contained within these data. The Leximancer scan revealed a considerable cluster of concepts around the key words of; information; reading; learning; audio; concept; diagram; learn; helpful and easier. From this investigation, the analyses of these qualitative data continued using NVivo software to explore four main themes:

1. The usefulness of having a combination of resources (139 comments)
2. The usefulness of audio (50 comments)
3. The place of reading within online environments (59 comments)
4. The right amount of choice (14 comments)

These four themes will be explored in relation to the four research questions, in turn.

Research Question 1: The first research question concerned whether multiple representations of content lead to improved learning outcomes and whether this varies across learning styles and modal preferences. The majority of students (93.4%) improved from the pre-test to the post-test after being exposed to the learning materials for Learning Concept 1 with the average change in performance from pre-test to post test being 41.4 percent. Likewise, the majority of students (91.8%) improved from the pre-test to the post-test after being exposed to the learning materials for Learning Concept 2 with the average change in performance from pre-test to post test being 48.3 percent. Learning Concept 1 was perceived to be easier to learn than Learning Concept 2 by the majority of students (58%). However, the majority of students enjoyed Learning Concept 2 (57.39%) more than Learning Concept 1. While students were asked not to guess the answers and to select 'don't know' where they did not know the answer, many students did select both correct and incorrect answers in the pre-test indicating some use of logic and/or guessing. The learning concepts used in the experiment were not difficult, and thus it may have been possible to make a logical assumption or an intelligent guess from the questions asked.

The experimental data did not reveal any differences in learning performance across the six groups and the six different conditions for either of the two concepts. This lack of support for the learning style "meshing" hypothesis is consistent with the findings of other experiments conducted by Massa and Mayer (2003) and Constantinidou and Baker (2002). However, it should be emphasized that the sample sizes (ten per cell) were too small to make any statistical inferences. Moreover, some methodological limitations were evident including the lack of participants with aural and visual learning styles, the possibility that the concepts were too simple or common sense resulting in inflated pre-test scores due to correct guessing and/or logic, the unnatural research setting, possible testing effects, and self-selection of students with higher average grade point averages (the average GPA of the participants was 5.06/7.00). Given the literature indicates that multimodal learning may be of greater benefit to lower-achieving students, while higher achieving students perform well regardless of how the content is presented, this could provide some explanation for the lack of impact of multiple representations of content on learning performance within this experiment (Zwyno, 2003).

Research Question 2: The second research question sought to determine which types of representations of content (visual/aural/text/kinaesthetic elements) lead to improved learning outcomes, and whether this varies across learning styles and modal preferences. While there were no differences across learning performance, most students indicated that all of the learning resources were helpful with the more enhanced multimodal learning resources considered to be the most helpful. Using the Friedman test, a ranking of the treatments was possible as indicated in Table 3. This finding indicates that the enhanced PowerPoint with audio and interactive diagrams with audio and transcript were significantly different to the other learning resources, with these two resources being considered to be the most helpful to the student learning experience. These two elements (included in condition 6) comprise greater representations of content and include visual, aural, text-based and kinaesthetic elements, aimed at appealing to a variety of learning styles and modal preferences.

Table 3
Perceived helpfulness of learning resources (7 point scale)

Learning resource	Mean	Ranking
PowerPoint with audio	5.62	1
Interactive diagram with script and audio	5.42	1
PowerPoint handout	4.22	2
Study guide	4.16	2
Interactive diagram with script only	4.20	2
Textbook reading	3.98	2
Interactive diagram with audio only	3.66	2

While the sample is too small to draw any statistical inferences, the data indicates (Table 4) that kinaesthetic learners, in particular, found the recorded PowerPoint presentations to be very helpful, while aural learners found the interactive diagram with transcript and audio to be very helpful. It is also interesting to note that the visual and kinaesthetic learners rated the textbook reading as being the least helpful, while the aural and read/write learners rated the interactive diagram with audio only as being the least helpful. This could indicate that visual and kinaesthetic learners may be at some disadvantage when the learning resources are primarily text-based.

Table 4
Perceived helpfulness of learning resources across learning style
(7 point scale)

Learning resource	V	A	R	K	MM	Ave
PowerPoint with audio	5.7	5.7	5.1	6.5	5.1	5.62
Interactive diagram with script and audio	5.7	6.5	4.3	5.3	5.3	5.42
Study guide	4.1	3.3	5.2	4.6	3.9	4.22
Interactive diagram with script only	3.5	4.7	4.0	4.2	4.4	4.16
PowerPoint handout	3.3	3.0	3.8	5.1	4.7	3.98
Textbook reading	2.3	5.5	4.7	2.6	3.2	3.66
Interactive diagram with audio only	3.5	2.5	2.4	4.4	3.2	3.20

Students were also asked open-ended questions concerning the various learning resources. Responses indicated that students have modal preferences for learning, and in many cases, in keeping with their predominant learning style. Many students commented on how the various learning resources assisted them in understanding and retaining the content, while others commented on which learning resources were easiest, more interactive or more enjoyable to use. A selection of student comments, across the various learning styles, is provided in Table 5.

The thematic analysis of the qualitative data revealed two major themes related to Research Question 2. The first theme related to the usefulness of audio (50 comments), and the second theme, related to the place of reading within online environments (59 comments). The use of audio in online learning environments has long been purported to provide advantages for student learning (Clark & Mayer, 2003; Fahy, 2005; Hazari, 2004). This finding was certainly confirmed and reinforced in this study. However, it is when audio is used in conjunction with other resources, such as images or text, that the advantage is most prominent. In the case of the study materials used for these environments, audio was provided in two main resources; the audio-enhanced PowerPoint presentations and in the interactive diagrams (with or without a transcript). The audio component was mentioned some fifty (50) times in the qualitative data, and on nineteen (19) of these occasions, audio was perceived to be a necessary component. This combination of resources was not only seen to provide information, but also led to a greater perceived understanding of the materials being presented and made learning more enjoyable. Previous studies have established that using a combination of verbal and non-verbal approaches, that stimulate both visuals and audio modalities, can increase working memory (known as "Dual Coding Theory") and have a significant impact on how students retain information, and consequently make learning more enjoyable (Calandra, Barron & Thompson-Sellers 2008; Clark & Mayer, 2003; Pavio, 1991). The following comments exemplify these attributes:

Table 5

A sample of comments regarding learning resources across learning styles

Learning style	Comments regarding different learning resources
Visual learners	▪ I enjoyed being able to interact with the buttons on the diagram ▪ The resources were more interesting and interactive ▪ I prefer having a visual aid while listening to the speaker ▪ There was less information to read – less information overload ▪ The combination of reading and listening was good ▪ The audio learning was the easiest, along with a visual aid being in the diagram ▪ It had a flowchart diagram which made it easy to organize the concept in my head ▪ I was able to listen to the slide show and see the words with pictures as they were spoken ▪ I did not enjoy Learning Concept 2 as there was no audio or diagrams. I find learning easier with additional aids. ▪ I could learn the same knowledge in a different way, which let me check my understanding fully ▪ The most helpful is the diagram with script and audio as there are two different modes of learning available.
Aural learners	▪ I like to see something and also hear it ▪ The visual provided a much better understanding ▪ Reading the visual diagrams certainly aided in memory retention ▪ The interactive diagram assisted with retaining information
Read/write learners	▪ I find the reading the most useful and I tend to get distracted with listening and I tend to understand more with reading ▪ Listening and reading was better for me ▪ I liked information in the written form ▪ I found the recorded lecture helpful with definitions and a summary of important points ▪ Lists appeal to me ▪ I found Learning Concept 1 easier because it was just reading, but in Learning Concept 2 you got to read it a few times and that helped me understand ▪ Repetition of the learning objectives helped ▪ Clicking on topics had definitions popping out of the screen ▪ I enjoyed reading the materials, but having a real person's voice added a personal element ▪ I liked the interactive part because it was fun to play around while learning ▪ A mix of stimulus material which tends to be better for maintaining concentration/focus on the topic – short/sharp tasks

Kinaesthetic learners	▪ I enjoy listening and seeing ▪ The combination of audio and visual kept me a bit more interested ▪ It was much more interesting to listen and interact ▪ It is more interesting to hear an actual person speaking about it ▪ It was more attractive and normally visual mechanics seem better tools for learning for me ▪ There were a couple of different ways I could learn the material. I didn't just have to read the material ▪ The interactive study guide with audio helps to cement my knowledge – also the interactive diagram ▪ The diagram really helped. The colors helped me when I was picturing what I had learnt ▪ Hearing the information spoken and maybe put into different words than the text book helped me to get a fuller understanding ▪ I could see what was being presented and therefore could recall the information much easier ▪ The audio reinforces what is being read ▪ The audio made concepts more confusing – like it clouded over what was supposed to be a simple concept
Multimodal learners	▪ I could first read a clear definition, and then I could see a diagram, and then I could listen ▪ Pictures that I click on made it easier to understand the flow and having the audio to read while I was looking at the diagram ▪ There was a variety of different approaches to learning the material and I could utilize all of them if I wanted ▪ The information was presented through the audio visual element which reinforced things ▪ A tangible and visual effect that enforced my learning capacity ▪ Someone explaining the concepts to me rather than just visual textual resources ▪ The interactive diagram was fun to do as I got to click on things while the PowerPoint slides had little pictures on them ▪ It is hard to focus on reading the text for a long time. Interactive learning is easy and more importantly it is enjoyable.

I enjoyed reading materials for both concepts, but hearing a real person's voice as part of Concept Two added a personal element that made learning more enjoyable. (Read/write learner)

Hearing the information spoken and maybe put into different words than the text book helps me to get a fuller understanding. (Kinaesthetic learner)

I think hearing the information helps my recall. The diagrams I can "picture" in my mind when recalling information. (Kinaesthetic learner)

The second theme arising from the thematic analyses concerned the place of reading in online learning environments. The fifty nine (59) comments about the reading materials (electronic and hardcopy) provided fell into three main categories; the lack of interest in using reading materials or the boring nature of the reading (40); the perceived sufficiency of the written materials provided (17); and two requests for less reading. In relation to the lack of interest in using reading materials or the boring nature of the reading, some students commented:

Even though I always do my textbook readings I find them long and boring and I get distracted easily when reading them. (Read/Write learner)

I lose my concentration when I'm simply reading, especially if it's new information. It's more interesting to hear someone speaking about something, as it's more personal. (Kinaesthetic learner)

Simply reading a text book doesn't engage me and I tend to become disinterested and start skimming through the text, identifying only what I believe I may be assessed on and not take in a lot of what is in the text. (Kinaesthetic learner)

I found the text book reading the least helpful because I found it to be less fun and sort of boring. It was overwhelming with all of the text and I found that I couldn't understand it as well as I could with the interactive diagram. (Multimodal learner)

These comments should not be judged in isolation, rather they should be considered in conjunction with the finding concerning the usefulness of providing a combination of resources. To illustrate this connection:

It was much more interesting to listen and interact, as I find that when I'm just reading I have to read over and over again for the concept to sink in. It is helpful to have things explained several times and in several different ways. It was helpful to listen at the same time as reading, as extra information was added on in the sound. (Kinaesthetic learner)

Having an aural aid [for Concept 2] made the concept more enjoyable, compared to Concept 1 where just reading it on my own was less enjoyable. (Multimodal learner)

Research Question 3: The third research question sought to investigate whether multiple representations of content lead to cognitive overload, thus reducing learning outcomes and whether this varies across learning styles and modal preferences. The experimental data did not indicate that multiple representations of content led to cognitive overload, thus reducing learning outcomes. No differences were found across the six conditions for either concept. However, the thematic analysis revealed comments concerning the perceived potential for cognitive overload and the perceived right amount of materials to be provided. Some students commented on being given too much choice (15 comments) with statements such as:

Having the audio made concepts more confusing - like it 'clouded' over what was supposed to be a simple concept. (Kinaesthetic learner)

The first Concept for me was information overkill, it appeared that there was so much for me to absorb with the diagram as well as the reading. (Visual learner)

More repetition of what was already learned, just another visual of what I had read. (Read/Write learner)

Indeed, some students found it sufficient to simply read their materials. For example:

The readings gave me what I needed to know without fluffing around with extras that may well have confused me, the information got straight to the point.(Visual learner)

> *I find the reading the most useful and I tend to get distracted with listening and I tend to understand more with reading. (Read/Write learner)*

Having seen that there can be some concerns around having too much choice, albeit that these comments are very much in the minority, there is sufficient evidence to suggest that a scaffolded approach, utilising a combination of learning materials (a multimodal approach) to the provision of key information may be optimal. Pashler, et.al. (2008) state that "It is undoubtedly the case that a particular student will sometimes benefit from having a particular kind of course content presented in one way verses another" (p. 116).

Research Question 4: The fourth research question sought to determine whether there is an optimal combination of representations of content for improving learning outcomes and whether this varies across learning styles and modal preferences. The experimental data did not reveal any statistical differences across learning conditions or learning styles with respect to learning performance. However, the qualitative data indicated that there may not be any optimal combination, with learners both within and across different learning styles expressing different preferences with respect to the learning resources. The thematic analysis revealed that a combination of resources was considered to be particularly useful (139 comments). Providing more than one representation of a particular concept was found to be the most valuable attribute of the materials. The following comments typify the sentiments being expressed:

> *I was able to access various types of learning materials which helped in the understanding of the material. After listening to the resources, I found it easier to take in what the material was trying to teach me, it reinforced it in my head. (Kinaesthetic learner)*
>
> *There was a variety of different approaches to learning the material and I could utilise all of them if I wanted.*
>
> *The combination of reading and listening was good. I do not find it easy to learn when I am just reading. By having the two resources I was seeing and hearing the information twice which helped. (Multimodal learner)*
>
> *It combines two powerful teaching styles; visual and audio. When you can integrate two or more teaching styles together, there is greater potential for learning. (Multimodal learner)*

Hence, a choice of resources and the reinforcement that choice allowed were fundamental to the students' appreciation of the learning environments. The main finding here may be that students like to have options and will gain benefits from those learning styles most suited to their learning style or modal preference.

Implications, limitations and directions for future research

While the experimental data for this study did not indicate that students perform better under multiple representations of content, the qualitative data clearly indicates that students have modal preferences for learning and perceive learning resources with higher representations of content to assist their comprehension, understanding and retention of content, and to be more interesting and enjoyable to use. In particular, students expressed a strong preference for a combination of learning resources and options. Given these findings, the importance of improving student progression and retention, and engendering a joy of learning leading to life-long learning, educators should be encouraged to continue to explore the use of educational technology and multimedia for developing multiple representations of content. Recorded PowerPoint presentations and interactive diagrams with transcripts and audio, in particular, were valued by students in this study.

A number of limitations should be considered before drawing conclusions from this exploratory experimental study. First, it is difficult to make any inferences from the quantitative data regarding the impact of providing multiple representations of content on learning performance due to small sample and limitations of the experimental methodology. In addition to the small sample size, there was a predominance of: (1) higher-achieving students; (2) multimodal learners who typically learn across a range of conditions; and (3) a lack of aural and visual learners in the sample. Given the literature indicates that multimodal learning may be of greater benefit to lower-achieving students, while higher achieving students perform well regardless of how the content is presented, this may be one factor that explains the lack of impact of multiple representations of content on learning performance within this experiment (Zwyno, 2003). Future research should involve a larger sample, higher representation of lower-achieving students, and a more even representation across learning styles. Future research could also involve more complex concepts to allow for a stronger measure of improvements in learning performance across pre and post tests.

A larger and more representative sample could be recruited to allow for an empirical investigation of the impact of using educational technologies for developing multimodal learning resources across various groups. For example, in addition to exploring differences across learning styles and modal preferences, differences across gender and age groups, lower versus higher achieving students, English Second Language (ESL) versus English First Language students (EFL), and on-campus versus distance learners could also be investigated. Moreover, the unnatural study conditions and difficulties in controlling for extraneous factors in an experimental design should be addressed (Sekaran, 1992). Ideally, future research would involve investigating learning performance under more natural study conditions to reduce possible testing effects. Under experimental conditions, students may be more actively involved in processing the learning content and pay greater attention to the content than they would in real life. The difficulties experienced with the experimental methodology in this study may provide some explanation for the dearth of empirical data on the impact of multimodal presentation of content on learning styles, despite calls from educators for evidence that technology-enhanced learning leads to improved learning outcomes.

References

Ainsworth, S., & Van Labeke, N. (2002). Using a multi-representational design framework to develop and evaluate a dynamic simulation environment, paper presented at the International Workshop on Dynamic Visualizations and Learning, Tubingen, Germany.

Barker, C., Pistrang, N., & Elliott, R. (2002). Research methods in clinical psychology: An introduction for students and practitioners (2 ed.). West Sussex: John Wiley & Sons Ltd.

Birch, D., & Burnett, B. (2009). Advancing E-Learning Policy and Practice: Influences on Academics' Adoption, Integration and Development of Multimodal E-Learning Courses. In Institutional Transformation through Best Practices in Virtual Campus Development: Advancing E-Learning Policies.

Birch, D., & Gardiner, M. (2005). Students' perceptions of technology-based marketing courses, paper presented at the ANZMAC 2005 Conference: Broadening the Boundaries, Fremantle, Western Australia, 5-7 December.

Birch, D., & Sankey, M. (2008). Factors influencing academics' development of multimodal distance education courses. *International Journal of Educational Development using ICT*, *4(1).*

Calandra, B., Barron, A. E., & Thompson-Sellers, I. (2008). Audio use in e-learning: What, why, when, and how? *International Journal on E-Learning*, *7(4),* 589-601.

Clark, R. C., & Mayer, R. E. (2003). E-Learning and the science of instruction: Proven guidelines for consumers and designers of multimedia learning. San Francisco, CA: Jossey-Bass/Pfeiffer.

Chen, G., & Fu, X. (2003). Effects of multimodal information on learning performance and judgment of learning. *Journal of Educational Computing Research, 29(3)*, 349-362.

Coffield, F., Moseley, D., Hall, E., & Ecclestone, K. (2004). Should we be using learning styles? What research has to say to practice? London: Learning and Skills Research Centre.

Constantinidou, F., & Baker, S. (2002). Stimulus modality and verbal learning performance in normal aging. *Brain and Language, 82,* pp. 296-311.

Cronin, J. J. (2009). Upgrading to Web 2.0: An experiential project to build a marketing Wiki. *Journal of Marketing Education*, 31(1), 66-75.

DePorter, B. (1992). Quantum learning: Unleashing the genius in you. New York: Dell Publishing.

Doolittle, P. E., McNeill, A. L., Terry, K. P., & Scheer, S. B. (2005). Multimedia, cognitive load and pedagogy. In S. Mishra & R. C. Sharma (Eds.). Interactive multimedia in education and training (pp. 184-212). London: Idea Group, Inc.

Fadel, C. (2008). Multimodal Learning Through Media: What the Research Says. San Jose, CA: Cisco Systems.

Fahy, P. J. (2005). Planning for multimedia learning. In S. Mishra & R. C. Sharma (Eds.), Interactive multimedia in education and training (pp. 1-24). London: Idea Group Inc.

Fleming, N. D. (2001). Teaching and learning styles: VARK strategies. Christchurch, New Zealand: Neil D Fleming.

Forte, A., & Bruckman, A. (2007). Constructing text: Wiki as a toolkit for (collaborative?) writing, paper presented at the 2007 International Symposium on Wikis (WikiSym ’07), Montreal Canada, Oct 21-23 (pp. 61-68): New York, Association of Computing Machinery.

Hazari, S. (2004). Applying instructional design theories to improve efficacy of technology-assisted presentations. *Journal of Instruction Delivery Systems, 18(2*), 24-33.

Karagiorgi, Y., & Symeou, L. (2005). Translating constructivism into instructional design: Potential and limitations. *Educational Technology & Society, 8(1),* 17-27.

Kearnsley, G. (2000). Online education: Learning and teaching in cyber space. Belmont, CA: Wadsworth/Thomson Learning.

Massa, L. J., & Mayer, R. E. (2006). Testing the ATI hypothesis: Should multimedia instruction accommodate verbalizer-visualizer cognitive style? *Learning and Individual Differences, 16*, 321-336.

Mayer, R. E. (2003). Elements of a science of e-learning. *Journal of Educational Computing Research, 29(3),* 297-313.

Mayer, R.E. (2009). Advances in applying the science of learning and instruction to education. *Psychological Science in the Public Interest*, *9(3),* i-ii.

Moreno, R., & Mayer, R. (2007). Interactive multimodal learning environments. *Educational Psychological Review, 19,* 309-326.

McLoughlin, C. (1999). The implications of the research literature on learning styles for the design of instructional material. *Australasian Journal of Educational Technology, 15(3),* 222-241.

McLoughlin, C., & Krakowski, K. (2001). Technological tools for visual thinking: What does the research tell us?, paper presented at the Apple University Consortium Academic and Developers Conference, James Cook University, Townsville, Queensland, Australia, September.

Moreno, R. (2002). Who learns best with multiple representations? Cognitive theory implications for individual differences in multimedia learning, paper presented at the EDMEDIA 2002 Conference: Denver, Colorado, USA, June.

Omrod, J. E. (2008). Educational psychology: Developing learners (6th ed.) Upper Saddle River, NJ: Pearson.

Pashler, H., McDaniel, M., Rohrer, D., & Bjork, R. (2008). Learning Styles: Concepts and Evidence. *Psychological Science in the Public Interest, 9(3),* 105-119.

Pavio, A. (1991). Dual coding theory: retrospect and current status. *Canadian Journal of Psychology, 45*, 255-287.

Picciano, A. G. (2009). Blending with purpose: The multimodal model. *Journal of the Research Centre for Educational Technology, 5(1),* 4-14.

Roth, W. M. (2002). Reading graphs: Contributions to an integrative concept of literacy. *Journal of Curriculum Studies, 34(1),* 1-24.

Sadler-Smith, E. (2001). The relationship between learning style and cognitive style. *Personality and Individual Differences, 30(4),* 609-616.

Sankey, M., & St Hill, R. (2009). The ethics of designing for multimodality: Empowering nontraditional learners. In U. Demiray & R. Sharma (Eds.), Ethical Practices and Implications in Distance Education (pp. 126-155). London: Ideas Group International.

Sarasin, L. C. (1999). Learning styles perspectives: Impact in the classroom. Madison, WI: Atwood Publishing.

Shah, P., & Freedman, E. G. (2003). Visuospatial cognition in electronic learning. *Journal of Educational Computing Research, 29(3),* 315-324.

Sprague, E. W., & Dahl, D. W. (2009). Learning to click: An evaluation of the personal response system clicker technology in introductory marketing courses. *Journal of Marketing Education, 32(1*), 93-103.

St Hill, R. (2000). Modal preference in a teaching strategy, paper presented at the Effective Teaching and Learning at University, Duchesne College, The University of Queensland, November.

Weston, T. J. (2005). Why faculty did - or did not - integrate instructional software in their undergraduate classrooms. *Innovative Higher Education, 30(2),* 99-115.

Zywno, M. S. (2003). A contribution to validation of score meaning for Felder-Solomon's Index of Learning styles. Proceedings of American Society for Engineering Education Conference and Exposition.

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Editor's Note: This article defines active learning before explaining the theory and practice of VoiceThread technology. It is a provocative, persuasive presentation of VoiceThread technology in action including available resources and how to produce it.

Inspiring Active Learning with VoiceThread Technology

Janet Holland

USA

Keywords: active learning, interactive learning, experiential learning, constructivist learning, engaged learning, motivated learning, hands-on learning, authentic learning, problem-based learning, case-based learning, group learning, team-based learning, collaborative learning, cooperative learning, simulation, game-based learning, discussion learning, production-based learning.

Active Learning

As the instructor looking into the eyes of the learners and watching their body language, are they sitting there as passive listeners drifting off into other activities? Are they checking cell phones, social networking sites, text messaging, or talking to their neighbor? Do you get the feeling the body is there but the mind is somewhere else? Then, it is time to consider active learning strategies to get students more deeply and actively engaged with the content. It involves putting the learners' mental, physical, and social capital into active applications for learning. It is a matter of capitalizing on students' strengths and interests in digital age technologies.

It seems like everyone in education today uses the term active learning to describe a whole host of classroom activities. When pinned down on what it really means, the responses tend to lack clarity and consistency. If educators are not sure what active learning really is, how can we effectively implement it into the instructional design of a course to inspire deep, memorable, high-level learning? In order to better understand the active learning conceptual beast, a literature review and classroom pilot was conducted to examine the implications for new and emerging online technologies.

As a college professor observing pre-service teachers, it is easy to see they have a strong interest in implementing active learning in the classroom as motivation for student learning. One way we, as instructors, can grab student interest is through the use of social technologies to foster dialogue for sharing and constructing new understandings.

With the current tight economic times and due to the cost associated with many current online learning management systems, many schools are unable to implement new hardware or software updates to improve audio instructional components. In addition, many tools are one-dimensional with respect to offering only one function at a time, such as audio as a stand-alone feature. This has led to a search for alternatives with respect to more open source, low to no cost solutions, with multiple interaction options for linking or embedding audio capabilities into instructional websites. Resulting from this search, VoiceThread ® was discovered to be an exciting way to use audio-based chat with the added capabilities it provides to show images at the same time, draw on the image, and attach messages for a personal, authentic, actively engaged teaching and learning experience for students.

Two of my synchronous on campus pre-service teacher courses became perfect candidates for classroom test piloting using VoiceThread technology to increase active learning. Most of the pre-service teachers in the course plan to work in elementary level classrooms upon completion of their degree programs. A primary course goal focused on preparing these future instructors to implement technology effectively into their curriculum while meeting learning standards. One of the unique features of the classroom demographic selected was related to the unique challenges facing pre-service elementary teachers when working with very young students, who have not yet developed a mastery of text-based communications. Therefore, audio interactions served as a bridge to close communication gaps by providing a voice and a window to students' intellectual thinking and social interactions.

VoiceThread Technology

VoiceThread is an audio-based technology solution for sharing images, text, video, drawing, and personal voice messages and responses. With VoiceThread, instructors and students have access to an innovative active learning platform taking advantage of both visual and auditory narratives. VoiceThread offers students a dynamic and engaging way to research, reflect, deliver content, and interact with the instructor and classmates. Through a web of social networks, learners build a community, locally, regionally, nationally, even globally if desired. In this article, you will learn more about VoiceThread and see how it can be used for active online group conversations for teaching and learning.

When working with new technologies such as VoiceThread, a browser based program with a limited prior research and reporting base, one is basically at the forefront using trial and error to determine if a new tool is a viable option for learning. Part of the process is determining: 1. whether or not the tool can assist in facilitating teaching and learning by assessing the strengths and weaknesses related to conveying the desired content; and 2. Whether or not the tool aligns well with the promotion of active engaged student learning.

The pilot video and online examples clearly demonstrated how instructors could use VoiceThread in the classroom for actively engaged, authentic inquiry-based learner critiques, explanations, analysis, interpretations, demonstrations, reports, presentations, debates, collaborative interactions, practice, and motivation. Learners can create digital narratives and documentaries while developing their personal voice and creating their own work portfolio. It is an ideal environment for differentiated instruction and inquiry-based learning applied to any content area of interest. Instructors can also post lectures, podcasts, slides, notes, demonstrations, and learning challenges for students who have the ability to ask additional questions and post responses.

My pre-service teachers used VoiceThread to create lesson examples for their future students, to then share with one another for critiquing, since they did not yet have their own classrooms within which to assign student projects. VoiceThread was found to be a great way for instructors to model the concepts to be taught using images, text, voice, and the drawing board directed towards the desired learning standards. The teachers worked to make the lessons more interactive for the students by asking probing questions and posing learning challenges to extend content learning even further. The topics the pre-service elementary teachers selected for presentations included; states, animals, holidays, art, music, literature, poems, maps, seasons, historical landmarks, famous states persons, symmetrical and asymmetrical, descriptive perspective, science processes, and historical events. The subsequent lessons were specifically designed to meet standards while combining the use of KidPix ® a digital elementary level software program for the illustrations and VoiceThread for sharing the examples, demonstrations, and communications. One secondary pre-service teacher in my course substituted the KidPix ® program for Adobe Photoshop ® for the image editing to align well with older students. Based on the initial pilot test it was easy to see that any content area could be integrated. With more knowledge of possible applications and more time and experience, teachers will be able to create an even wider variety of learning opportunities.

Pre-Service Teacher Examples: Combining VoiceThread and KidPix

States Research http://voicethread.com/share/792209/
Animal Research http://voicethread.com/share/797858/
Holiday http://voicethread.com/#e702711
Art http://voicethread.com/share/697055/
Literature http://voicethread.com/#q.b696998
Poems about the Seasons http://voicethread.com/share/697084/
Little Red Riding Hood http://voicethread.com/share/696950/
Kansas Historical Landmarks – Matching by Drawing – Embedded into Website http://studentaccess.emporia.edu/~athorne1/website1/historygeography.html
French Impressionist Art http://voicethread.com/#u563201.b686806.i3630554
Famous Kansan – Amelia Earhart https://voicethread.com/#u563220.b697025.i3685852
Literature – Book Holes https://voicethread.com/#u563219.b686748.i3630118
Van Gogh http://voicethread.com/share/696865/
Literature Review - The Very Hungry Caterpillar http://voicethread.com/share/696810/
State Fact Postcard http://voicethread.com/share/686926/
Seedfolks – Create Your Own Garden http://voicethread.com/share/696927/
Art Landscapes http://voicethread.com/share/686802/
Maps http://voicethread.com/share/686818/
Animals in the Atlantic Ocean http://voicethread.com/#u563231.b686677.i3629698
Symmetry http://voicethread.com/share/974142/
Symmetry (used the drawing tool) http://voicethread.com/share/961589/
Descriptive Perspective http://voicethread.com/share/961962/
Colors of the Rainbow http://voicethread.com/share/961681/
Impressionist Painting http://voicethread.com/share/974022/
Musical Instruments http://voicethread.com/share/974240/
Life Cycle of a Star http://voicethread.com/share/974460/
The Battle of Lexington and Concord (multiple slides) http://voicethread.com/share/961618/

Some additional resources are provided through the VoiceThread website or they may be obtained from an Internet search to further support the implementation of VoiceThread into your own setting. From the VoiceThread site one of the tabs along the top links to their "Library" containing numerous examples applied to different content areas to help in brainstorming classroom application examples, located at http://voicethread.com/library/. Also, while viewing the VoiceThread site, look along the top tabs, select "Press" link to gain access to additional articles at http://voicethread.com/press/. One external site, with many good resources for planning classroom implementation, can be found at Digitally Speaking at http://digitallyspeaking.pbworks.com/Voicethread. An external site called VoiceThread 4 Education Wiki is a good place to find other classrooms to collaborate with and share examples at: http://voicethread4education.wikispaces.com/. When searching TeacherTube ® for potential educational applications, one video containing some great examples was found at http://www.teachertube.com/viewVideo.php?video_id=79814. Search TeacherTube for additional examples at http://www.teachertube.com or YouTube ® for many excellent tutorials at http://www.youtube.com. If you are interested in merging SlideShare ® with VoiceThread check out the PBS ® Teachers site at http://www.pbs.org/teachers/learning.now/2008/04/slideshare_and_voicethread_not_1.html. Edutopia ® has an informative article from a teacher working with VoiceThread. You may find it is a great way to extend learning beyond the traditional classroom day: http://www.edutopia.org/voicethread-interactive-multimedia-albums.

Using a combined media approach, one has the potential for adding value for even richer learning experiences. For example, in the past, teachers developed an Art lesson for their students using a digital art program to create their own artwork. The teachers could then use the lesson developed for authentic hands on learning experiences for their students while combining the project with any content area of interest to be taught. Even though the content had depth, the project itself was one-dimensional in that, when completed, the learning ended. When you take it one step further to display the students' work on VoiceThread, it opens up a whole new dimension, with the students providing their own story and voice reflections on the learning process. In addition, the instructor, classmates, family, friends, and the global learning community are able to add comments and questions to extend the content, and support learners' efforts.

Security issues will need to be considered, such as whether VoiceThread will be limited to the instructor's classroom alone or opened up to other controlled classrooms or even the larger global village. In general, the younger the students, the more controlled the environment may need to be to protect those students. The more open the learning environment, the more likely teaching Internet safety and etiquette may be beneficial. To protect students, if a more open community is desired, students may use sketches in place of actual student photos and first names only or even using nicknames. If the instructor wants a more controlled classroom environment, that option is still available. Anytime the instructor is working with minors, parent or guardian permission for working online will be needed. Often the district has a form for parents to sign at the beginning of the year to document this type of permission. Finally, the more open the environment, the more the instructor will need to monitor the learning environment.

VoiceThread Technology Issues

VoiceThread has five ways to post individual or group comments; including microphone, telephone, text, audio file (MP3/WAV), or webcam. To use visual media in VoiceThread is enticing as it supports a broad based group of software including Adobe ® PDF, Microsoft ® Word, Excel, PowerPoint ®, images, or imported images from Flickr ®, Facebook ®, or the web. VoiceThread also has a doodling feature allowing you to draw on top of the media as you record your comments. VoiceThread can be embedded into your webpage or alternatively, if you are a Moodle ® user, VoiceThread includes a download plug-in to allow embedding into the learning management system. In addition, the option for a customizable VoiceThread authenticated domain portal skinned to reflect the desired branding logo and colors is possible. VoiceThread has many export options, from burning a DVD, to downloading, to an MP3 player or other mobile device. The VoiceThread moderator can select which comments to show to everyone else. In this way, if desired, it is possible to show only the top five comments. Learners can have individual avatar identities, multiple identities, or group identities. VoiceThread allows complete security control from private to public, with a default to private. The program was built with accessibility in mind, so those with physical disabilities can still have access and participation options. VoiceThread is set up within a browser-based program with no software to download, manage, or update. The only additional requirement is to have a current version of Adobe Flash ® web browser plug-in installed on the computer; not much of an issue since most of the PC's come with it installed.

Creating Your Own VoiceThread

To get started creating your own VoiceThreads, go to their website at http://voicethread.com/ and register for an account. Educators can select the desired options and resulting price points, ranging from free to discounted professional educator with some feature limitations to a yearly classroom subscription with all features and options included. VoiceThread also has additional price options for use in Higher Education and business. If you are working in the K-12 setting, select the K-12 link from the main page, then from the next page select the learn more link, then the purchase options to see a feature comparison chart. For this example we selected the free account and the apply button. This takes one to a page where one can elect to complete the form and register. All one then has to do is complete the additional information form, select the submit button and you have successfully applied for an account.

To specifically create your own VoiceThread, go to the main website at http://voicethread.com to select sign in or register, then type in your email and password before selecting sign in, which will take you to a page where you can view all VoiceThreads. From this page, select the create tab along the top and it will take you to a page where you can select the upload link to bring in your images, documents, or videos from your computer, media source, or from a website address. After uploading the desired media, the next step is to select the comment link, then from the media window select the second comment link below the media to be able to edit. You will be able to record, type, or use a webcam to record a video, or make a comment by phone. To record your own voice, simply select the record button and begin talking. When you are finished, press the stop recording button. Press the save button to save the recording, or if you make an error, press cancel and you may record again. To listen to your recording, press the personal icon on the left side of the media. With your media and voice recorded, select the share button and you will see several options. If you select the publishing options along the bottom you can make the VoiceThread open to the public, if desired. Since we are using teacher recordings delivered to students, this is the option we select to allow anyone to view comments and save the setting. Another share option is the link along the bottom called "embed" to place the VoiceThread directly into a web page. From the embed window, highlight the embed code in the text box, select the copy button, and the done button. If you are embedding the VoiceThread into a web page using a web authoring program, switch to the Code view, click between the body tags and go to Edit>Paste. Then, switch to Design view and save the page. Next, go to File>Preview in Browser to test before uploading the page to the server. Alternatively, if you do not want to embed VoiceThread into a web page from the share page, select the "get a link" button and then the "copy the link" button. The classroom teachers, in the pilot, elected to allow anyone to view and comment; so, it would be open to the public for anyone to view. Before leaving the create window, select "add a title" and "description" link; then, from the tabs along the top, select "my voice" to be able to view it. Each VoiceThread has a small thumbnail and in the lower right corner you will find a menu with a wheel icon. By selecting the menu you will find additional editing options.

If you need any additional assistance when you login to VoiceThread at http://voicethread.com, along the top of the window you will find a help menu in the top right corner. There you will find many tutorials and a frequently asked question (FAQ) area for additional support. YouTube also has many excellent tutorials, if needed.

The pre-service teachers believed using the VoiceThread program was would be a good way for their students to take abstract concepts and make them more concrete by creating their own images. Additional perceived benefits include having students use their own voices and thoughts to communicate concepts, ideas and feelings. This illustrates "how the child becomes a cast of one, taking on *multiple roles* (i.e., artist, author, director, scripter, performer and narrator) and selecting when and how to play with all the available voices offered through the multimodal media – drawing, 'telling', dramatization, expressive sound effects, gesture and movement" (Wright, 2007, p. 1). VoiceThread, opens up a whole new dimension with the students providing their own stories and voice reflections on the learning process. "Learners need time to make sense of new information and ideas on their own; they also need time to think aloud and exchange thoughts with others" (Nash, 2009, p. xxi). In addition, through VoiceThread the instructor, classmates, family, friends, and the global learning community are able to add comments and questions to extend the content, all to support learners' efforts.

Student Centered Active Learning

Student centered learning means to "responsibly share power with students in the interest of positively influencing their motivation and learning" (Weimer, 2002, p. xi). "It is about what best achieves a goal that faculty endorse" (Weimer, 2002, p. xv). "It is about creating climates in classes and on campus that advance learning outcomes" (Weimer, 2002, p. xvii). It is about how "content is used to develop learning skills" (Weimer, 2002, p. xviii). It is about developing "skills necessary to sustain learning across a career and lifetime" (Weimer, 2002, p. xviii). It is about "giving students more voice in learning decisions that affect them" (Weimer, 2002, p. xxi). By actively engaging students in the learning process and sharing some power and control we can empower our students to ask questions while seeking out their own solutions to foster independent learning skills to become autonomous life-long learners. By using tools like VoiceThread, "learner-centered teachers are guides, facilitators, and designers of learning experiences" (Weimer, 2002, p. xviii). Properly structuring learning opportunities for our students assists in facilitating deep, memorable, high-level learning.

Fraser, Treagust, and Dennis (1986) developed a college level survey to measure classroom environments using seven subscales. It would be worth further study to see if the same concepts will apply to all levels of the classroom environment in regards to using current classroom collaboration tools such as VoiceThread for inspiring active student-centered learning. Based on the classroom pilot, it appears that the subscales will align nicely with the use of: 1) personalized interactions, 2) student involvement, 3) student friendly, 4) student satisfaction, 5) clear organized tasks, 6) innovation, and 7) students individualization by learners making their own decisions based on their own learning needs.

To further support the development of autonomous life-long learning skills, student self-assessment rubrics could be implemented for further reflections. The online student dialogue used through VoiceThread can also be used to increase students' perspectives while expanding the shared knowledge base through collaborative interactions. "The active classroom is a place where students are frequently encouraged to actively reflect on and process information, skillfully practice the art of communication, purposefully move and share, and continually engage in their own learning" (Nash, 2009, xvi).

Conclusion

Bonwell and Eison (1991) generally defined active learning as an instructional method used to engage students in meaningful learning activities with reflections on those activities. Active learning literature research extends the concept through the potential benefits resulting from increased student engagement, collaboration, cooperation, positive attitudes, improved study habits, enhanced critical thinking, and problem-based learning for fostering a "deeper approach to learning and helps students retain knowledge longer than traditional instruction" (Prince, 2004, p.7). Bransford, Brown, and Cocking (1999) report that students are, subsequently, better able to understand complex material and transfer knowledge from one setting to another through practical applications, so learning is better retained. Active learning may not be the answer for all instructional design issues but it does offer important options when aligned to learner needs, content, and learning goals.

One of the most important technological advantages of using VoiceThread for active learning is how the media options are extended through the use of multiple channels at one time. Instead of pure text-based chat or whiteboards, or graphics used individually or separately, these features are combined in one place with the addition of two-way audio communications. This multi-media approach opens up the possibility of reaching more diverse student populations and learning preferences through the combined use of audio and visual communications. The audio dialogue increases the number of perspectives offered and can contribute to the students overall knowledge base. Online interactions become more immersive for student participants by fostering active engaged learning opportunities. Students benefit from the learning processes through formulating questions, researching, analyzing, solving problems, presenting, and reflecting on their own learning. By incorporating student-centered structures, learners have more autonomy and control over their own learning to become the active independent life-long learners we desire.

VoiceThread Online Resources

Digitally Speaking http://digitallyspeaking.pbworks.com/Voicethread
Edutopia: The George Lucas Educational Foundation http://www.edutopia.org/voicethread-interactive-multimedia-albums
Educause http://www.educause.edu/ELI/7ThingsYouShouldKnowAboutVoice/173329
PBS Teachers
http://www.pbs.org/teachers/learning.now/2008/04/slideshare_and_voicethread_not_1.html
SlideShare http://www.slideshare.net/suziea/voicethread-examples-in-education-presentation
TeacherTube http://www.teachertube.com
VoiceThread http://voicethread.com
VoiceThread 4 Education Wiki http://voicethread4education.wikispaces.com/
YouTube http://www.youtube.com

Resources

Bonwell C. C., & Eison J. A. (1991). Active Learning: Creating Excitement in the Classroom. Retrieved Feb. 11, 2010. http://www.ntlf.com/html/lib/bib/91-9dig.htm

Bransford, J. D., Brown A. L., & Cocking R. R. (1999). How people learn: Brain, mind, experience, and school. Washington, D.C.: National Academy Press.

Cuseo, J. (2010). Active learning: Definition, justification, and facilitation. Retrieved Feb. 3, 2010. http://74.125.95.132/search?q=cache:0eKHNbZxfkMJ:www.uwc.edu/administration/academic-affairs/esfy/cuseo/Active%2520Learning--Definition%2520Justification%2520and%2520Facilitation.doc+Active+learning:+definition,+justification,+and+facilitation&cd=1&hl=en&ct=clnk&gl=us

Fraser, B. J., Treagust, D. F., and Dennis, N. C. “Development of an Instrument for Assessing Classroom Psychosocial Environment at Universities and Colleges.” *Studies in Higher Education*, 1986, *11*(1), 43-53.

Grabinger R. S. & Dunlap J. C. (1995). Rich environments for active learning: A definition. Retrieved Feb. 3, 2010. http://74.125.95.132/search?q=cache:ywLqq5HuIiMJ:repository.alt.ac.uk/11/1/CALT_A_00302005_O.pdf+Rich+environment+for+active+learning:+a+definition&cd=5&hl=en&ct=clnk&gl=us

Harmin, M. & Toth, M. (2006). Inspiring active learning: A complete handbook for today’s teachers, 2nd Edition. Alexandria, VA: Association for Supervision and Curriculum Development (AECS).

Mayer R. (2004). "Should there be a three-strikes rule against pure discovery learning? The case for guided methods of instruction". *American Psychologies* 59(1): 14-19. Doi:10.1037/0003-066X.59.1.14.

Meyer C., & Jones T. B. (1993). Promoting Active Learning: Strategies for the college classroom. San Francisco, CA: Jossey-Bass An Imprint of Wiley.

Nash R. (2009). The active classroom: Practical strategies for involving students in the learning process. Thousand Oaks, CA: Corwin Press.

Prince M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education*, 93(3), 223-237).

Silberman, M. (2006). Teaching actively: Eight steps and 32 strategies to spark learning in any classroom. New York, NY: Pearson Allyn and Bacon.

Weimer, M. (2002). Learner-centered teaching: Five key changes to practice. San Francisco, CA: Jossey-Bass, John Wiley and Sons.

Wright, S. (2007). Graphic-narrative play: Young children's authoring through drawing and telling, *International Journal of Education & the Arts*, *8*(8). Retrieved [Jan. 3, 2010] from http://ijea.asu.edu/v8n8/

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Editor's Note: Reusable Learning Objects attract researchers as a modular architecture for distance learning. Significant work has been done by the US Military (SCORM), by companies such as Oracle, and by University systems in Canada and elsewhere. Each new iteration brings us closer to a universal system with a repository of proven and flexible learning objects.

Course E-Generation Using Atomic Learning Objects

Salah Hammami, Ameur Touir, Hassan Mathkour
Saudi Arabia

Abstract

E-learning technology is driven by several factors. Among these factors is the principle of sharing and reusing existing teaching materials. This is in addition to the possibility to personalize courses according to several criteria such as the preferences, capabilities and students' needs. In this paper, we analyze the existing standards and technologies related to the subjects. We aim at providing an original technique for a modular architecture of an e-learning system which allows designing and implementing an e-generation course. The e-generation course maintains a consistent view on the entire authoring process, and provides automation of courses based on an existing atomic learning object in a course repository. The process of e-content structure is objectives-based. To create a course the author has to be aware in each step of the course generation of the objective and the relevant information for the learner.

Keywords: course e-generation, atomic learning object, e-content structuring, content management.

Introduction

E-learning is growing very fast and with the spread of broadband Internet and the growth of information technology, many e-learning solutions have been developed [1] [6] [4]. However, existing e-learning solutions focused more on the convenience of construction and management of solution provider but less on the reusing and adapting learning objects respectively in and to different contexts. To provide such features, in this paper we analyze current standards and proposals for e-learning system architecture. The emphasis is on the technical structure and system components but also e-content management is described. Therefore, many e-learning systems have been developed to improve science education in recent years [20]. These systems aim to provide high quality educational resources for students and teachers and help them build up their own courses through various learning services and reusable learning objects. Existing e-learning systems have several sets of technology standards, each of which is based on a specific authoring tool [8] [9]. However, most authoring tools are designed to create an e-content with a set of objects. Nevertheless, the reusability of the e-contents objects remains relatively low. In order to increase the reusability of the e-content objects, we present in this paper a solution of an e-generation course which has been designed and composed by re-usable entities This course offers an authoring tool that facilitates the building of e-content based on a particular structure called pedagogical learning objective. The proposed solution allows publishing, updating, deleting reusable learning objects, and creating course structure. The system provides the opportunity/possibility to define the e-content repository that enables uploading, classifying and accessing of reusable learning objects.

The paper is organized as follows: Section 2 gives a related work of a basic e-learning system and what services are generally offered by different e-learning platforms. Section 3 describes the proposed e-generation course component based on the learning content manager. The latter offers a set of tools for the managements of courses, lessons and teaching materials. Section 4 concludes the paper and presents our future work.

Related work

E-learning, in general, can be seen as technology-delivered or technology-enhanced learning [3]. Therefore many architectures of online education have been developed [1] [6] [4]. The goals of the different solutions can differ and so the offered functionalities because they are impacted by various aspects including available technologies, pedagogical principles [10] and [12], usability, true awareness and benefits as well as cultural impacts.

The most common standards are Blackboard [5], WebCT [19], Moodle [11], ALFANET [2], and LRN. Blackboard [5] provides course and content management systems, collaboration tools and a number of other services combined in an “Academic Suite” and a “Business Suite”. It is one of the most popular and successful commercial e-learning systems. It can be extended according to own needs. WebCT [19] was a commercial Course Management System. WebCT's solutions are designed to address the needs of the entire educational enterprise – from administrators serving the needs of a broader student demographic, to students and faculty looking for ways to enhance teaching and learning. In 2006 WebCT was acquired by Blackboard. Moodle [11] is a free Course Management System (CMS). The lesson module of Moodle provides different learning paths. ALFANET [2] [13] was developed within an European project from May 2002 to April 2005. Its architecture is service-oriented. It uses multi-agent technology and it is based on several standards [17] such as IMS-LD, IMS-QTI, IMS-CP, IEEE-LOM, and IMS-LIP.

Those platforms provide authoring tools based on the ADL Sharable Content Object Reference Model (SCORM) [18]. The main limitation of the SCORM-based courseware authoring tools is that they are based on a “single learner model” [14]. Moreover, the interaction between users is abstracted in the SCORM. Also, the SCORM-based authoring tools limit the interoperability between systems to only content interoperability.

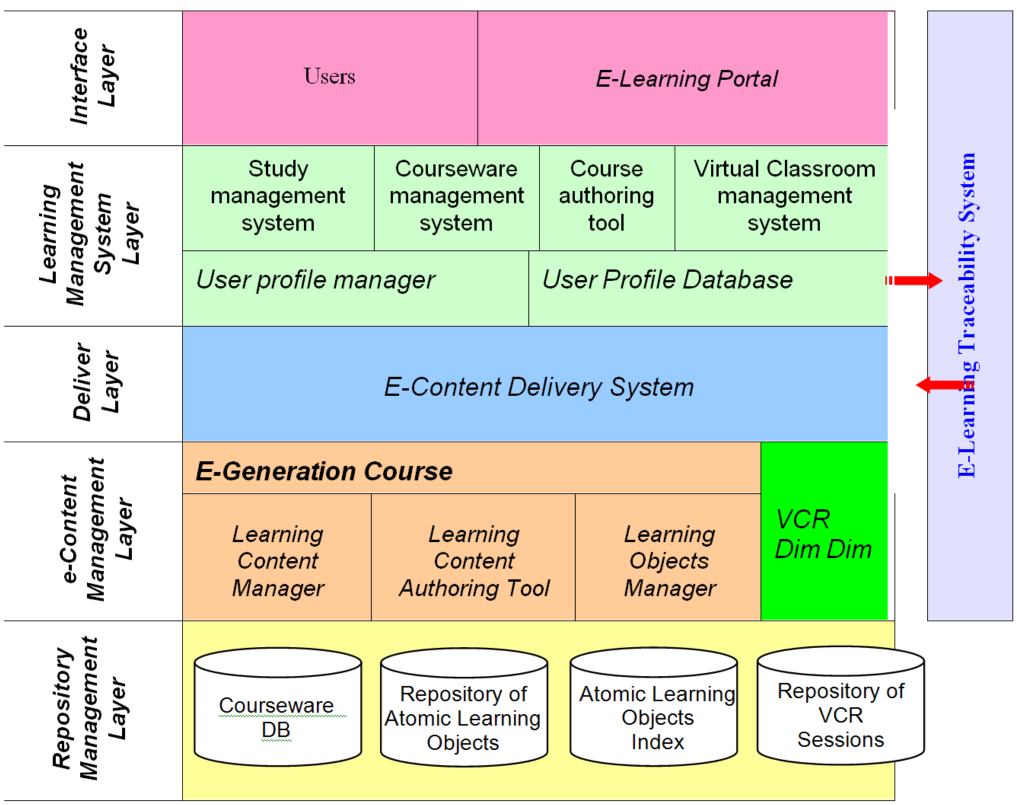

Figure 1: E-Learning Functional Model

On one hand, a main shortcoming of those systems is the re-usability and that they do not support all the required functionalities in a learning process. On the other hand, they are not flexible enough to support different pedagogical approaches and they require extensive redesign effort in order to be used in different domains [14]. Our aim in this paper is to propose a system that covers part of these shortages. The architecture of the developed system is divided into a learning system and an E-learning Traceability System [16] as shown in Figure 1. The learning system is itself structured into five layers. The proposed architecture makes the functional responsibility more clear and tries to cover all the e-learning function components. We also define the learning objects exchanges protocol between each entity, which is related to current existed learning standards. Figure 1 below shows the functional model. The design of the e-learning platform depends on the needs of the different kinds of users [16]. This architecture was enhanced by the development of an e-traceability system (ETS) [15]. The ETS gives relevant information concerning the standards of design and development, program delivery and provides a relatively easy approach for the evaluation of the richness of e-learning resources and interactions. Using the ETS, we can evaluate the full course cycle from course design to course validation including authors, tutors and students' participations.

In the following section, we describe the proposed e-generation course component as a service layer based on the Repository Management layer. The e-generation course offers a set of tools to manage atomic learning objects, courses and any related teaching materials.

The e-generation course observes the full life cycle of a development course from initially creating the content to delivering it to end-users. It provides the following components:

- Repository Management Component;
- E-content Management Component.

E-Generation Course

Repository Management Component

In a previous work [16], we showed that part of our architecture is a repository management component. The latter includes learning contents. These contents are arranged into a Repository of re-usable Atomic Learning Objects, Atomic Learning Objects Index (ALOI), Courseware Repository and Repository of Virtual Class Room Sessions.

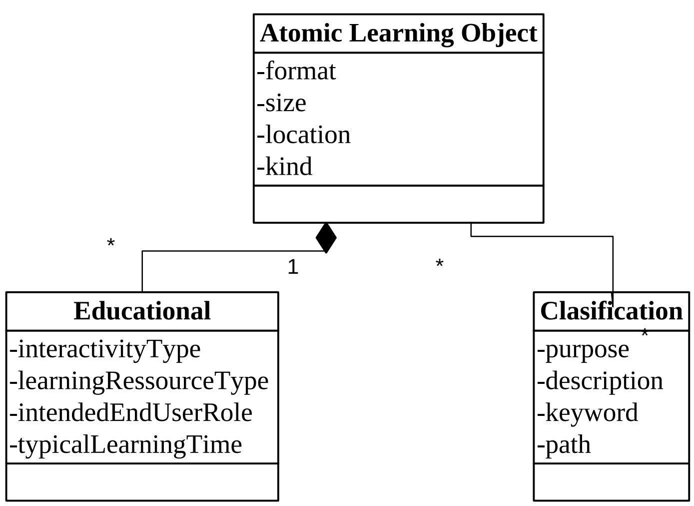

Figure 2: ALO UML class diagram.

Repository of Atomic Learning Objects (ALO): We define an ALO based on [7]. An ALO may contain ALOs used in various stages of an e-learning objective. An ALO may be defined as a single idea about a specific topic, and can be displayed in one web page. It can be a short text, an image, an exercise, a video, an audio …etc. and can be equivalent to a one hour lecture in a traditional learning class. Figure 2 shows the UML class diagram of the ALO. The Educational Class groups the educational and pedagogic characteristics of the ALO and the Classification Classes describes this learning object in relation to a particular classification system [7].

Atomic Learning Objects Index (ALOI): Nowadays, the most successful techniques for medium size databases combine online and indexed searching. The ALOI is a word-oriented mechanism for indexing an ALO in order to speed up the search task when we want to define an e-learning objective or to reuse ALO. The ALOI structure is composed of two elements: the vocabulary and the reference. The vocabulary is the set of main words that describe the learning object and each reference refers to an e-learning object.

Courseware Database: The Courseware Database is divided into three levels. The first level contains a set of domains. Each domain represents a set of courses and it is related to a graph of precedence that describes the order of each course's prerequisites. The second level contains plans of the Global Objectives of courses and General Objectives they consist of. The third level contains the Learning Objectives. Each learning Objective is organized in an AND/OR directed acyclic graph with the various nodes connected by arcs representing whether one is preliminary to another. Each node represents a reference to an ALO. Figure 3 shows the structure of the courseware database.

E-content Management Component

This component offers services that allow managing the contents. This component focuses particularly in the creation, the import and the export of the related object from/to the Repository Management layer.

a. ***Learning Content Manager:*** The Learning Content Manager offers a set of tools that allows managing courses, lessons and teaching materials. Once a course is built, the Learning Content Manager retrieves the related teaching materials and structures the ALOs into Learning Objectives according to the profile, the pedagogical purpose and the authoring process. The pedagogy and the authoring process mirror the activities of the teachers to conduct the courses in a heterogeneous environment and a collaborative and synchronous situation (context). The content is structured on the basis of the concept of the Learning Objective. As stated above, this latter is defined as a set of ALO that can be evaluated according to some performance goals to develop coherent information structures that help build knowledge schemata that are in the learner's mind.

   The Learning Content Manager component allows previewing and publishing courses to the students via the E-content Delivery System. Governed by objectives, the content authoring tool creates the process of e-content structure, is. The author has to be aware of the required objectives and the information of relevance to the learner in each step of the course creation from the analysis to the evaluation step.

b. ***Learning Content Authoring Tool:*** At the beginning, the author lays down the Global objective (GO) of the course that leads to a degree qualification or a certification. The GO is the highest stratum. Next, the course is built up of a list of Learning OBjectives (LOBj). Each LOBj may concern a lesson, a chapter, a theme, a specific knowledge etc.. Using the list of LOBj, the author will create the course plan. Next, the author examines each LOBj, where he has to keep in mind the specific knowledge that will contribute to attain either a more general LOBj or its related GO. The specific knowledge constitutes a learning objective which encompasses several Atomic Learning Objectives. A Learning Objective is organized in an AND/OR directed acyclic graph with the various nodes connected by arcs representing whether one depends on the other. Each node refers to an ALO in the Repository of Atomic Learning Objects. Each node has associated with it a weight.

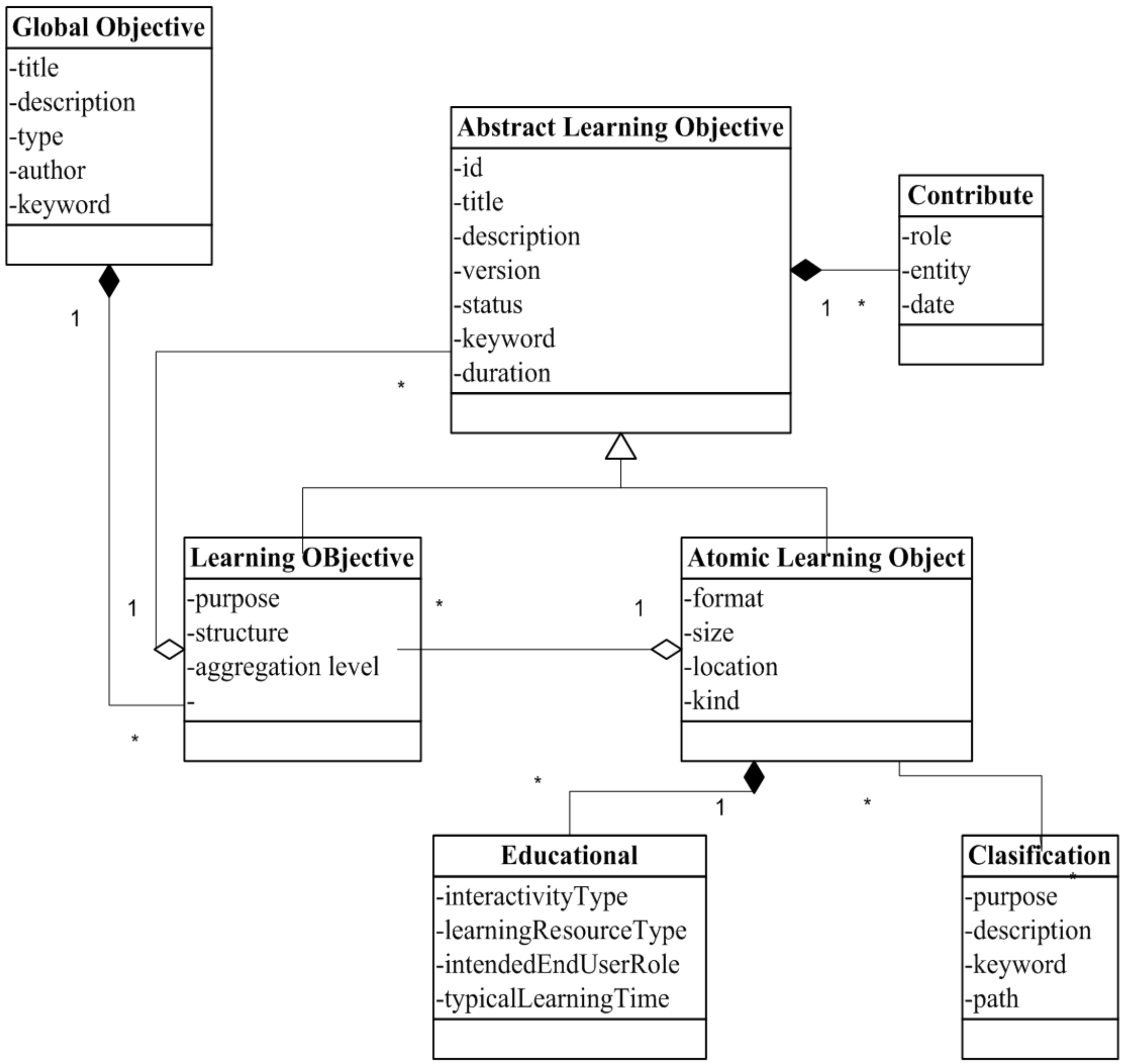

Figure 3: UML class diagram of an e-content

c. ***Learning Objects Manager:*** The overview of the meta-model is presented in figure 3. The learning objects manager allows authors to create and modify learning content objects. It allows authors to locate existing contents to reuse or to repurpose them rather than recreate them. This makes possible the use of the atomic learning object repositories allowing developing, indexing, finding, and reusing atomic learning objects. The learning content authoring tools is intended to help instructors developing multimedia-based e-contents using OCATLO [16] among other editors and focusing on creating an interactive content using various rich media.

Conclusion

We presented in this paper the design of a course e-generation system. The system generates a sequence of atomic learning objects based on objectives. The course e-generation system focuses on content creation by proposing a clear e-content development methodology that reflects the modularization in the educational systems. It also provides an automation of the authoring activities based on a specific organization and structure of the content repository. One of the main issues that we intend to study is: How accurate the result is in terms of the coherence between the different Atomic Learning Objects in a Learning Objective, and between the Learning Objectives themselves within a generated course.

References

[1] Ahmad, H., Udin, Z.M., Yusoff, R.Z., “Integrated process design for e-learning: a case study”, The Sixth International Conference on Computer Supported Cooperative Work in Design, 2001, pp. 488-491.

[2] ALFANET. http://rtd.softwareag.es/alfanet.

[3] Anna T. and Marco R., “A General Architecture for M-learning”, Journal of Digital Contents, 2003, Vol. 2, pp. 31-36.

[4] Ambjörn N., Nilsson M., Palmér M., Paulsson F., “Contributions to a public e-learning platform: infrastructure; architecture; frameworks; tools”, Int. J. Learning Technology, 2005, vol. 1, n. 3.

[5] Blackboard - Educate. Innovate. Everywhere. http://www.blackboard.com.

[6] Gerhard, J., Mayr, P., “Competing in the elearning environment-strategies for universities”, Proceedings of the 35th Annual Hawaii International Conference on System Sciences, 2002, pp. 3270-3279.

[7] IEEE 1484.12.1-2002, “Draft Standard for Learning Object Metadata”, Sponsored by the Learning Technology Standards Committee of the IEEE].

[8] Jeff Harris, An Introduction to Authoring Tools, March 2002 edition of ASTD's Learning Circuits online magazine.

[9] CHORFI H., Jemni M., “Evaluation and perspectives of an innovative Tunisian e-learning experimentation”. International Conference Advances in Infrastructure for e-Business, e-Education, e-Science, and e-Medicine on the Internet, L'Aquila, 2002, Italy.

[10] Koper, R. Learning Design. A handbook on modelling and delivering networked education and training. In Koper & Tattersall (Eds). Berlin: Springer, 2005.

[11] Moodle - A Free, Open Source Course Management System for Online Learning. http://www.moodle.org.

[12] Noble, D. “E-learning Application Infrastructure,” “Fool’s gold: Digital diploma mills, Part V”, 2001, http://communication.ucsd.edu/ Sun Microsystems . White paper of Sun Microsystems, 2002.

[13] Peter Van Rosmalen P., Vogten H., Van Es R., Passier H., Poelmans P**.**, “Authoring a full life cycle model in standards-based, adaptive e-learning”, Authoring a full life cycle model in standards-based, adaptive e-learning. Educational Technology & Society, 2006, vol. 9 n.1, pp.72-83.

[14] Pythagoras K. and Demetrios S. “A flexible authoring tool supporting learning activities” In Proc. Of IADIS International Conference on Cognition and Exploratory Learning in Digital Age (CELDA 2004), Lisbon, Portugal, pp. 51-58.

[15] Hammami S., “Evaluating E-Learning Systems Using E-Traceability Systems”, journal of Computer Science, 2010, vol. 6, n. 2, pp. 210-216.

[16] Hammami S., Mathkour H., “The Implementation and Evaluation of an Online Course Authoring Tool”, Journal of Theoretical and Applied Information Technology, 2008, vol. 4, n. 9, pp. 780-788.

[17] Santos, O. C., Boticario, J. G., & Barrera, C. “A Machine Learning Multi-Agent architecture to provide adaptation in a standard-based Learning Management System”, 8th WSEAS International Conference on Computers, 2004, Athens, Greece. pp. 468-473

[18] Sharable Content Object Reference Model. http://www.scorm.com.

[19] WebCT.com. http://www.webct.com.

[20] Xiaofei L. , El Saddik A., and Georganas N.D., "An implementable architecture of an e-learning system”, presented at Electrical and Computer Engineering, 2003. IEEE CCECE 2003. Canadian Conference on, Montreal, Canada, 2003, pp.717-720.

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Editor's Note: If you cannot see the forest for the tress, it is time to take a broader view and reassess. This study tracks changes in educational philosophy and training programs in Taiwan for the past 20 years.

The Trend Analysis of Long-term Changes for Technology Education Researches in Taiwan

Jia-Rong Wen, Sheng-Huang Kuo
Taiwan

Abstract

The Taiwan technology education started in the Chin dynasty. The educational goal changed from vocational exploring to industrial culture reorganization as well as teaching technology literacy to students. Imitating the United Stated of America, Taiwan's technology education emphasized and cultivated labor habits, but now there are big differences between Taiwan and United States of America in implementing technology education. The purpose of this study was to explore the trend of technology education in Taiwan. This study used "Taiwan Periodical Literature" as the inspection tool, and did content analyses of the papers with "technology education" in the title. Two hundred and seventy two papers were selected from eighty journals between 1976 and 2009. Four major findings were identified. The result of this research will offer the trend of Technology Education as the result for reference in any further study.

Keywords: Content Analysis, Industrial Arts, Living Technology, Taiwan Periodical Literature, Technology Education, Technology Education Curriculum

Introduction

In keeping with social development, Taiwan had moved from labor intensive agriculture and industry to the post industry society of science and technology orientation. As Zhang (1999) said: "Technological changes play a key factor in social and economic development so that people's knowledge, attitudes and abilities about technology influence the choices for national development. Taiwan technology education started from Chin dynasty. Its educational goal changed from vocational exploring to industrial culture reorganization as well as teaching students technology literacy. Imitating the United Stated of America, Taiwan's technology education emphasized cultivating labor habits, but now there are big differences between Taiwan and United Stated of America in implementing technology education. Taiwan did not specifically set up organization of teacher education and academics for technology education in 1952, before the establishment of Taiwan Normal University (now known as the National Taiwan Normal University) Department of Industrial Education. After the establishment of the Department of Industrial Education and the growth of Taiwan's technology education into an organized and systematic discipline, the Department of Industrial Education in the United States assisted in the development of Taiwan's industrial arts education. The Industrial Education Department has trained with professional teachers who implemented industrial arts education in the past and technology education now (Chang, 2005). Taiwan's technology education was patterned on the educational technology in the United States, however, where the current status of technology education and implementation is concerned, Taiwan is lagging behind the United States (Lin, 2003).

Since 2001, Taiwan has been engaged in curriculum reform. The Ministry of Education divided all subjects into seven major fields of study. Before the *Grade 1-9 Curriculum Reform*, technology education in grades 1-6 was integrated into "Arts and Crafts" and was typically taught by art teachers. Even with the latest reform, the program lacks competent teachers to teach it, and the credit hours of the technology education program have been almost cut in half. Technology teachers are finding it more and more difficult to allocate time to technology education because "Science and Technology" is often dominated by science educators (Fang, Teng & Chen, 2007). Technology education began to take root in Taiwan, but did not thrive. After the implementation of *Grade 1-9 Curriculum Reform*, the status of technology education was questionable in Taiwan: (a) ineffective in education reform, (b) the qualities of teacher education were uneven, and (c) equipment was not complete and could not be sustained (Chiang, Weng, & Lo, 2008).

According to Shavelson and Towne (2002), the advances in scientific knowledge are achieved through long term scholarly efforts of the scientific community to create new understanding in the form of models or theories that can be empirically tested. Accumulation of scientific knowledge over time is non-linear and indirect, and often involves highly contested or controversial results that undergo professional scrutiny, skepticism, and criticism. Through this process research results are questioned, studies are replicated, and results confirmed or rejected and, therefore, multiple studies using multiple methods in varying contexts are needed to establish a verifiable base of understanding (Johnson & Daugherty, 2008). Moreover, the U.S. Department of Education (2007) published the *Report of the Academic Competitiveness Council.* This report addresses concerns within the science, technology, engineering, and mathematics (STEM) disciplines that focus largely on research methods (Johnson & Daugherty, 2008). For the above reasons, the purpose of this study was to explore the trend of technology education in Taiwan. This study used "Taiwan Periodical Literature" from 1976 to 2009 as the inspection tool, content analyzing the papers that were titled with "technology education". The following questions were explored to accomplish this purpose.

1. What types of research have been used in technology education in Taiwan?
2. What research methods have been most commonly used in technology education research in Taiwan?
3. What types of population groups were represented in technology education research in Taiwan?
4. What types of data were collected in technology education in Taiwan?
5. What types of research focus have been conducted in technology education in Taiwan?

Technology education

The National Research Council (NRC) released "The Advancing Scientific Research in Education" (Towne, Wise, & Winters, 2005) This publication brought widespread attention to the quality of educational research (Johnson & Daugherty, 2008). Technology education is one kind of education; general education is another kind: the goal is to assist the student in understanding the technical and the technical question, the curriculum connotation is of the scientific knowledge primarily (Lee, 1999; Wang, 2007). Accordingly, to "determine the conceptual framework for technology education" the technology education's definition is: "technology education is in research, science and technology and to the individual, social and the cultural influence. Technology education's basic task is to help each person understand he or she lives in the technical society, then can offer the mental effort." (Savage & Sterry, 1990). American technology education evolution: (1)1980s Jackson's Mill Industrial Arts Curriculum Theory, (2)1990s A Conceptual Framework for Technology Education (Jackson's Mill II), (3) International Technology Education Association (ITEA) in 1995. ITEA (1995) defines science and technology as "technology is human innovation in action, it uses mathematics; the science and the technical principle solve the curriculum problems”. For curriculum development purposes the document describes technology education as being made up of four "strands": a "process" strand-Design, Make, Appraise and three "content" strands: Materials, Information and Systems.

These strands provide an overall framework for the planning, teaching and assessment of design and technology education in the compulsory years of schooling. (QSCC, 2000; Stein, McRobbie, & Ginns, 2002). Technology education could be better served if the curriculum would focus on the integration of engineering design in technology education classes which emphasize teamwork and personal ethics (Wicklein, Smith, Jr, & Kim, 2009). The current emphasis on engineering within technology education indicates a need to examine and assess the status of technology education research over the past ten years to identify strengths and areas that need to be addressed in order to guide the field into the future (Johnson & Daugherty, 2008) and Cajas (2000) synthesis technology educators opinion, that reflections provide suggestions for needed research, such as:

- 3W (what, where, when) and 1H (how) to research. It is necessary to plan around student learning of key technological ideas (concepts) and skills (processes) identified for literacy (AAAS, 1993; ITEA, 2000).
- Curriculum materials and classroom instruction.
- Common issues with researchers in science and mathematics education.
- Teachers themselves understand-or come to understand-technology.
- Determine the most efficient and cost effective ways to provide competency for technology educators.
- Educational research methods can vary greatly, case studies would be useful to create an adequate basis for later formal research.

More recently, Johnson and Daugherty (2008) conform to Shavelson and Towne's (2002) "guiding principles" of scientific inquiry, and gauge the alignment of technology education research with the current national trend toward a "gold standard" for educational research methods that surveyed 199 papers published between 1997 and 2007 in (a) the *International Journal of Technology and Design Education* (ITDE), (b) the *Journal of Industrial Teacher Education* (JITE), (c) the *Journal of Technology Studies* (JTS), and (d) the *Journal of Technology Education* (JTE). Further, this research goal was designed to determine the types of research conducted within the technology education field, including the research focus, methods, primary data sources, and data types. Below are descriptions of each category:

1. Primary research focuses including teaching, learning, curriculum, opinions-attitudes, design, problem solving, assessment-evaluation, gender-race, professional development, educational technology, and completion-retention.
2. Type of research methods including descriptive, interpretive, case study, quasi-experimental, correlation, causal comparative, Delphi, and protocol analysis.
3. Primary data sources including students, teachers, professionals, college faculty, administrators, documents, graduates, parents, and general public.
4. Primary data types including self report, perceptions, observable behaviors, test score, documents, verbal protocol, and archival data.

The development of the evolution of technology education in Taiwan

Taiwan's industrial arts/technology education is in the process of evolution, most of the development of the United States is the same. Although in existence for a short time, it is still based on the principle of American development as a reference. Strictly speaking, Taiwan's technology education curriculums in 1993, were revised in the beginning, then again after a short time and then again after five years of reform. Although the curriculum name is the same, the curriculum objectives and content are very different with a two-stage living technology. It should not be classified as the same curriculum, or else the outside world find it difficult to understand the nature of life science and technology curriculums. Even life itself is difficult to adapt to new technology, teachers and cognition (Lee, 1986). See Figure 1.

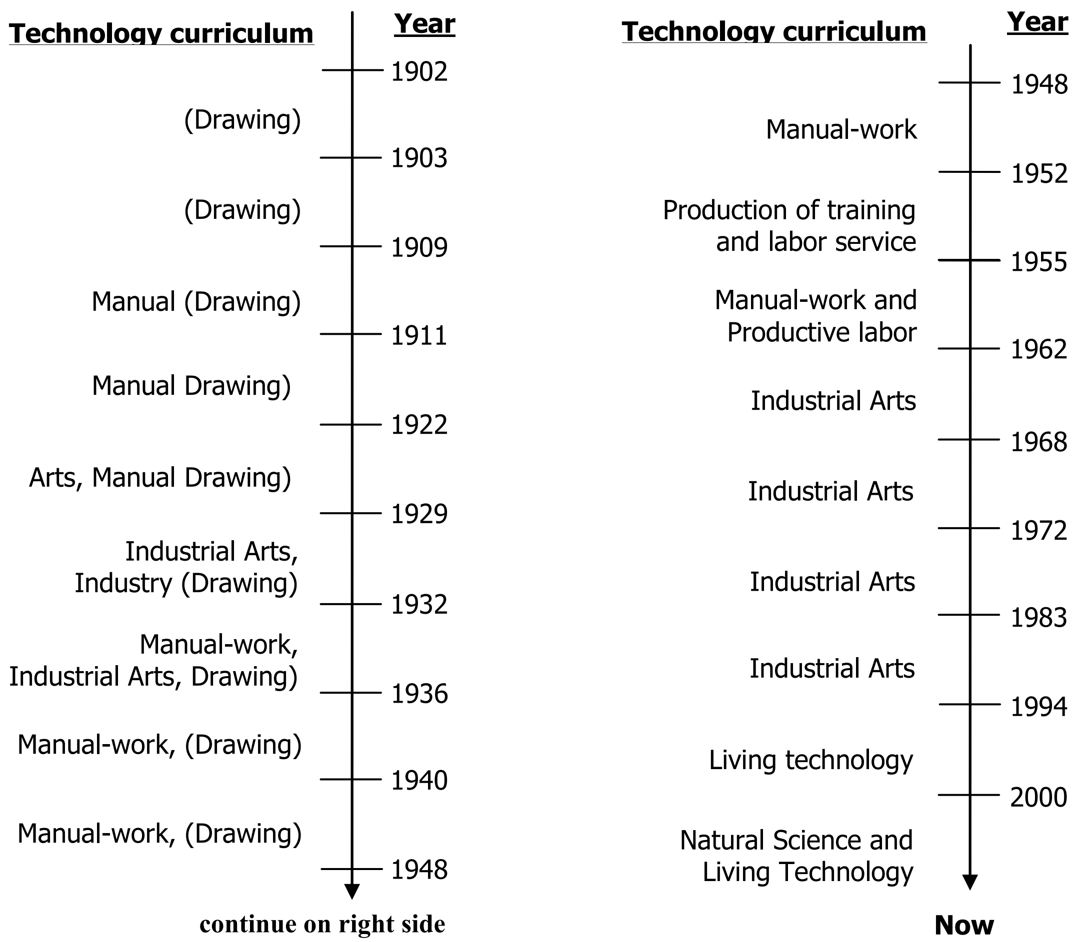

Figure 1. The evolution of technology education curriculum (Lee, 1986)

Industrial arts/technology education curriculum has evolved and, at different times, has had different objectives and curriculum content (Yu, 2005). In comparison of "process and technology", and "education" as two different concepts, (such as comparing the living technology with the nine-year old living technology), living technology curriculums can be found to have had great change in just five to six years, and therefore extend a number of related issues, such as teachers' distress and problems with adaptation, teaching materials, classroom planning, and teacher professional development. These problems must be solved immediately.

Table 1
Industrial Arts and Living Technology Curriculum Comparison (Yu, 2005)

Curriculum Comparison Project	Industrial Arts Curriculum	Living Technology Curriculum	Domain of Natural Science and Living Technology: Living Technology Curriculum

Implementation Time	Before 1995	From 1996 to 2001	After 2002
Teaching Object	Male student-centered	Male and female are grouped together and equally important	Male and female are grouped together and equally important
Knowledge Base	Life skills	Living technology systems	Natural science and living technology of integrated instruction
Teaching Objectives	Through the tools, machines and materials to use, technology literacy training	The whole concept of learning technology systems, science and technology literacy training	1. To train for interest in science, develop the habit of constant study. 2. By Learning the Science and Technology of the inquiry approach and the basic knowledge, students can apply their knowledge in current and future life. 3. To train for loving the environmental resources and have an attitude of respect for life. 4. To train for independent thinking, problem solving skills. 5. To explore the interaction between people and technology.

Table 1 for the three stages of curriculum: objectives, content, and implementation methods, a comparison can be found: the teaching goal is to follow the evolution of social changes and response measures derived from the use of skilled technical training tools, from the bottom of the inherent right to technology to realize the conservation of culture, the last to develop and adapt to society as the goal of fostering the capacity-building approach to target the needs of today's social scientific and technological personnel, but also significant considerations tend to solve problems, curriculum change and social development of technological process to each other.

Taiwan Periodical Literature System

The computerization periodical was borrowed from the "US Electronic Information Exchange System" plans in 1976 (Turoff and Hiltz, 1982). The Taiwan National Library started in 1970 to distribute the paper book, "Taiwan periodical paper citation index", and, in 1998, distributed the World Wide Web (WWW) altogether to include the periodical 4,813 journals, and 2,286,495 papers in December 2009 (Taiwan Periodical Literature System, 2010). "Taiwan Periodical Literature System" is mainly offered in Chinese and foreign languages in Taiwan, published in academic journals, professional journals, journals and some journals published in Hong Kong and Macao, which contain contents that can be divided into scholastic articles and general articles, including the rigorous review by the National Science Council of the TSSCI (Taiwan Social Sciences Citation Index, i.e., Taiwan's SSCI) journals (showed in Figure 2).

Method

Sample

The samples for this research were selected from "Taiwan Periodical Literature" about "technology education" title from 1976 to 2009 in Taiwan. The totals of 272 papers were selected to this study-content analysis.

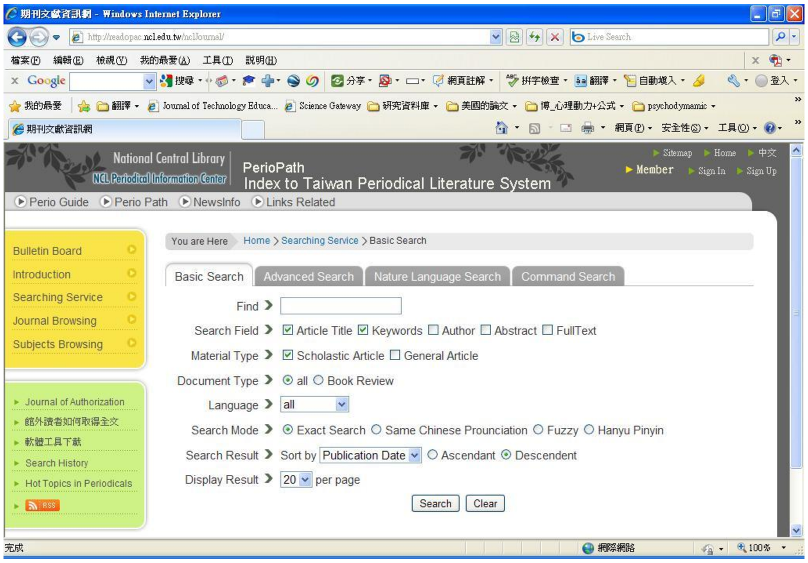

Figure 2. Taiwan Periodical Literature System

Research Procedure

1. The study was implemented through the procedures. The whole process was divided into seven phases:

1. The first step in planning the study is to define the problem.

2. Whenever new ideas appeared, the researcher discussed these with the advisor in order to understand the possibility of transforming the ideas into the research topic about "technology education".

3. The material which is collected makes the record. It also serves as a permanent record of the original study objectives and the study methods and procedures.

4. Compute for frequency and percentage of category.

5. Analysis: use content analysis.

6. Analyze and interpret the results.

7. Discussion and conclusions.

Content analysis

Content analysis is a research technique that can produce insightful and valid inferences from "naturally" occurring raw data of textual materials (Shi et al., 2006). Neuman (1997) defined content analysis as: A technique for gathering and analyzing the content of text. The "content" refers to words, meanings, pictures, symbols, ideas, themes, or any message that can be communicated. It defines the analysis units and establishes the categories, that is, the outstanding repeated elements, for analyzing the raw data (Frank, 2005). Content analysis of published articles in academic journals has been conducted in a variety of professional fields where these studies provided insightful information about overall research trends and identified important scholars and papers (Shih, Feng, & Tsai, 2008). It is primarily concerned with the study of basic concept categories, which occur in any text or document which the researcher searches for structures and patterned regularities in the text and makes inferences on the basis of these regularities (Gokhale, Deokattey, & Kumar, 2006). Content analysis including three steps: open coding, axial coding, and selective coding, it would be step by step to complete. Content analysis, a research method, is consistent with the goals and standards of survey research. In a content analysis, an attempt is made to measure all variables as they naturally or normally occur. Some types of random sampling of the units of data collection is typical, making the findings generalized compared to a larger grouping or population of messages (Holsti, 1969). Therefore, the process of coding is basically one of selective reduction, which is the central idea in content analysis (Prasad, 2009).

Data processing and analysis

This study used the "Taiwan Periodical Literature System" as inspection tool, and analyses the papers that were entitled with "technology education". Two hundred and seventy two papers were adapted from 87 journals between 1976 and 2009. The researcher uses conceptualization, as well as coding skill. 272 papers after open coding, implements axial coding, and by ITEA(1995) and Cajas(2000) proposed that suggested to the technical study and the technology education's research, discovers common and the different point, the concept changes into nine categories, such as Table 2:

Table 2
Technology education categories

Coding No.	Category name
01	Technology education concepts
02	Technology education strategy
03	Technology education development
04	Technology education review
05	Technology education problem solving
06	Foreign technology education
07	Comparison of Taiwan and foreign technology education
08	Technology education curriculum and instruction
09	Technology education for teacher education and training

Percent Agreement

This criterion is concerned with whether codes agree as to the precise values assigned to a given variable, Holsti"s method (1969): in cases in which two coders code the same units (which is the recommended method), this is equal to percent agreement. A conceptual formula for percent agreement could be written as follows:

$$PA=[2X/(Y+Z)]x100$$

PA stands for "proportion agreement, observed," X is the number of agreements between two coders, and Y and Z are the number of units coded by coders Y and Z, respectively. This statistic also ranges from .00 (no agreement) to 1.00 (perfect agreement).

Reliability

Reliability should be assessed at two points in a content analysis. A formula and Table 3 follow:

[N(PA)]/[1+(N-1)*(PA)] ……………….….n is the total number of coders*

Table 3
Reliability of content analysis on technology education

coder	coder1	coder2
coder2	0.84	----------
coder3	0.82	0.80

Average PA=(0.84+0.82+0.80)/3=0.82

Content reliability=3* 0.82 / [1+(3-1)* 0.82]=0.93

Research results

Research samples

Table 4 and Figure 3 illustrate the number of studies on "technology education" from 1976 to 2009. In the longitudinal aspect, the number of studies on "technology education" has decreased in recent years. From the quantitative data, the number of studies from 1976 to 1980 (7 papers, 2.57%), from 1981 to 1985 (5 papers, 1.84%), and from 1986 to 1990 (3 papers, 1.10%); then comes from 1991 to 1995 (95 papers, 34.93%) and from 1996 to 2000 (95 papers, 34.93%), these two groups of papers were the most, and finally, comes from 2001 to 2005 (49 papers, 18.01%) and from 2006 to 2009 (18 papers, 6.62%). Actually, from 2001 to 2005 the number of papers on "technology education" decreased about 41.08%, and from 2005 to 2009 the number of papers decreased about 63.24%.

Table 4
Papers and percentages of technology education

Years	Papers	Percentages
1976-1980	7	2.57%
1981-1985	5	1.84%
1986-1990	3	1.10%
1991-1995	95	34.93%
1996-2000	95	34.93%
2001-2005	49	18.01%
2006-2009	18	6.62%
Total papers	272	

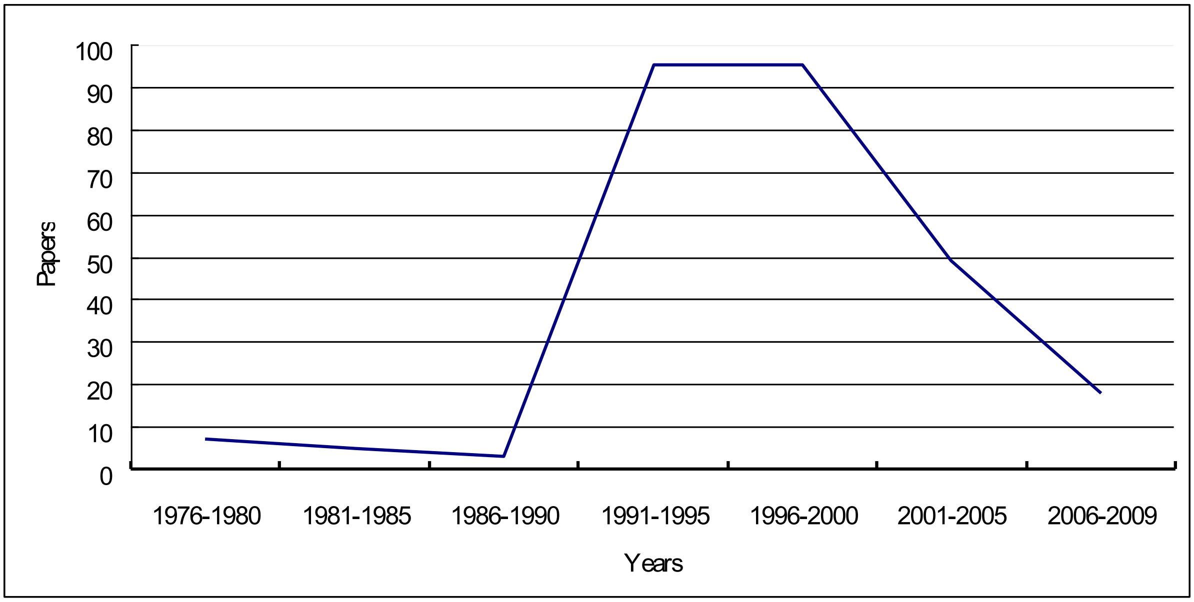

Figure 3. Papers of long-term changes for technology education researches in Taiwan

Categories of technology education

Table 5 showed the shifts of categories from 1976 to 2009. The categories "Technology education concepts" and "Foreign technology education" ranked top two, with the number of studies of 94 and 49 of the total research papers. The category, "Technology education concepts", consistently ranked top one from 1976 to 2009 with an average of 34.56% of the total research papers. This category had a descending trend within these years. The category "Foreign technology education" also ranked top two from 1976 to 2009, with an average of 18.01% of the total research papers. Otherwise, the category "Technology education for teacher education and training" consistently ranked last one from 1976 to 2009, with an average of 1.10% of the total research papers.

Table 5
Papers and percentages of categories

Ranks	Category name	Papers	Percentages
1	Technology education concepts	94	34.56%
2	Foreign technology education	49	18.01%
3	Technology education curriculum and instruction	42	15.44%
4	Technology education development	39	14.34%
5	Comparison of Taiwan and foreign technology education	23	8.46%
6	Technology education strategy	9	3.31%
7	Technology education problem solving	8	2.94%
8	Technology education review	5	1.84%
9	Technology education for teacher education and training	3	1.10%

Conclusions

This study used the "Taiwan Periodical Literature" as the inspection tool, and content analyses of the papers that were entitled "technology education". Two hundred and seventy-two papers were adapted from 87 journals between 1976 and 2009. Four findings were concluded. The result of this research will offer the trend of Technology Education as the result for the reference of further study.

1. After open coding, implements axial coding, and by ITEA(1995) and Cajas(2000) proposed that suggested to the technical study and the technology education's research, discovers common and the different point, the concept changes into nine categories.
2. The category "Technology education for teacher education and training" consistently ranked last from 1976 to 2009, with an average of 1.10% (only 3 papers) of the 272 papers.
3. From the quantitative standpoint, the numbers of studies from 1991 to 1995 and from 1996 to 2000 papers were the largest: 95 papers which equals 34.93% of the total papers. These results were consistent with 1990s Jackson's Mill II and the ITEA "technology is human innovation in action" in 1995.
4. The technology education papers decreased from 2001 to 2009 gradually: From 2001 to 2005 the technology papers decreased about 41.08%, and from 2005 to 2009 these papers decreased about 63.24%. The reason for the number decrease is that the technology education curriculum entitled, "Living Technology Curriculum" from 2001 to 2005was renamed in 2005 to "Domain of Natural Science and Living Technology: Living Technology Curriculum". Therefore, the number of researches in technology education was substantially reduced.

References

American Association for the Advancement of Science. (1993). *Benchmarks for science literacy.* New York: Oxford University Press.

Cajas, F. (2000). Technology education research: potential directions. *Journal of Technology Education,* 12(1), 75-85.

Chang, C. H. (2005). *Technology Education in Junior–high School-based Curriculum Development*. Unpublished MA Thesis. Department of Industrial Technology Education, National Taiwan Normal University.

Chiang, W. J., Weng, Y. Z., & Lo, Y. H. (2008). The reflection of technology education in Taiwan from the Finnish experience. *Living Technology Education*, 41(6), 37-48.

Druckman, D. (2002). Content analysis. In Kremenyuk, V. A. (eds). *International Negotiation: Analysis, Approaches, Issues (2nd ed.)*, 288-312. San Francisco: Jossey-Bass

Fang, R. J., Teng, C. C., & Chen, C. C. (2007). How Taiwanese and Americans Think About Technology. *Journal of Technology Education*, 18(2), 7-23.

Frank, M. (2005). A Systems Approach for Developing Technological Literacy. *Journal of Technology Education*, 17(1), 19-34.

Gokhale, P. A., Deokattey, S., & Kumar, S. (2006).Accelerator driven systems (ADS) for energy production and waste transmutation: International trends in R&D. *Progress in Nuclear Energy*, 48(2), 91-102.

Holsti, O.R.(1969). *Content analysis for the Social Sciences and Humanities*. Reading, Mass.

International Technology Education Association. (1995). *What is technology education?*. Retrieved Dec 2, 2009, from the World Wide Web: http://www.iteaconnect.org/AboutITEA/about.htm

International Technology Education Association. (2000). *Standards for technological literacy: Content for the study of technology*. Reston, VA: Author.

Johnson, S. D. & Daugherty, J. (2008). Quality and Characteristics of Recent Research in Technology Education. *Journal of Technology Education*, 20(1), 16-31.

Lee, L.S. (1999). The Grade 1-9 curriculum,teaching,review of science and technology domain. *Journal of Living Technology Education*, 32(5). 2-6.

Lee, L-S. S. (1986). Development of industrial arts curriculum for junior high school in Taiwan. Industrial Arts Education, 19(5), 2-10.

Lin, K. Y. (2003). United States and Taiwan's technology education paragon comparisons. *Living Technology Education*, 36(6), 18-27.

Ministry of Education in Taiwan [MOET] (2000). *The Ministry of Education 1999 Progress Report. Implementation of Guidelines for a 9-Year Joint Curricula Plan for Elementary and Junior High Schools*, Mar 1, 2010. Retrieved from http://english.chna.edu.tw/ct.asp?xItem=7042&ctNode=784&mp=11.

National Research Council [NRC]. (2002). *Investigating the influence of standards: A framework for research in mathematics, science, and technology education*. Committee on understanding the influence of standards on K-12 science, mathematics, and technology education. Washington DC: National Academies Press.

Neuman, W. (1997). *Social research methods: qualitative and quantitative approaches*. Needham Heights, MA: Allyn & Bacon.

Prasad, D. (2009). Empirical Study of Teaching Presence and Critical Thinking in Asynchronous Discussion Forums. *International Journal of Instructional Technology and Distance Learning*, 6(11), 3-26.

Queensland School Curriculum Council (QSCC). (2000). *Technology: Years 1–10 syllabus-in-development pilot draft*. Terms 1 to 3, 2000. Brisbane: The State of Queensland.

Savage, E., & Sterry, L (1990). A conceptual framework for technology education. *The Technology Teacher*, 50 (1), 6-11.

Shavelson, R. J., & Towne, L. (Eds.). (2002). *Scientific research in education*. Committee on Scientific Principles for Education Research, National Research Council. Washington, DC: National Academies Press.

Shi, S., Mishra, P., Bonk, C. J., Tan, S., & Zhao, Y. (2006). Thread Theory: A Framework Applied to Content Analysis of Synchronous Computer Mediated Communication Data. *International Journal of Instructional Technology and Distance Learning*, 3(3), 17-38.

Shih, M., Feng, J., & Tsai C. C. (2008). Research and trends in the field of e-learning from 2001 to 2005: A content analysis of cognitive studies in selected journals. *Computers & Education*, 51(2), 955-967.

Stein, S. J., McRobbie, C. J., & Ginns, I. S. (2002). Implications of missed opportunities for learning and assessment in design and technology education. *Teaching and Teacher Education*, 18(1), 35-49.

Taiwan Periodical Literature (2009). *Taiwan periodical paper citation index.* Retrieved Dec 2, 2009, from the World Wide Web: http://fx.hyweb.com.tw/cgi-bin/ncl3web/hypage51?HYPAGE=Home.txt

Taiwan Periodical Literature System (2010). *National Central Library Periodical Information Center*. Retrieved Feb 12, 2010. from http://readopac.ncl.edu.tw/nclJournal/

Towne, L., Wise, L. L., & Winters, T. M. (Eds.). (2005). *Advancing scientific research in education*. Committee on Research in Education, National Research Council. Washington, DC: National Academies Press.

Turoff, Murray and Hiltz, Starr Roxanne.(1982). The Electronic Journal: A progress Report. *Journal of the American Society for Information Science*, Vol. 33, pp.195-202.

U.S. Department of Education. (2007). *Report of the Academic Competitiveness Council*. Washington, DC: Author.

WANG, D.M. (2007). The elementary school science and technology educates the creation thinking curriculum design. *Journal of Living Technology Education*, 40(2). 11-17.

Warner, S.A. (2003). Teaching design: Taking the first steps. *The Technology Teacher*, 62(4), 7-10.

Wicklein, R., Smith, P. C., Jr., & Kim, S. J. (2009). Essential Concepts of Engineering Design Curriculum in Secondary Technology Education. *Journal of Technology Education*, 20(2), 65-80.

Yu, C. (2005). *Study on the development of industrial arts education in Taiwan*. Taipei: Chuan Hwa Book CO., LTD.

Zhang, Y. H. (1999). The survey of teachers college students" technological attitude - Take national Hualien Teachers College as an example. *NHLTC Magazine*, 8, 297-31.

Zuga, K.F. (1989). Relating technology education goals to curriculum planning. *Journal of Technology Education*, 1(1), 34-58.

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Editor's Note: Peer assessment has been used to increase student autonomy and promote active learning. It has positive results when used as a collaborative process, especially for team assignments. This study looks at pros and cons of various approaches to make it's research findings.

The Implementation and Evaluation of a Peer Assessment Based Online Course

Harun YILMAZ
Turkey

Abstract

This paper focuses on the role of the peer assessment in an asynchronous course in higher education. The course was designed for adult learners who have a job which is mostly teaching-related in the K-12 setting and pursue their master's degree in education. In this course, the students were exposed to the instructional planning skills and knowledge to develop educational courses and materials. The paper addresses the different aspects of peer assessment in this particular setting where the author, as a facilitator, had to create and maintain an environment in which students were expected to work effectively to accomplish tasks, interact with each other, share their knowledge so that promote peer learning, provide reflections related to their learning and their team's work, and also they were required to meet the attendance and participation requirement. The study indicates that use of collaborative assignments and peer assessment not only facilitates student learning of course content and group work dynamics including communication, interaction, timing, diversity, leadership, conflict management, and a common goal, but also helps students develop lifelong learning skills to assess others and improve their own work based on peers' feedback.

Keywords: peer assessment, e-learning, adult learning, online course, asynchronous learning environment, self assessment, collaborative learning, team work, higher education, online student reflections, instructional design.

Introduction

Peer assessment in an online environment has become one of the most popular methods to make students active in their learning process, as well as playing a role in their work assessment (Boud & Falchikov, 2007; Davies, 2006). In peer assessment, students are required to assess the rest of group members (McLuckie & Topping, 2004). While students are encouraged in giving feedback on peers' work, they are realized the strengths and weaknesses of their work during the peer assessment process. Thus, they have chance to make their work better and facilitate their learning (Van Den Berg, 2006). In addition, by peer assessment, students are encouraged to engage in learning activities in class rather than assignment products or grades (Chen, 2010).

Peer assessment is considered as an innovative method to enhance learning by giving students some autonomy to provide feedback on each other's work, as well as their work in the assessment process and to promote learning by involving students more in their learning process (McDowell & Mowl, 1996). According to Topping (1996) there are several advantages of peer assessment including that it helps students to develop evaluating and justifying skills, and to utilize content knowledge in order to conduct peer assessment. Also, in such an environment in which peer assessment being conducted, students are expected to share and discuss what they know with each other, help peers regarding assignments, and students gain insight.

Although peer assessment has many benefits, there are some drawbacks that need to be considered to enhance learning. Especially the reliability and validity issues need to be taken into account to make students feel that they have been assessed by peers accurately and assessment is valuable for them (Grieves, McMillan, & Wilding, 2006). Elliot and Higgins (2005) argue that accuracy of peer assessment is problematic, while Topping (1998) and Sahin (2008) found that there is high correlation between peer assessment scores and lecturer scores. In order to minimize the reliability and validity problems in peer assessment, Sluijsmans (2006) suggested providing students criteria explicitly defined for their use during peer assessment. Since criteria are used to correspond with students to create a common understanding, the success of peer assessment mostly depends on how much students use criteria in the peer assessment process.

In addition to peer assessment, using collaboratively designed assessments increases students' motivation and satisfaction level; therefore, learning from collaborative group projects or assignments is facilitated more in an online environment (Fisher, Phelps, & Ellis, 2000). Since students interact with each other to complete their own tasks and accomplish a common goal which is submission of a group project to instructor on time in such an asynchronous environment, students become more active in their learning process. In this process, students not only learn to work with peers to, but also they overcome some group related challenges including being on time, giving feedback, and achieving tasks. Thus, students have some group experiences which can be used in their work and learn the course content as well in a collaborative learning environment (Murphy, Mahoney, & Harvell, 2000).

The Case

The course was aimed to provide students with the instructional planning skills which they are required to use when developing educational courses and related materials. The 14 participant students were distance students who were mostly teachers in the K-12 settings and pursue a master's degree in education. They were grouped into three teams by the author and for the team formation, geographical regions and time zones were considered. Each team was specifically assigned to the Team Room in which they were required to interact online on a regular basis to complete their team assignments and evaluate their individual assignments and provide feedback to each other. Also, students were encouraged to coordinate their work without the use of teleconferencing or instant messaging, since this was an asynchronous learning environment. In addition, it was announced that amongst the team members, tasks should be allocated and every student should be able to do their tasks on their own time, and post questions and discussions on this coordination in their team room. In order for the team members to post their discussions in the team room was important because the participation of students was accounted for grade based on these posts.

The students were required to post their thoughts and reflections related to the facilitator's questions and students' responses to the Main Room individually. In this room, students were expected to participate in the discussions with minimal submissions and all communications are in the form of text-based.

Several assignments in the class were completed by teams of four to five students. After each team assignment, students were asked to complete a peer evaluation form to assess the contributions of each member of team. These forms were taken into account when assessing individual contributions to the team assignments. Each student was required to complete a project individually and this project was broken into four parts. In relation to each part, students were required to submit their partial assignment to the Team Room where team members were expected to assess the assignment and provide feedback. Based on the feedback, each team member was expected to revise his/her assignment.

Also, students were required to submit a paper summarizing what they learned by evaluating other students' assignments. In addition to performance of the assignments, students were evaluated for the quality of their participation in the Main Room in which most interactions and knowledge transmissions took place, as well as in the Team Room in which team related activities and interactions took place.

The third room was a Chat Room in which students interact with each other to meet and share their biography with others. This room is used for social activities such as personal introduction and sharing course related web links or resources.

Methodological Approach

In this paper, both a qualitative and quantitative case study approach (Erickson, 1998) was presented. In order to understand what the peer assessment role is for student learning in the online environment, students' contributions in the course rooms are presented and analyzed.

Berge's four dimensions of online instructor roles (1995) were used to analyze the data. In the same way, Ashton and her friends (1999) suggested the 'four hats' of the instructor model consisting of four dimensions consisting of pedagogical, social, managerial, and technical. In order to understand the role of instructor in the online environment, these dimensions are helpful. The first dimension, pedagogical, gives instructors a facilitator role requiring asking questions to students for critical thinking and making students focus on course content. The second dimension is a social role that is required to create a warm and social environment in which students interact with each other to promote learning via collaboration. The third is a managerial role, involving developing assignments and setting deadline for each assignment and online activities. The last role of instructor is a technical role which helps students use online environment without any technical problem, lets technology be transparent in students' online learning process.

Implementation

In this case, the instructor is responsible for developing a course syllabus that includes a course description, objectives, assignments and their points, course policies, information about attendance and participation, instructor's contact information including name, title, email, phone, and available times. In addition, course syllabus provides some information about team assignments and contact information for technical problems. The instructor is also responsible for creating a learning environment in which students feel comfortable to interact with peers and instructor. When a course is electronically open to students, the instructor submits a welcome message to everybody and his biography to the Chat Room. He also asks students to introduce themselves to the class. When each student submits his or her bio, he submits a follow up message and asks some questions so that students quickly become accustomed to the class environment.

After the class meets each other, the instructor assigns students to teams including four or five students considering their geographical regions and time zones then he gives some directions about how they work together in their group room. Once teams are formed, he submits some questions to the Main Room. All students are required to answer these questions and these answers should be supported by course readings. The instructor gives some feedback on students' answers and asks some triggering questions to enable students to understand course content well and have students use critical thinking skills. If needed, the instructor refers the course readings for question answers.

Being on time in assignment submissions is important and if students submit their individual and group assignments late, their points are cut based on how many days they are late. This penalty policy is written on the course syllabus and also it is submitted to the Main Room as a message so that all students have more chance to read.

Quantitative Analysis

The participation level of 14 students was different in the asynchronous classroom. Although the teams were formed based on geographical regions and time zones, some teams seemed to be more active than others. In Table 1 the number of students' message submissions to the groups is given. According to the table, the instructor participation level is higher than % 65 of the students. Also, his participation is higher than the average of the student participation in the Chat Room. Since the instructor only observes the Team Room and participation of students in this group, there is no message submitted to the Team Rooms. Instead, he sent general warning messages to the Main Room to draw attention.

Table 1
The number of students' message submissions

		Main Room	Team Room	Chat Room
Team A	Student #1	129	32	37
	Student #2	99	26	16
	Student #3	215	26	22
	Student #4	86	39	15
Team B	Student #5	79	50	21
	Student #6	53	56	22
	Student #7	49	28	10
	Student #8	48	30	4
	Student #9	60	28	4
Team C	Student #10	70	8	8
	Student #11	51	4	1
	Student #12	95	19	16
	Student #13	151	13	18
	Student #14	59	8	15
Instructor		87		17

In addition to the Table 1, to demonstrate the level of team participation in class groups, Table 2 is given. It seems that Team A produced the highest rank in the Main Room even though they had four members. On the other hand, Team C had the lowest rank in the Team Room and the Chat Room. It is interesting to see that while Team B had the lowest rank in the Main Room, they generated the highest rank in the Team Room.

Table 2
The team ranks

	Team	N	Mean Rank
Main Room	A	4	11.50
	B	5	4.20
	C	5	7.60
	Total	14	
Team Room	A	4	9.00
	B	5	10.80
	C	5	3.00
	Total	14	
Chat Room	A	4	10.38
	B	5	6.70
	C	5	6.00
	Total	14	

Differences between team ranks in the three different rooms are tested by using Kruskal-Wallis H test (Siegel & Castellan, 1988). According to results represented in Table 3, there is a significant difference in the Main Room submissions ($Chi^2_{2,14}$; $p<0.05$). Also, the Team A members submitted more messages than other team members. While in the Team Room, there is a significant difference ($Chi^2_{2,14}$; $p<0.05$), there is no significant difference in the Chat Room ($Chi^2_{2,14}$; $p=0.25$).

Table 3
The comparisons of team ranks

	Main Room	Team Room	Chat Room
Chi-Square	6.77	9.47	2.74
df	2	2	2
Asymp. Sig.	0.034	0.009	0.254

After weekly team assignments, students were asked to submit their evaluations on team members' performance. When students were evaluating the peers' performance, they considered six items including preparation, presence, contribution, timeliness, interpersonal relations, and feedback. For each item, a 4-point Likert type scale (1: Strongly disagree, 2: Disagree, 3: Agree, and 4: Strongly agree) was used to evaluate a student performance. The average of Team A Peer Evaluation is 3.958333, the average of Team B Peer Evaluation is 3.8, and the average of Team C Peer Evaluation is 3.986667. It is interesting to have these results. Although Team C had the lowest mean rank which is 3.00, they had the highest average peer evaluation result which is

3.958333. On the other hand, while Team B produced the highest mean rank, 10.80, the same team had the lowest average peer evaluation result which is 3.8.

Qualitative Analysis

Students were required to submit their individual assignments to their team for review. Based on peer reviews, they were supposed to make some improvements in their assignments before submitting them to the course instructor for grade. 14 students were asked to submit their peer evaluations regarding the most important concepts that they learned from the peer review process. Time was revealed as one of the most important concepts from these evaluations. This concept becomes very important when students work for their team assignment from different regions and time zones. One student summarized this view:

> *I have really learned that time is of the essence. It is better to complete your work early allowing time for changes and or peer review. Also, it is amazing how we are all working in different parts of the country, yet we are completing thorough, cohesive assignments through collaboration.*

Another student confirmed this opinion: "Everyone finishing their parts on time so the whole assignment can be reviewed before the assignment is due".

The second most important concept that emerged in the peer evaluations was importance of feedback. A majority of students stated giving and receiving feedback was crucial for the success of collaborative team work, even though some students may not be willing to share what they know with others. As one student explained:

> *We are all willing to see others view point and be willing to put ourselves into their classroom situations. I sometimes think we all take pride in our work and it is very hard to put a lot of effort into something and then have it changed.*

The same student also added: "I learned that feedback is so key into really understanding items that can confusing". On the other hand, one student put a negative side of giving feedback into consideration: "It is uncomfortable to point out mistakes in other people's work but my group members seemed to take it in stride". Benefits of feedback were expressed by students as "it is helpful to assist the writer in fixing his or her paper", "reviewing others work helps you to review your own work with a more critical eye", and "it assists everyone in writing a clear, precise paper".

During the peer evaluation process, students stated that they learned why a team requires understanding and commitment, the power of leadership, organization, and communication. One student explained how communication plays an important role in a team: "Sharing information about your personal life helps to establish the lines of communication and I believe that my team members feel confident in each other and his/her abilities. Everyone has really "stepped up" to the plate". Since team work requires different people in terms of gender, age, and culture to work together, a team work becomes a melting pot for these people. It was interesting to have one student stated: "Patience is a very important concept to keep in mind when working with a group. As we are all busy individuals, coming together as a group can be difficult due to individual time constraints".

In addition to concepts that students learned from the peer review process, students were also asked to reflect how they will use this learning in their future team work. A majority of students stated that time management at the online environment and for the peer review process was important. One student reflected this issue: "I must be apt to getting my work done in a more timely fashion rather than waiting a day or two before its due. I plan to really set a schedule and space out my work so it does not affect the team's peer review of my work". Another student confirmed this student: “I plan to work on my time management so I can put my input earlier for a better discussion”.

Another learning experience that arose in the peer evaluations was being flexible while working at the asynchronous environment. One student asserted that “Hope to give my students a better understanding of why they should be flexible when working with new people”. One female student considered the peer review process as a good learning opportunity for herself and she reflected: “Working with people who have different priorities in life and different styles is helpful in any educational or work setting”.

In addition to the peer evaluation reflections, students were asked to write a paper to summarize what they learned by evaluating and reviewing other students` instructional plans. A majority of the students declared that reviewing and evaluating peers’ work enabled them to learn creating a well-documented instructional plan. In addition, they liked the process of reviewing and evaluation other’s work. One student stated: “Reviewing and evaluation other students’ instructional plans is an important tool in reflecting and evaluating my own work. By reflecting and evaluation my own instructional plan, I am able to determine the strength and weaknesses within my own instructional designs”. Another student confirmed this view: “Evaluating and reviewing other student’s instructional plans is a very valuable and enriching experience. Since each student’s plan applies the principles of instructional design to a different content area, peer review offers the opportunity to develop a deeper understanding and insight into the design process. By discovering strengths and weaknesses in each plan, reviewers are able to reevaluate their own understanding of the process and improve their own instructional plan. Although the strengths and weaknesses of the instructional plans varied based on the individual student, some commonalities became apparent”.

One student pointed a negative side of the reviewing and evaluating others’ instructional plans: “Reviewing and commenting on a peer’s work product can be difficult. Finding a balance between making suggestions for improvement and being supportive is a skill teachers employ daily with their learners in the classroom but seldom practice with their peers. Some reviewers skirted this difficult task by concentrating on mechanics rather than content”.

Discussion and Conclusion

In this paper, peer assessment and collaborative learning have been argued to implement successful online courses in which the instructor is concerned with how well students are learning new concepts and skills. Students were required to assess both their own performance and peers’ performance to learn concepts and skills and suggest necessary corrections to peers. In addition, peer assessment is the way to evaluate the collaborative team assignments and of how much and each student has contributed to the final of the team assignments. Overall, students participated more in the Main Room to give responses to the questions that were submitted by the instructor were accounted to the final class grade. However, team members who participated in less than other teams tend to give more points, when they evaluate peer performance in the team. A reason for this tendency may be that students achieved the team objective with less but constructive participation or they may have more motivation to complete team assignments (Fisher, Phelps, & Ellis, 2000) because the same team participated more in the Main Room.

It seems that a leadership role plays an important role in the online courses. In each team one or two students got involved more either in the Main Room or the Team Room and acted a leadership role in completing assignments, giving feedback, and submitting the weekly team assignments to the instructor. Therefore, the online course structure needs to encourage students to take steps in the online teams. Also, class policies, information about participation, attendance, team construction and dynamics are important to provide students beforehand that the class starts.

During the peer assessment process, to prevent reliability and validity problems, it is crucial to provide students with rubrics that communicate with students and explain what students are expected when using rubrics to evaluate team members (Grieves, McMillan, & Wilding, 2006).

The concepts of timeliness, constructive feedback, being flexible and patient, and communication have been raised in this study. A majority of the students stated that being on time is the essence of online courses so the online class implementation should consider this issue and encourages students extrinsically such as giving extra points or sending warning messages to all students. Another issue is giving feedback and interacting with class and team members via constructive messages. Students need to differentiate between class related submissions and personal submissions. In order for students to consider these differences, the online environment needs to be divided into several parts including the Main Room, the Team Room, and the Chat Room. In addition, there should be another room for the assignments that is restricted to students to see and open others' documents. Before the class starts, it is important to provide students with information about how team works and how communication occurs and what they need to do in case of team conflicts. This support can be done by providing some tutorials and readings, as well as proactively sending messages or giving some directions regarding these issues to the class by the instructor.

References

Ashton, S., T. Roberts, & L. Teles. (1999). *Investigating the role of the instructor in collaborative online environments*. Poster session presented at Computer Support For Collaborative Learning (CSCL) 1999 Conference, Stanford University, CA.

Berge, Z. (1995). Facilitating computer conferencing: Recommendations from the field. *Educational Technology, 35*, 22-30.

Boud, D., & Falchikov, N. (Eds.). (2007). *Rethinking assessment for higher education: Learning for the longer term*. London: Routledge

Chen, C.-h. (2010). The implementation and evaluation of a mobile self- and peer-assessment system. *Computers & Education, 55*, 229–236.

Davies, P. (2006). Peer assessment: Judging the quality of students' work by comments rather than marks. *Innovations in Education and Teaching International, 43* (1), 69-82.

Elliott, N. and Higgins, A. (2005) Self and peer assessment: Does it make a difference to student group work?. *Nurse Education in Practice, 5*(1), 40-48.

Erickson, F. (1998). Qualitative research methods for science education. In B. J. Fraser & K. G. Tobin (Eds.), *The international handbook of science education* (1155-1173). Dordrecht, The Netherlands: Kluwer.

Fisher, K., Phelps, R., & Ellis, A. (2000). Group processes online: Teaching collaboration through collaborative processes. *Educational Technology & Society, 3*(3), 1-16.

Grieves, J., McMillan, J. & Wilding, P. (2006). Barriers to learning: Conflicts that occur between and within organisational systems. *International Journal of Learning and Intellectual Capital*, *3*(1), 86-103.

McDowell, L., & Mowl, G. (1996). Innovative assessment: Its impact on students. In G. Gibbs (Ed.), *Improving student learning through assessment and evaluation* (131-147). Oxford: The Oxford Centre for Staff Development.

McLuckie, J. & Topping, K. J. (2004). Transferable skills for online peer learning. *Assessment & Evaluation in Higher Education, 29*(5), 563-584.

Murphy, K. L., S. E. Mahoney, & T. J. Harvell. (2000). Role of contracts in enhancing community building in web courses. *Educational Technology and Society, 3*(3), 409-421.

Sahin, S. (2008). An application of peer assessment in higher education. *The Turkish Online Journal* of *Educational Technology*, *7(*2*),* 5-10.

Siegel, S. & Castellan, N. J. (1988). *Nonparametric statistics for the behavioral sciences* (second edition). New York: McGraw-Hill.

Sluijsmans, D. (2006). A conceptual framework for integrating peer assessment in teacher education. *Studies in Educational Evaluation, 32*(1), 6-22.

Topping, K. (1998). Peer assessment between students in colleges and universities. *Review of Educational Research*, *68*, 249-276.

Van den Berg, I. (2006). Design principles and outcomes of peer assessment in Higher Education. *Studies in Higher Education, 31*(3), 341-356.

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