Using webcasts in education: Evaluation of its effectiveness

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Abstract

Educational webcasts are nowadays widely used by many organizations and institutions all over the world. However, the educational effectiveness of webcasts when used as an autonomous method is yet to be explored. In this paper, the clarification of certain issues concerning their educational effectiveness is attempted. Following specific instructions, an educational webcast was developed, and then a between group evaluation experiment was conducted. The experiment compared traditional learning and an educational webcast. A total of 66 gymnasium (middle school) students were placed in two groups based on a pretest method. The results of the evaluation showed that educational webcasts can be very effective on certain conditions. On the one hand, the educational effectiveness of the webcast was particularly high when applied to tasks that required simple comprehension. On the other hand, the webcast had poor performance in the consolidation of complex tasks.

Introduction

e-Learning has become an increasingly important part of education. Many technological tools and methods (games, quizzes, etc.) are already employed as autonomous educational means or in combined mode (Ha & Ganahl, 2007; Virvou & Katsionis, 2008) in order to meet in the best possible way the educational needs that are likely to arise, while they provide flexible learning opportunities in terms of time, cost and accessibility. However, the performance of e-learning tools in teaching is often poor and learners do not always use them in an effective way.

The usage of webcast for learning purposes demonstrates increasing trends over the last years (Thompson, 2011), while the same rapid increase is established by a large number of institutions and business organizations providing their content using webcasts. Furthermore, there are many video search engines featuring educational videos (http://www.youtube.com) while there are even specialized learning-oriented search engines for educational videos (eg, http://www.youtube.com/edu, http://www.mylearningtube.com). In addition, universities (Stanford, Oxford, MIT and some 800 other) offer lectures on iTunes and other broadcasting media. As a result, today one may take lessons on anything from math to zoology.

In the present study, an asynchronous webcast was employed. The use of asynchronous webcasts could benefit students by enhancing in their learning, especially in large classrooms. Webcasts not only provide students who have missed a lecture the opportunity to catch up, but also enable others, especially slow learners, to review difficult concepts (Tan, 2007). This forces teachers to
**Practitioner Notes**

What is already known about this topic

- Advocates of webcasting in education indicate that these technologies can improve student performance; they mention that webcasting lectures in their entirety are useful for revision, reviewing purposes and assist students to fill in learning gaps.
- Webcasts provide students the opportunity to actively engage with the material by allowing learners to directly and repeatedly access a specific section of presentations and/or control the speed to play the media file.
- Prior studies (e.g., McKinney, Dyck & Luber, 2009; Traphagan, Kucsera & Kishi, 2010) also found that students who reported using lecture webcasts as a replacement for the in-class lecture exhibited lower performance.

What this paper adds

- We focus on the effectiveness of webcast as an autonomous learning tool and find that in some cases, webcast’s performance can reach traditional learning performance.
- This research found that in simple comprehension tasks, webcasts seem to have much better performance compared with traditional learning.
- Findings indicate that in tasks where a greater degree of comprehension is required, webcast and traditional learning seem to have the same performance.
- This research found that in complex tasks that required additional comprehension and a great degree of consolidation, webcasts had very low performance and few of the students coped with the complex task.

Implications for practice and/or policy

- Asynchronous-autonomous teaching with webcasts may demonstrate good performance.
- Webcast is more efficient when it comes to light-epidermal tasks (e.g., multiple choice questions).
- For knowledge that has to be comprehended and consolidated, in order to be used in combination with other knowledge for solving complex tasks, the webcast is not recommended because its performance in this area is very poor.

record and provide their lessons and set online quizzes (e.g., http://www.teachertube.com). Recording the traditional instruction in the classroom and delivering it to the students through the Web is a reasonable and helpful operation. In our study, we developed a 15-minute educational webcast, in order to avoid problems such as student boredom because of the long duration of the didactic hour, traditional teaching interpretations and leveraging of the potential of pictures and graphics.

The main aim of this comparison is to investigate the effectiveness of autonomous webcasts. Thus, an evaluation study between an asynchronous educational webcast and the traditional way of learning was conducted, with the purpose of training students of the second grade of gymnasium in the course of Informatics and, more specifically, in “Picture Attributes” in the section of multimedia (Arapoglou, Maravoglou, Ikonomakos & Fitros, 2006). The main focus of this research is to measure the educational effectiveness of a webcast compared with traditional learning. A t-test method was used to analyze the overall results of each teaching group. Additionally, the results of each type of task were also comparatively analyzed using a t-test method.
The paper is structured as follows. In the next section, the literature review and the aim of the research are outlined. The third section presents the methodology employed in this study to test (measure) the effectiveness of the two learning methods. The fourth section presents the empirical results and deals with the emotional and social aspects of the use of webcast. Finally, the paper concludes with theoretical and practical implication, discusses the results and makes recommendations for future research.

Background

Literature review

Webcasting has emerged as one of the premier push technologies for delivering video and audio content. Many educators advocate the use of webcasts for educational purposes (Bell, 2003; Copley, 2007; Giannakos & Vlamos, 2012). Scutter, Stupans, Sawyer and King (2010) and Deal (2007) mention that webcasting lectures in their entirety are useful for note taking and for test reviewing. Van Zanten, Somogyi and Curro (2012) indicates that webcasts are used widely from students, for revision and review purposes, during exam preparation. Harris and Park (2008) argue that webcasts can also be used for several reasons, such as, knowledge dissemination, supplementing class materials, guest lecture presentations and as a marketing tool for attracting prospective customers. In point of fact, we wish to argue that webcasts provide an easy means for a potential learner to study any topic he or she desires.

Additionally, students have reported that they benefit from having the lectures available to assist their understanding and to fill in the gaps (Evans, 2008). Moreover, numerous positive responses have been recognized, related to students’ ability to control webcasts by being able to cull through the content, rewind and skip content as they desire (Dale & Pymm, 2009). Maag (2006) indicated that webcasts are useful for test reviewing and decrease anxiety before an examination. In addition, students believe (Maag, 2006) that repetitive review and the ability to scan through lecture content are useful practices. Kutz, Fenwick and Ellsworth (2007) highlight a significant increase in final project grades of their students when using webcasts. Moreover, Evans (2008) claims that students are more receptive to learning material provided in the form of a webcast than a traditional lecture or textbook and that students believe that webcasts are more effective revision tools than the typical book and than their own notes in helping them to study.

The cognitive theory of multimedia learning may provide an explanation for the possibility of webcast’s good performance. According to the theory, a learner’s system includes dual channels for visual and verbal processing and a learner constructs understanding by integrating information between these channels (Mayer, 2001, p. 41). Moreover, empirical studies (Giannakos, Chorianopoulos, Johns, Inkpen & Du, 2011) have shown that students learn and communicate better from words and pictures than from words alone. For instance, studies in webcasting covered the public sector government documents (Library Hi Tech) and marketing (Haygood, 2007). Some learning cases in secondary (Giannakos & Vlamos, 2010) and higher (Yunus et al., 2006) education argue that if webcasts are developed properly, it may demonstrate optimum performance.

Traditional classroom teaching is an emotional, social and cognitive experience where teachers use their own voice and movement and address the learners with questions and stories; humor makes the students attentive and creates a learning atmosphere (Nordkvelle, Fritze & Haugsbakk, 2009). A webcast, however, provides no opportunities for the learner to react to the teacher. Furthermore, webcasts are experienced on a computer screen as a version of the teacher’s reality, which has been filtered through several technological processes and capabilities. Therefore, personal reactions to the webcast cannot be the same as those to the traditional teaching given in the class. Additionally, with the widespread adoption of media, such as the advanced video repositories (YouTube), video systems (Chorianopoulos, Leftheriotis & Gkonela, 2011) and online webcast
communities (Khan Academy), important new research emerges from the learner acceptance, emotional and social aspects of the use of webcast perspective.

**Aim of this research**

Given the motivational advantages of educational webcasts, as well as the criticism that has been exerted upon them, this study aims to investigate advantages and limitations of the use of webcasts for educational purposes. Such an investigation may lead to useful instructions for the creation of educational webcasts and for understanding emotional and social aspects of the use of webcast. As the educational webcasts have been increased over the last years (e.g., Khan Academy, PBS Teachers, TeacherTube) the investigation of asynchronous webcast as an educational means is of high importance, due to the lack of guidance and aid in this field.

Previous studies conducted have shown that there is a significant difference in the effectiveness between live and pre-produced ways of learning (Yunus et al., 2006). Although webcasts cannot replace actual teachers (McKinney et al., 2009), the crucial question, however, is whether a pre-produced webcast can be of help as an autonomous educational medium and if we can come up with some instructions for its usage, in order to increase its effectiveness and detect cases in which webcasts would probably be successfully used.

**Methodology**

*The educational webcast*

According to Courau (2000), if a listener does not participate in the talk, he/she can remain focused at most for 20 minutes, even if his/her attention is triggered by visual and hearing aids (projector, slide show, etc). The audience can retain 20–30% of the information transmitted when focused. When the speech exceeds 20 minutes, the percentage falls to 5%. The educational webcast, which is used in this study, was implemented by the authors and was reviewed by specialized educators several times prior to its use.

The content selected for the webcast (pictures attributes, unit of multimedia, in the course of informatics of second grade students at gymnasium, in Arapoglou et al., 2006) was reviewed several times in order to optimize its performance. Two snapshots of the webcast are presented in Figure 1. Another key webcast characteristic that must be considered is that it should not require any background knowledge from the learner. For example, the selected course is quite fragmented because it describes terms like image resolution, properties of basic colors, means of image input and output. Misunderstanding of a term does not prohibit understanding of another. In addition,
the 15-minute video webcast presented on a 17-inch screen using headsets (MP4 format) and the content taught in the traditional way originated from the same educational content.

Sampling
The first part of the experiment was to select the two groups that were going to participate in the experiment. The school has two classes with 33 students in each class. A pretest procedure was conducted twice on the two sections prior of the section of the experiment (Computer Characteristics and Digital World), both tests were developed with the assistance of the teachers and were same in terms of size and questions type. The proposal of the teachers and the results obtained from the pretest procedure allowed us to form the two different groups (the webcast-experimental group and the traditional learning-control group). Thus, the two groups consisted of 33 students each, with high similarity in their performance rate (first group: $M = 6.88, SD = 1.54$; second group: $M = 6.72, SD = 1.42$). The webcast group included 13 males and 20 females, while the traditional teaching group included 14 males and 19 females. Students that participated in the experiment were 13–14 years old and attended the second grade of gymnasium. They were taught the same syllabus and they attended an educational webcast once a week for the last 4 weeks before the experiment, in order to minimize the effect of students’ enthusiasm.

Measures
Four types of tasks were employed. The first task was a multiple choice exercise. Four sentences were presented with each sentence with a missing word and four possible words to choose from. The second task consisted of five sentences evaluated through a true or false questionnaire. The third task involved a matching exercise presenting two terms, “digital” and “vector,” on the left side and four qualities of these terms on the right side. The student had to connect each term with the matching qualities. The last task featured increased complexity, during which students were given the properties of an image and they had to identify its size according to an equation. Each subgroup’s performance was analyzed (separately for each exercise), in order to demonstrate how the process of understanding was affected by each educational procedure. While the first exercise required simple comprehension, the second and the third exercises required a greater degree of comprehension than the first one, because of the involvement of difficult definitions, concepts and terms. The fourth exercise required additionally a great degree of consolidation; the students had to use the concepts they had learned to be able to cope with the task.

Procedures
The experiment took place in Greek state gymnasium, which may be considered (in terms of the number of the children, their random decision to subscribe and the infrastructures) a typical school. The study was conducted over a weekly period from May 2–7, 2010. The traditional teaching part of the experiment took place in the classroom; the duration was 20 minutes, a little longer than the webcast because of the interaction with the teacher. Considering that a typical lesson in Greece lasts 45 minutes, we used 20 minutes for the instruction, 5 minutes as a free time for the students and 20 minutes for the cognitive test. In this respect, the study aimed at investigating how school children would watch an educational webcast in a classroom setting, where a different form of education would be rather unexpected. In the webcast group, tutors were present and they were asked to observe their students watching the webcast without being actively involved. A technical assistant was also present who helped students with technical matters.

In respect to the content, students were taught the basic principles of “Picture Attributes” in the course of informatics. This particular content selection was made due to the great degree of content fragmentation and the visualization ease. The traditional learning course was conducted based on the instructions given by the Greek Ministry of Education (Greek Pedagogical Institute,
2009) for the course of Informatics. The experimental group was taught the same content based on the webcast. The main differences between the two teaching methods were the interactivity with the teacher in the traditional learning group and the potential technological benefits (the graphics, the images, the design of the systems screen and the text flow) of the webcast. For instance, Figure 1 indicates the visualization benefits of webcast in the color depth (left) and image resolution (right) terms.

Data analysis
As aforementioned, 66 second grade gymnasium students were involved in the evaluation. They were separated into two 33 student groups. One group was engaged in the asynchronous educational webcast and the other group was engaged in traditional teaching. An independent samples t-test was conducted in order to compare the improvement in the performance for the respective groups. T-test method was chosen, because it applies to the problem of estimating means of a normally distributed population.

Except for the data provided by cognitive tests, this study gathered information from other sources. Although there are legal implications with the recording of interviews, this study used light interviews/conversations with the students and the teachers of the experiment. As such, we achieved one form of data triangulation using the results from the cognitive tests, conversation/interview with students, conversation/interview with teachers and researchers’ observations. This form of triangulation provides a vehicle in order to interpret and validate the results.

Research results

Overall performance
Based on the frequency analysis, it can be inferred that both teaching methods produced almost the same performance in the experiment. Even more remarkable is that none of the webcast students scored under 5. Additionally, according to the teachers, who were present in the lab at the time of the webcast, all students even the weakest ones that normally do not pay attention in the class, sat carefully in front of the computer and watched the webcast. This might be the reason why there were no students scoring lower than 5. Using a t-test of two groups, webcasting ($M_1 = 6.94$, $SD_1 = 1.58$) and traditional learning ($M_2 = 6.70$, $SD_2 = 2.01$), the results showed no significant difference $t(64) = -0.55 < 2.03$, $p > .05$. As a consequence, there was no difference between traditional learning and webcast in their overall effectiveness of the test, even though the former is an interactive way of learning.

Each one of the exercises features different characteristics and attributes. The first exercise examines the level of understanding of some general information in the field. It investigates the students’ competence to insert the correct word in the sentence. The second exercise examines the capability to distinguish between true and false sentences. The third exercise examines the capability to match each term with its characteristics. The fourth task was a problem (complex task) that investigates the capability to use knowledge in order to solve a problem. Students had to crosscheck their knowledge in order to solve the fourth exercise. Four t-tests (for each kind of exercise) concerning the comparison of the improvement of the effectiveness for the respective groups were performed.

Performance in simple comprehension
The first task was a multiple choice exercise. A frequency analysis of the results leads to the remark that in the first (webcast) group there were no students scoring under 5, whereas in the second (traditional) group over 20% of the students scored under 5. Also, in the first group 50% of the students succeeded in solving the whole exercise correctly, whereas in the second group only 25% succeeded. Using a t-test of two groups, webcasting ($M_1 = 8.64$, $SD_1 = 1.66$) and
traditional learning ($M_2 = 6.21$, $SD_2 = 3.37$), the results showed a significant difference $t(64) = 3.7 > 2.03, p < .05$. This leads to the result that webcasting had a higher performance in this kind of tasks than in traditional teaching. According to the teachers’ interview, the webcast was able to attract the attention of all the students, even those who typically pay no attention in the classroom. However, all students (from the webcast group) answered at least one question, as shown in the frequency analysis; this is the basic factor for the big difference in the standard deviation of the two methods.

**Performance in complex comprehension**

The second task was a true or false exercise. According to frequency analysis, it can be easily concluded that the performance of the two groups ranged within similar levels. The distribution of the two groups is the same (normal distribution), and this is based on the similarity of the groups’ potential. We can also observe a slight difference in lower scores attributed to the fact that the students who watched the webcast had a minimum score of 4, whereas the other group (traditional learning) had a minimum score of 2. Additionally, using a t-test of two groups, the following scores were deduced: webcasting ($M_1 = 6.55$, $SD_1 = 2.08$) and traditional learning ($M_2 = 6.18$, $SD_2 = 2.31$). The results indicated no significant difference $t(64) = 0.67 < 2.03, p > .05$.

The third task was a matching exercise. According to the frequency analysis, it can be concluded that the webcast group demonstrated a slight (insignificant) increase in their performance. In addition to the difference in the average scores, the distribution is quite close according to the standard deviations. Nevertheless, this difference is not highly important as the t-test proves: webcasting ($M_1 = 8.64$, $SD_1 = 2.08$) and traditional learning ($M_2 = 7.96$, $SD_2 = 2.54$), $t(64) = 1.19 < 2.03, p > .05$. It can be generally observed once more, that there are more students from the group of traditional teaching who scored between 2.5 and 5.

**Performance in a high degree of consolidation**

The fourth task featured a complex exercise. Based on the frequency analysis, it was observed that 50% of the students in the webcast group were not able to start solving the problem, whereas in the other group the percentage was 25%. Moreover, the students who managed to solve it successfully in the traditional learning group were four times as many as the students in the webcast group. According to the t-test results ($t[64] = 2.52 > 2.03, p < .05$) and the average score of each group (webcasting: $M_1 = 3.94$, $SD_1 = 3.91$; traditional learning: $M_2 = 6.44$, $SD_2 = 4.15$), there is a significant difference in the performance of the two groups, which was measured around 61% (higher for traditional learning), which is quite a big percentage. Because of the similarity in the performance of the two groups and having in mind the test results, it can be said that the students taught in the traditional (interactive) way have an advantage in understanding and solving tasks that require complex procedures.

**Discussion and conclusions**

As previously mentioned (Scutter, Stupans, Sawyer & King 2010)), the ability to repeat the lectures offers the advantage of information absorption or in his own words getting the information “into students’ heads.” Re-listening to the courses and taking additional information from the webcast would also appear to encourage the usability of this medium. Furthermore, this paper’s focus is not on the after-lesson advantages of the webcast, but on its effectiveness when using it as an autonomous manner. As previously noted, the webcast’s effectiveness fluctuates according to the level of cognition. Using the webcast, in order to deliver information is likely to be more efficient than traditional (interactive) lectures, a fact that may arise from the benefits of the use of multimedia in the learning process (Mayer, 2001). However, using the webcast for teaching complex tasks is much more inefficient than traditional learning, a fact that may arise
from the need for interactivity and cooperation in order to understand complex tasks. Hereinafter, this study proposes the use of well-designed webcasts in the learning process and in an autonomous manner, but urges educators to prefer this method, either as an information delivery or as an introductory medium in order to achieve better effectiveness.

Learners’ and teachers’ emotional, social and cognitive experience plays an important role in teaching. Traditional classroom teaching offers a variety of opportunities (eg, social interactions and exchange of information) in students’ and teachers’ to exchange emotional and social aspects. For the case of educational webcasts, emotional and social exchange is differentiated from the traditional teaching, due to the lack of interactivity. Teachers who participated in the experiment were interviewed on the educational benefits of the webcast and the attitude of their students when using it. Most of them were particularly impressed by the effect of the webcast on students who otherwise would pay no attention in courses. They reported that students who were not easily disciplined in class seemed absolutely absorbed by the webcast and kept watching quietly without talking to anyone and without disturbing fellow students. In general, teachers thought that webcasts’ use was highly beneficial for students that were considered non-disciplined in class. In fact, teachers thought that students who watched the webcast seemed so immersed that their behavior in class changed and they appeared to be very interested in the teaching content. Some students suggested that they should even watch the webcast on their own laptop in classroom and they could even use it at home in order to study in this way. In general, the results counter positive emotions and beliefs for the use of webcasts.

From the students’ perspective, although a structure interview could not be perform due to legal issues, they had a light interview/conversation with the researcher based on the key questions and guidelines of Brotherson (1994). In the conversation, students supported that the continuation of webcasts will be very positive, this has been previously addressed by Tynan and Colbran (2006). Indeed, they came to ask for the possibility to include webcasts for different courses. The strong demand observed on the student side for webcasts is likely to enforce our attempt to study in depth best practices for using them in schools. However, although students indicated that they like the possibility of attending webcast lectures, there was a number of possible problems mentioned such as: “I do not have my own computer,” “I need to buy a headset” and “My mother does not allow me to stay for a long time in front of my computer.” While, these perceptions do not differentiate between students, this issue was discussed with the teachers who were surprised by the interest of non-disciplined students as they normally pay little attention in traditional teaching practices.

Another crucial issue was the students’ sense during the experiment. Based on the researchers’ observation in the lab it can be presumed that some students felt “shortchanged.” Teachers were there and they were asked to observe students watching the webcast, but they were not actively involved. Researchers’ opinion regarding the “shortchange” of the students arise from some “glances” in the lab and some comments like “next time we can do it all together” after the experiment.

The findings of this study must be interpreted in light of some limitations. First, the generalizability of this results must be carefully made, because it was conducted in a single school with specific instructions. Second, our research was a pretest quasi-experimental design including all the benefits and the limitations of this method (Moore, 2008). Third, the design described students at one grade level and was not longitudinal so the data could not reveal the continuation of the webcast performance. However, we know from literature that when webcasts are available, students typically use them without attendance wearing off greatly (Brotherton & Abowd, 2004; Traphagan et al, 2010; Zupancic & Horz, 2002). Nevertheless, we try to eliminate the effect of the one session study by using educational webcast once a week in the last 4 weeks before the
experiment. Based also on the results of Traphagan et al (2010) for the webcast attendance, we can assume that after the third week the attendance of the students stabilizes. Despite these limitations, the findings generate valuable insights, which can be used as part of hypotheses for representative follow-up studies in technological tools’ educational effectiveness.

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