Educational Multimedia Systems: The Past, the Present, and a Glimpse into the Future

A Concept Note on the ACM Workshop on Educational Multimedia and Multimedia Education

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ABSTRACT

The progress in multimedia capture, analysis, and delivery, combined with the rapid adoption of broadband communication, have resulted in educational multimedia systems that have advanced traditional forms of teaching and learning. In addition, new trends in multimedia technology, such as multimedia on handheld devices or advanced approaches for the automatic analysis of multimodal signals, offer novel and exciting opportunities for teaching and learning. However, the question about how multimedia can really make education more exploratory and enjoyable is as yet unanswered, and we are just beginning to understand the real contribution of multimedia to education. This concept note provides a motivation for the ACM Workshop on Educational Multimedia and Multimedia Education. Based on a brief overview of the history of educational multimedia systems and a rough analysis of the current situation, we venture a glimpse into the future and argue that educational multimedia is a vivid and relevant area for research.

Categories and Subject Descriptors

K.3.1 [**Computing Milieux**]: Computers and Education-Computer Uses in Education

General Terms

Human Factors

Keywords

Eduational Multimedia, Distance Education, Technology-Augmented Classroom Teaching

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EMME'07, September 28, 2007, Augsburg, Bavaria, Germany.
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1. INTRODUCTION

Ever since the advent of computational devices in education, efforts have been made to answer the question of how to properly integrate them and take advantage of their capabilities. Educational multimedia systems promise to make learning easier, more convenient, and thus more effective. For example, classroom teaching enriched by vivid presentations promise to improve the motivation of the learner. Concepts may be given a perceivable existence in a video show and the observability of important details can be stressed. Video capturing of lectures has become common practice to produce distance education content directly from the classroom. Simulations allow to explore experiments which would be otherwise impossible to be conducted physically.

Today, almost every university claims to have a strategy to utilize sthe opportunities provided by the Internet or digital media in order to improve and advance traditional education. Together with the advent of the World Wide Web in the mid 1990s, the term *e-learning* was coined (along with other terms such as *e-commerce* or *e-government*) and created a hype. Some people predicted dramatic changes in the educational environment or the end of traditional education in general. Like any other hype, disillusion started to spread a few years later and today, we face ubiquitous criticism claiming that many excellent ideas have been shadowed by the mass of mediocre and uninteresting work in this area. In fact, especially in relation to new media, it seems that the question how multimedia technology can really make learning more exploratory and enjoyable has still not been answered. For example, do the various web sites and lecture videos produced as part of the e-learning hype really exploit the full potential of multimedia-based teaching?

Despite many projects that produced rather mediocre results, we believe that interesting and important contributions have been made and will be made in this field before, during, and after the hype. In the following, we support this hypothesis by providing a quick historical overview (Section 2), and a rough description of the current context and situation (Section 3). Based on this high-level analysis, we present a motivation not only for the *Workshop on Educational Multimedia and Multimedia Education (EMME)*, but also for educational multimedia in general as an important and relevant research area with many open problems.

2. THE PAST

Approaches dealing with the use of multimedia and/or computers in education can generally be either classified as related to *Distance Education* or *Technology Augmented Classroom Teaching*. In the following, we take a brief look at the historical background of these two areas.

2.1 Distance Education

Many people believe that distance education is a new phenomenon appearing with the raise of the World Wide Web as part of the e-learning hype. However, the demand for providing education to people regardless of time and place is a very old one. In fact, the history of distance education goes back to at least about AD 50-60 when Saint Paul wrote his epistles to provide religious instruction to his church members at a distance. The letters were sent to distant Christian communities in order to be read aloud in front of the congregation.

In 1840, Sir Isaac Pitman, the British inventor of shorthand, taught his "Stenographic Soundhand" to local students as well as to anybody in reach of the British Empire's Penny Post [7]. Any student who wanted to learn writing in shorthand could send a self-addressed stamped envelope to him. He then responded with lessons containing mostly Bible verses to be transcribed into shorthand [4]. As a consequence, Pitman is generally recognized as one of the first modern school teachers to give *correspondence courses*, and therefore probably the first distance educator recorded in modern times. His courses were born out of the need to provide schooling to students in remote, sparsely populated areas that could not support a school. Correspondence courses were mostly paper-based, i.e. all material was sent out by mail. Communication with instructors worked via radio transmissions or again by mail.

The first institutionalization of distance education took place after the second World War. One of the oldest remote education universities is the University of South Africa, which has been offering correspondence courses since 1946 [8]. Today, probably the most important distance education universities in Europe are the Open University in the UK, which was founded in 1969, the Fernuniversität Hagen in Germany, founded in 1974, the Centre National d'Enseignement à Distance (CNED) in France, founded in 1939, and the Universidad Nacional de Educación a Distancia (UNED) in Spain, founded in 1972. Even though the roots of the Internet in the 1960s and 1970s are closely connected to universities, videotapes via postal mail, the telephone, and in the 1980s also cable and satellite delivery remained the transmission media for distance courses until the end of the 1980s.

It took until the 1990s for the Internet to be taken seriously as distance education medium. Then, however, the popularity of distance education started to grow at an unprecedented rate. Today, each of the above-mentioned universities has more students than could possibly be reached by attendance teaching. It is therefore no surprise that the introduction of the World Wide Web also motivated many regular universities to start distance education projects. The Web has added a whole new dimension to distance education as such traditional, i.e. non-distance-education, universities began to see the opportunities for a different way of teaching and for reaching new audiences. Many projects were inspired by the new possibility to broadcast video and audio data easily as well as the ability to create interactive animations.

2.2 Augmented Classroom Teaching

In the same way as examples for distance education can be found long before the Internet era, there are rather early examples for the usage of educational multimedia systems in classrooms. One is the *PLATO system* [6] (Programmed Logic for Automated Teaching Operations), developed at University of Illinois in 1963. It had custom-built multimedia teaching terminal stations connected to the mainframe. A proprietary language called *TUTOR* was created for authoring educational software. More than 15,000 hours worth of instruction material were developed for PLATO. Features like chat and bulletin-board notes were added in the early 1970s. In 1976 Control Data Corporation (CDC) established PLATO-IV as a commercial educational product, with its successor still around [5].

Ideas like using pen-based input devices for classroom teaching were already around in the 1980s. An early example of digitizer tablets which even used the chalkboard metaphor is the *ChalkBoard PowerPad* by Chalkboard Inc. It was available for the C64 and the Atari 800/XL/XE and came with educational software. Additional edutainment programs were sold for the PowerPad. Each came with a plastic clamshell box to serve as a customized template that was laid over the PowerPad's surface. The first commercially available notebook-sized computer with integrated input pen was the *GRiDPad* from GRiD Systems, released in September 1989. Its operating system was based on MS-DOS. In 1991 another tablet computer, the *Momenta Pentop* [3], became available, this time with a dedicated operating system from Go Corporation, called PenPoint. Unfortunately, these early examples were generally commercial failures, suffering from, for example, insufficient handwriting recognition performance, and from the products' high costs and weight. The Momenta, for example, weighed seven pounds and had a purchase price of about $5,000.

Xerox PARC not only pioneered the graphical user interface, its former division LiveWorks also produced the first digital whiteboards, the *LiveBoard* [1]. The system used a rear-projection screen controlled by a built-in workstation, and a set of tracked pens for different colors. The system allowed overlay annotations and had the ability to interoperate seamlessly with remote LiveBoards in other locations.

These early systems have been the basis for many of todays devices. For example, digital whiteboards are now available at reasonable prices and come in different flavors including various sizes, front vs. rear projection models, and systems requiring special pens for input vs. touchscreen-style devices. However, pen computing really took off in the classrooms when pen-based tablets the size of a regular computer display were introduced to the mass market at reasonable prices. Examples include LCD screens augmented with touch or pen technology, such as the WACOM Cintiq, as well as the Windows *Tablet PC*, released in late 2002.

3. THE PRESENT

Generally, it can be said that many approaches which have been pursued as part of the e-learning hype have not been able to withstand the high expectations, turned out not to be feasible in an everyday teaching scenario, or might just have been bad ideas in the first place.

On the other hand, if we look at the situation at today's educational institutions, we can observe that distance education and technology augmented classroom teaching indeed have become established parts of everyday teaching and learning. We can see that multimedia plays an important role in this process:

Distance education extends the classes offered at regular universities. Multimedia supplements are used intensively by institutions traditionally dealing with remote students. Due to increasing performance and dropping prices, traditional computing devices (e.g. desktop PCs, laptops, and data projectors) as well as newer tools (e.g. electronic whiteboards, LCD displays with pen-based input, and TabletPCs) set foot into the classroom. Often, these devices are now used to enhance traditional teaching methods, for example, with multimedia supplements. A good and comprehensive overview of the state of the art of e-learning technologies in general can be found in [2].

The research done in the last couple of years did not only create these devices but also studied, evaluated, and established useful usage scenarios. Obviously, usage of computer technology for teaching varies from subject to subject and from teacher to teacher. However, in general, three approaches can be observed to have reached a predominant position in the field of computer-supported education today: Intensive use of digital slide-show presentations, the utilization of educational mini applications (e.g., specialized software, dynamic web pages, or Java Applets), and recording (e.g. via traditional video taping or automatic screen capturing) and/or transmission of classroom lectures.

Slide-show presentations have long since replaced overhead projector slides. The structure of the presentation is entirely planned in advance taking into account all required resources. Visual means like tables, diagrams, images, or even animations can be directly presented to the audience. Slides can be annotated during the presentation using electronic pens and writing surfaces. For distance education use, computer-generated slides may be printed out or put onto web sites, so that students do not have to copy the content for later recall.

Educational mini applications like dynamic web pages, Flash animations, or Java Applets are used for presentation as well as for individual training by student at home. Pedagogical software like this is particularly common in K12 education with a wide range of commercially available programs. Research universities usually prefer to develop their own solutions often targeted to the audience of a single course.

Recording a video of the entire lecture showing the board, the lecturer, and featuring an audio track enables students to follow a lecture remotely and to recall previous sessions. In order to transmit classes, it has become common to use standard Internet video broadcasting systems taking advantage of their availability and straightforward handling. Existing solutions either focus on recording and transmitting a session or using video conferencing tools to establish a bidirectional connection (i.e., a feedback channel). Such approaches combine technology augmented classroom teaching with distance education.

We can see from this short discussion that despite all the (often justified) critizism against many "results" produced as part of the e-learning hype, change actually did happen, and many technologies indeed got accepted and made their way into todays teaching and learning process. Some of these changes might seem pretty small, for example, using PowerPoint slides instead of overhead transparencies or chalk boards. However, even they can have a high impact on teaching and learning. For example, teachers prepare and give a lecture differently when using PowerPoint instead of a chalk board. In the same way, students consume it differently if a chalk board is used (where the content is being erased aferwards), if it is given by the use of electronic slides (which can be downloaded after the lecture), or if it even gets recorded (and therefore can be re-watched after the live event).

4. THE FUTURE

We have argued that despite many failures and mediocre projects, sustainable results have been achieved in the last couple of years. Ironically, both the positive as well as negative results motivated some researchers and educators to turn down the main idea and doom e-learning and multimedia education to be not a research topic anymore. We disagree mainly for three reasons.

First, we do not think that the full potential of technology usage for education has been exploited yet. For example, we argued that the usage of electronic slides vs. chalk boards or transparencies and the recording of lectures can have a significant influence on the teaching as well as the learning style of the lecturers and students, respectively. It is yet unclear what the "best solutions" are. For example, are slides the right solution for presenting content in a lecture or can new media be of better aid to the teacher? How can we make the production of educational material easier and existing applications more reusable? How can we better automize the tasks that recording technicians have to perform in a lecture hall? How can new technology such as mobile devices be used to improve participant interaction in classrooms and lecture halls? How can we analyze their interactions and how can we use the collected information? Multimedia systems will play a significant role in answering all these questions because most of the data involved is multimodal in nature.

Second, as described before, desktop PCs and laptops as well as data projectors are ubiquitous artifacts of many classrooms today and used by teachers intensively. Pen-based input devices are slowly but continuously making their way into the lecture halls as well. Many universities already have wireless networks on their campuses. Computer usage in the classroom is no longer restricted to the lecturer, but many students have notebook computers which can be included in the learning process. Smaller mobile devices such as PDAs or cellphones are becoming more and more powerful and ubiquitous. How can we take advantage of the increasing avaiability of such devices in the classroom? How can we exploit the great potential offered by the ongoing advancement of technology for educational applications in general?

Third, we believe that multimedia data will play an even greater role in the future of computer-supported education than it already does. Teaching and learning is an activity which naturally involves different modalities. The new devices and advancements in technology improve signal processing possibilities. However, there are still many open questions related to how educational content should be presented, deployed, navigated, searched, retrieved, edited, combined, and reused in a proper way.

Solving the challenges involved in the issues discussed above requires techniques from different fields such as ar-

tificial intelligence, computer vision, speech processing, but also areas such as human-computer interaction and psychology. In addition, new trends and emerging areas are gaining increasing importance. For example, classrooms with wireless networks and the integration of handheld devices raise several open questions related to the rather new field of mobile computing. Trends such as semantic computing offer promising perspectives for the automatic analysis and better processing of multimodal signals.

Given the high importance of multimedia in this context, the data is what combines all these researchers from different fields with their various backgrounds, diverse viewpoints, and varying procedural methods. Hence, the multimedia community seems to be the perfect platform for bringing all those researchers and educators with different backgrounds together in order to help improve multimedia-based education and therefore teaching and learning in general. Motivated by this, we organized the Workshop on Educational Multimedia and Multimedia Education to identify new trends, highlight future directions in this area, and foster the active discussion and exchange between researchers from different fields.

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