Can We Escape the Trough of Disillusionment?

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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. New trends in technology, such as mobile multimedia or advanced approaches for the automatic analysis of multimodal signals, offer novel and exciting opportunities for teaching and learning. However, many scientists have stopped working on the topic because they were disappointed with mediocre results that seemed to have no impact. In this article, we investigate the reasons for this and argue that the question of 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. 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 (still) a vivid and relevant area for research.

The Past
It all started in the mid-1960s, when interactive computing came about, with the illusion of what was called programmed instruction. What came out was computer based training (CBT), and thereby a rather "behaviorist" approach to teaching. In the mid-1970s, AI came about, leading to the illusion of perfect intelligent tutoring systems (ITS) capable of mastering all possible human misconceptions. When hypertext was ready in the mid-1980s, many preceding approaches had just caused frustration about "computers as teachers'" since ITS had exposed its limitations. This accelerated the next illusion: now, many believed that properly (hyper-) structured information was the silver bullet and that learners could be left alone, without any guidance, if only the learning material was perfectly prepared. Explorative learning was a common term for this trend. Multimedia and the Web "prolonged" it into the '90s, and all three technological advancements (hypertext, multimedia, and the Web) were melded in the new term "E-Learning." The previous failing of hypertext was attributed to insufficient spread and insufficient appeal, and both were claimed to be conquered by the Web and by multimedia. When time was ripe to admit that no solution was perfect, blended learning was invented as a neat way of saying "we cannot abolish face-to-face teaching." For each wave, in-vitro experiments showed that all approaches mentioned above have great value and can indeed improve teaching and learning. However, from in-vitro experiments to wide spread use, the path is long and painful. About four decades after the advent of programmed instruction, we see CBTs and WBTs well established in the marketplace, with increasing sales figures.

The Present
When mentioning the subject of e-learning or educational multimedia these days, one can usually expect one of two typical reactions from the scientific community. Either people regard it as an outdated topic from the 1990s, or they think of E-Learning 2.0 as a long considered really hot field. The first reaction can be explained by ample disappointments experienced from the first e-learning wave. Not surprisingly, many approaches that have been pursued as part of the e-learning hype have not been able to withstand the high expectations, have turned out not to be feasible in an everyday teaching scenario, or might just have been bad ideas in the first place. This e-learning wave actually paralleled an even bigger hype also boosted by the advent of the Web at the end of the 1990s: The e-commerce hype, later to be called the dot-com boom. Often rather questionable business models were preferred with the sole p urpose of attracting lots of users, get famous, go public, and then get rich.

Following the typical "hype" development, there was a big depression about the greatly exaggerated expectation in both cases. People stayed away for a while, and it took some time before the lasting results became visible. However, despite the burst of the dot-com bubble, not

everything produced in that time turned out to be just hot air. In fact there are few companies that not only survived the crash but also flourished and became new industry leaders, such as Google, Amazon, and eBay. Similarly, there are lasting results from the e-learning hype. If we look at the situation in 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.

Research and development performed in the last couple of years did not only create tools and systems 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 have reached a prominent position in the field of computer-supported university education today: Extensive use of digital slide-show presentations, the utilization of educational mini-applications (for example, specialized software, dynamic Web pages, or Java Applets), and recording (for example, via traditional videotaping or automatic screen capturing) and/or transmission of classroom lectures. Recently these have also begun to be published as podcasts, enabling learners to use the materials even on their mobile audio devices.

Early online materials were mere "webified" text books, providing only Internet access to long texts with an occasional static image embedded. Now, educational mini-applications like dynamic Web pages, Flash animations, or Java Applets are used for presentation as well as for individual training for students at home where immense amounts of such educational online materials can be accessed. Pedagogical software like this is particularly common in K-12 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 videoconferencing tools to establish a bidirectional connection (such as, a feedback channel). Such approaches combine technology augmented classroom teaching with distance education.

ACM's Workshop on Educational Multimedia and Multimedia Education

Striving to get some insights into the recent developments of multimedia research on e-earning, we organized the first ACM Workshop on Educational Multimedia and Multimedia Education (EMME) at the ACM Multimedia Conference in 2007 The workshop aimed at gathering current trends in educational multimedia and at identifying sustainable results. The event showed that there are quite a number of fresh new approaches due to a new generation of technology existing which opens a range of new opportunities. For example, 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 cell phones are becoming more and more powerful and ubiquitous.

Better pen-based interfaces and screens are becoming available. Trends such as semantic computing offer promising perspectives for automatic analysis and renew the efforts on the many still-open questions on how educational content should be presented, deployed, navigated, searched, retrieved, edited, combined, exchanged, and reused in a proper way.

The workshop attracted a great variety of contributions centering on different aspects. For example, some authors focused more on innovative applications and promising new approaches for e-learning. Sharda et al. [1] represented multimedia education, discussing the use of digital storytelling to enhance creativity and innovation with e-learning pedagogy and to teach learners to combine knowledge from different areas. Percival et al. [2] focused on educational multimedia, describing the use of computer edutainment to motivate and assist musicians in routine exercises and to provide automatic feedback on their performance.

In addition to these application-oriented papers, other authors focused more on technological trends and engineering aspects of new approaches for e-learning. Some of these outstanding

technical contributions have been selected for publication in a special section of IEEE MultiMedia. Wang and Zhang [3] present the technological implementation of the above described system for training musicians. And Anthony et al. [4] describes a project exploring handwriting recognition for applications in intelligent tutoring systems for learning algebra. Finally, Lampi et al. [5] illustrates the design of an automatic cameraman for lecture recording, handling zoom and scene selection to provide enjoyable and lively recordings.

The workshop also featured a panel in which experienced multimedia teachers and researchers discussed the current status and future of multimedia education. It was mainly targeted at the multimedia community. However, questions such as how can new media be used to improve teaching in the best possible way and can multimedia help keeping learning material more up to date, have a high relevance for the general e-learning community as well. A summary of the main panel results was recently published in the Media Impact column of IEEE MultiMedia [6].

The Future

The workshop demonstrated that there is considerable potential for valuable outcomes from an active research community. Most researchers agree that the benefits of multimedia education comprise: higher "bandwidth" of computer-to-machine interaction due to the use of multiple channels, including video and audio that have higher raw data rates than written text; adaptiveness with respect to the "right choice" of media according to the subject to be conveyed and/or the recipient (this latter point is only true if multiple alternative media are offered for the same subject); better motivation due to more fun with multimedia based material; and improved engagement, especially in case of interactive and/or immersive media, in particular games and simulations. While all of these advantages can be debated about on the general level, they surely exist for appropriate subjects and learning settings. The common agreement was that despite the commonplace impression of many projects that produced rather mediocre results, we believe that interesting and important contributions have been made and the next step is to learn from the mistakes in order to end hype and disillusion and to reach a stable state of productivity.

As seen in the previous background discussions, each time computer science brought about new major advancements, extremely high expectations were raised as to the effect on computer-supported teaching and learning. Not surprisingly, frustration followed each time, resulting in a typical hype cycle (see Figure 1) with an extraordinarily sharp peak and down slope.

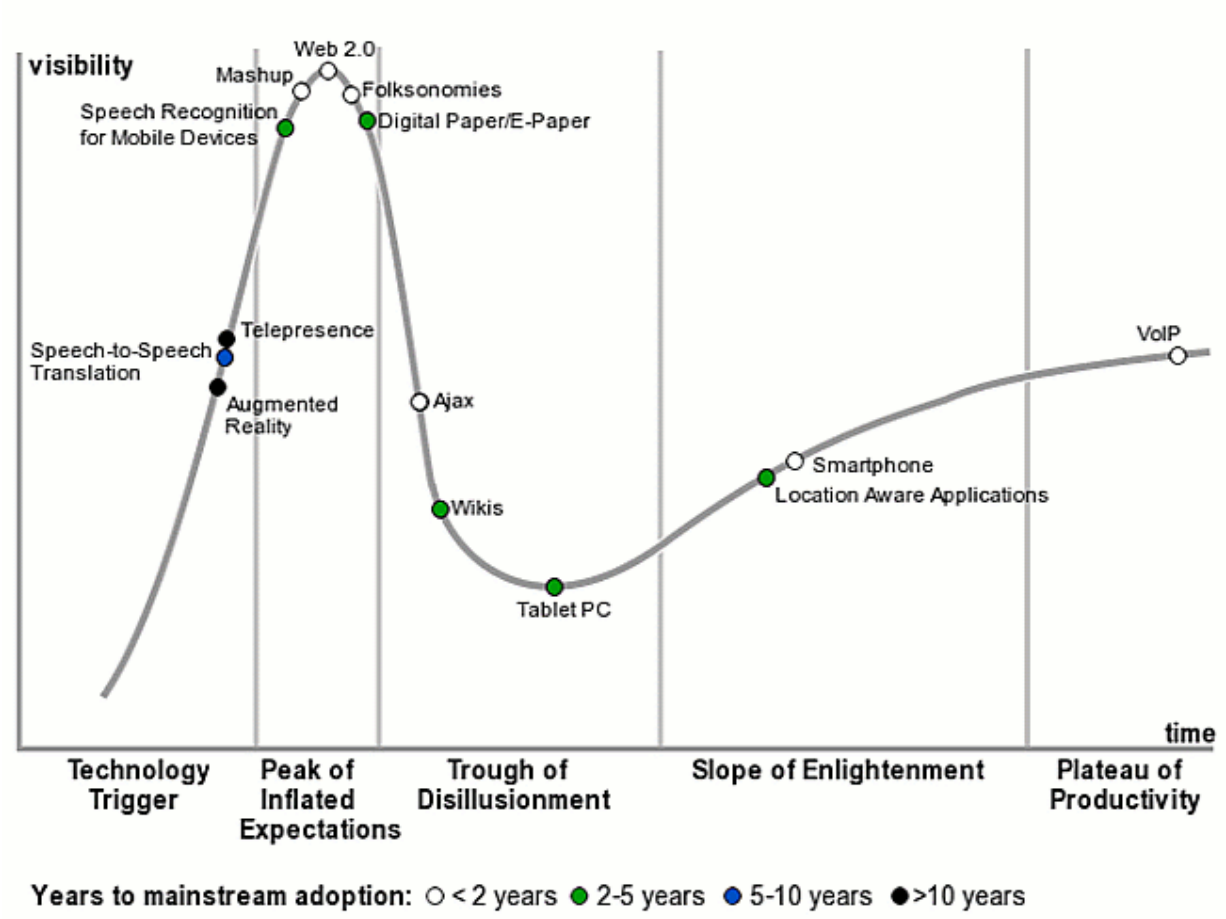

Figure 1. *Emerging Technologies Hype Cycle 2006 (selected data points displayed only) according to Gartner, Inc.*[7].

In general, the following conclusion can be drawn: Major computer-based teaching/learning approaches, proven in-vitro to be successful, can make their way to the market, but with very considerable delay; if their penetration is left to the forces of a free market, a delay of several decades is not unusual. On this way to success, these approaches incorporate technological advancements much faster than more sophisticated pedagogical/didactical approaches. The fact that the addition of multimedia contributed much to the success of CBT may be viewed as a general sign that multimedia can considerably improve the learning experience, and that it can be commercially successful despite high cost.

Nobel Laureate Niels Bohr is credited for noting, "it is hard to predict (anything), especially the future." Despite this uncertainty, there are a few very strong lines of research advancements and of spreading technologies which will almost inevitably influence e-learning. Among these are Semantic Technologies for text (natural language processing) and media (multimedia content analysis); the upcoming post-PC era where computers become ubiquitous, networked and worn or embedded in the environment (ubiquitous computing, aka ambient intelligence); and social uses of the Web like forums, blogs, wikis, media sharing, and interaction spaces, commonly referred to as Web 2.0. All three can greatly improve e-learning by providing improved computer-based access to text and multimedia on the Web (semantic learning), by connecting learning to the actual real-world experience (ambient learning), and by connecting institutional teaching with global informal learning (E-Learning 2.0).

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