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Educational Media: From Canned Brain Food to Knowledge Traces

Michael Herczeg
Institute for Multimedia and Interactive Systems (IMIS)
University of Luebeck
Luebeck, Germany
herczeg@imis.uni-luebeck.de

Abstract: During the development of computer-based learning applications there have been many paradigms to think, construct and understand these systems. This contribution will discuss the genesis of learning systems together with their learning paradigms which have been the underlying pedagogical principles. It will be discussed where learning systems come from, what we achieved and what can or should be expected for the future. The question of being passive or active as a general or an individual learner will be emphasized.

Introduction

The genesis of educational media and their usage is characterized by remarkable technological inventions and developments. However, looking back to the learning and teaching strategies it is hard to find equally important milestones. The enhancements by technology have not always been accompanied by enhancements in didactical methods or pedagogical theories. To get a closer understanding what happened and what did actually not happen to education it is helpful to order the developments that took place in a sequence of *generations of educational computer-based media applications*. By this it is easier to identify that the same educational principles just have been converted or embedded into other media forms without major progress. However, obviously there is a dormant potential that might get visible, exploitable and relevant after another major step, which can be expected in near future. This step is the emergence of individual computer-based learning and certified personal knowledge. We might overcome the old method of providing teaching contents as a kind of *canned brain food* by switching to a better teaching and learning strategy which is characterized not only by constructivist's models of learning but as well by the social perception of visible and provable personal *traces of knowledge* in social networks. The principle of learning by contributing relevant content into social networks and by acknowledging the individual contributions by a community of users and contributors can open a more natural, motivating and effective way of understanding and practicing learning and teaching.

Generations of Educational Media Applications

When we look at the history of educational media applications (E-Learning) we can identify several generations of electronic and computer-based systems that have been conceptualized, implemented, and deployed into many educational contexts. Some of them have been successful and are long lasting; others have vanished even before their intended introduction. In the following classification system they have been ordered into *E-Learning generations* with certain characteristics or foundations in four dimensions: *theory*, *methods*, *technology*, and *applications* (Herczeg 2007).

The E-Learning generations that will be discussed are:

1. Centralized E-Learning
2. Decentralized E-Learning
3. Multimedia E-Learning
4. Distributed E-Learning
5. Individual E-Learning

Fig. 1 shows some of the basic characteristics or foundations of these generations and depicts that a generation always wraps around the previous ones. This is an instance of what already Marshall McLuhan identified as being typical for media in general. He observed that new media are usually embedding existing media (McLuhan 1964).

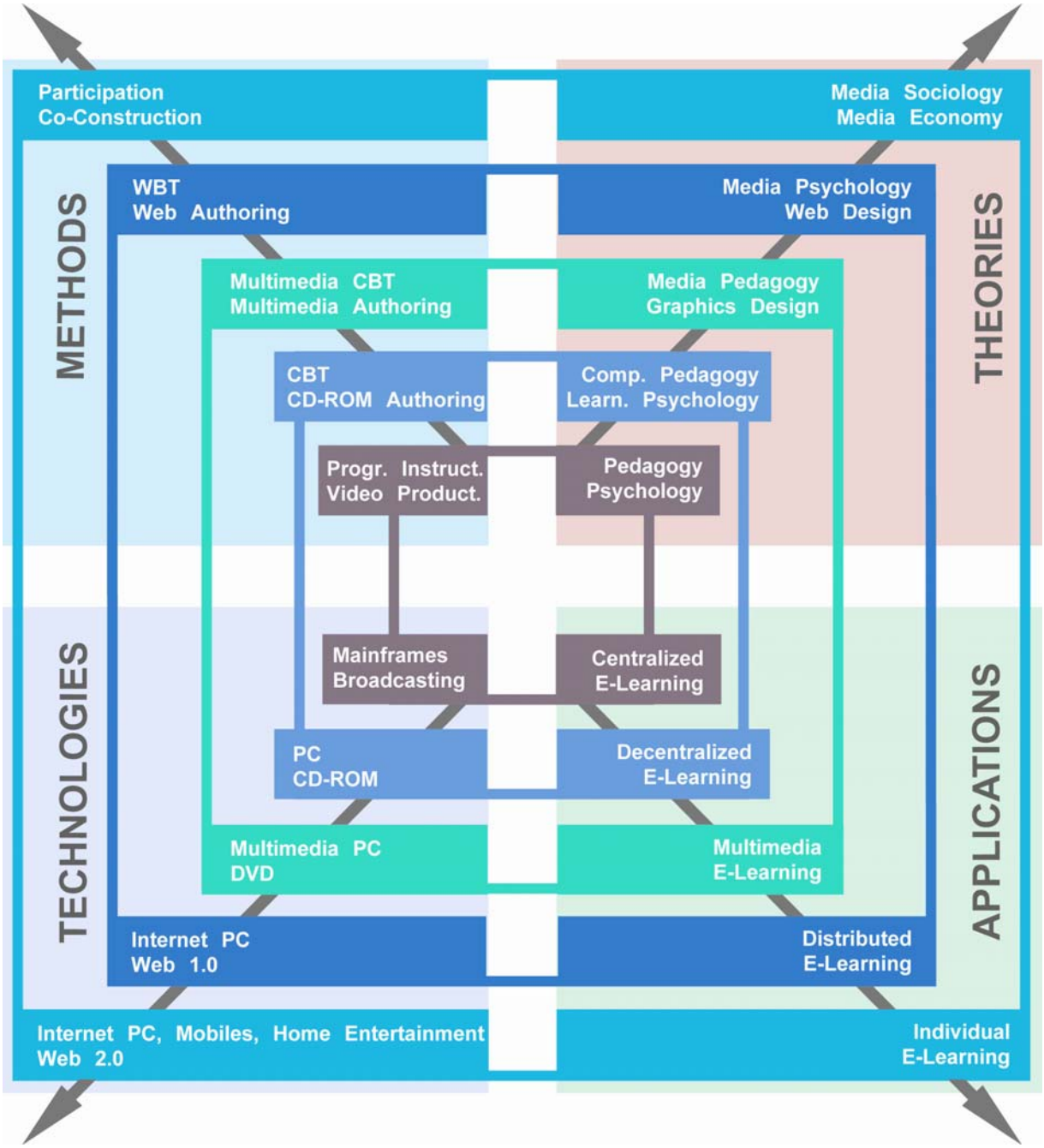

Figure 1: Generations of Educational computer-based Media Applications (E-Learning Generations)
(adapted from Herczeg 2007)

1970s – 1st Generation: Centralized E-Learning

The early concepts and systems for E-Learning have been based mainly on two technologies, the television broadcasting system and the first available mainframe computers.

As a first generally available electronic device we had the television broadcasting receiver, which found its way in form of the commercial TV set into the households by millions. In many countries video-based learning modules had been developed and broadcast on a daily basis, trying to replace or to enrich the traditional education system like schools and universities. The basic learning paradigm was somehow that of *canned brain food*, where knowledgeable people provided content for *knowledge cans* to deliver them to the millions of learners on the other end of the broadcasting channel. These usually well defined pieces of information have in many cases been part of a higher level curriculum, i.e. a canonical structure of knowledge that has been generally accepted by the official education system. This basic approach to learning can still be found as the key concept in most of the current E-Learning applications. Neil Postman expressed his fears and critique about the fast replacement of the old oral culture of discourse by these one way media which reduce the people to *consumers* in the best case (Postman 1996).

In the same decade the first large computer systems, called mainframes, were built. They started to be capable of generating human-computer dialogues for hundreds or even thousands of users at a time. One of the very first ideas about using theses large and expensive computers has been replacing school teachers by these systems. So-called *Intelligent Tutoring Systems (ITS)* have been defined as one of the major goals to pursue (Sleeman & Brown 1982; Carbonell 1970; Brown, Burton & de Kleer 1982). The teaching method has been called *programmed instruction*, where computer algorithms have been taken as the driving engine of a predefined learning process (Skinner 1953; Skinner, 1954). The basic idea reaches even back to Thorndike's behaviourism (Thorndike 1914; Thorndike 1932).

The computer as the replacement for the teacher was thought of being the new communication partner for the students. This *communication partner paradigm* can still be found in many educational software systems, where the student is brought into a dialog with the computer system. Huge learning systems like PLATO (Programmed Logic Automated Teaching Operations) have been developed by universities together with mainframe manufacturers. They have been developed and filled with immense volumes of content (in PLATO more than 15.000 hours). These systems in a way are a modern implementation of the mechanistic idea of the Nuremberg Funnel delivering fragmented and mostly decontextualized learning contents into the brains of the learners. The students have to sit in front of the computer screens and proceed along a *programmed path to knowledge*.

1980s – 2nd Generation: Decentralized E-Learning

With the availability of *Personal Computers (PCs)*, first on the office desktop and later in the homes, the foundations for another paradigm of E-Learning had been laid. These computers came already with ideas about personal learning environments like Alan Kay's Dynabook (Kay & Goldberg 1976; Kay 1977), going back to even Vannevar Bush's idea of MEMEX (Bush 1945), the *"memory extender"*. *Computer-based Training (CBT)* was thought to be possible wherever local computers are available, without the need of expensive mainframes. The contents had been delivered mainly by CD-ROMs. Dependent on the power and the generation of the PCs used, the contents contained more or less elaborated text and graphics elements. The learners were free to select from menu systems which part of the content shall be presented and learned next. Exercises with automatic evaluation functions enabled the learners to check their current *level of knowledge*. In the offices of companies CD-ROMs were distributed to enable the workers to update and renew their knowledge in respect to their current task areas.

One basic observation has to be noted here. Most of the users of these CD-ROMs admitted later, that they were basically bored about the modules within a few minutes. Only few productions have ever been used extensively. Mainly the game-oriented productions have been extensively used and not primarily for the reason of learning, but more for entertainment. As a result, more and more learning games found their way into the homes, only a few of them into companies.

After all Alan Kay's idea of a Dynabook, a personal and dynamic information environment, did not find its way into PC-based learning environments. Instead of implementing Kay's idea, the CBTs as another form of canned brain food, did not add much more to learning than the early systems already did. At the same time they were loosing the controlled rich learning environment of the campus mainframes of the 1st E-Learning generation. The educational technology was stuck.

1990s – 3rd Generation: Multimedia E-Learning

Personal Computers paved the way to media-rich computing environments. While the first PC-based systems did not provide much more than text, vector graphics, color and a few simple animations, *Multimedia Computers* added time-based media like video and audio, high resolution graphics as well as a high computing power for more sophisticated simulations. Today these multimedia machines and certain learning applications are even used by professional pilots to train for new airports or special manoeuvres. This is at least a kind of proof that these applications can be useful in demanding educational fields.

Game developers used the notion of teaching and learning to sell their products independently of any real pedagogical qualities. Historic events, settlements, development of cities or even social simulations deliver a high level of entertainment, which often has been sold as *edutainment*.

So the problem seemed to be solved at a first sight. Highly motivating learning environments were generally available. But who took care of the distribution? In some cases the producers and manufacturers of games and simulators. But they did not reach any substantial part of the educational systems. Some niches had been filled, but there was no broader effect to be recognised and actually the computer has not been used with its full potential of an *input-output machine to the real world*. So there is a dormant large potential left out for new forms of learning like educational *Mixed Reality Systems* (Winkler et al. 2002-2007). In applications like this, the learners are connected with much of their motor-sensory system creating a bodily experience. Learning takes place in a much more natural form bridging the gap between cognitive symbol systems and the human body.

2000s – 4th Generation: Distributed E-Learning

With the general availability of the internet in the developed countries a variation of CBT, the so called *Web-Based Training (WBT)* solved the problem of the distribution of CBT-modules. With linked knowledge structures combined with multimedia capabilities everything seemed to be solved like expressed in the early ideas of Vannevar Bush (1945). All former generations of E-Learning technologies like mainframes, PCs, and multimedia converged into one. The web brought the school or the university to your finger tips. Virtual education institutions like virtual universities including virtual campuses have been set up. Why going somewhere when you can get everything at home or even mobile (Melzer et al. 2006)? Content, campus, people all bound together onto one screen. The school of tomorrow, virtualized through high-bandwidth networks, high-performance processors, high-resolutions screens, high-speed frame rates implemented into a few hundred dollar device plugged to a few dollar flat rate network access line.

So is this the final solution? Learning and teaching anywhere, anytime, anything and without the loss of social relations? Educational systems take the form of 24/7 services. A Second Life® even in respect to education?

But what did we actually win? We packed mainly the old schooling system into a new technology. Like McLuhan told us about old media wrapped into new media (McLuhan 1964). The more realistic the rendering of contents, rooms and people the more we will step back to our old system. Of course, the physical schools expect us to be at their place at a certain time. So we defeated space and time somehow, except the fact that the people have still to meet sometimes. But what else did we get? Trouble logging in, incompatible drivers, new versions that need to be downloaded immediately to prevent the virtual world from crashing, lost data, and the same boring contents which have always been there, in the book, the video, the modules delivered by mainframe, the CBT CD-ROM, and the WBT via the web-browser. We are back in the old school curriculum, which has never been able to reflect the learner's knowledge or their goals.

2010s – 5th Generation of E-Learning: Individual E-Learning

With developments like Web 2.0 (o'Reilly 2005), there are some challenges and changes to enable us for another step in educational media. The main feature of the next version of the internet, the so-called Web 2.0, is that it will be a real participatory system, i.e. everybody who is online as a *consumer* can become a *producer* immediately, or, as Marshall McLuhan and Quentin Fiore worded it already back in 1967: *"The results are startling and effective. The perennial quest for involvement, fill in, takes many forms."*

But what does this mean for educational applications? Web 2.0 and its successors might be a better foundation of learning as it should happen in a natural way: a constructive, social, and dialectic process, where information from many sources, provided in many representations and presentations, are discussed, transformed, and bound together to a *personal knowledge space*. This of course has to happen in the human brain. Participatory web services however can play a key role in these individual learning processes as they allow creating personal web structures, annotating or augmenting the available sources and connecting to other knowledgeable people and their information spaces. The result will be a personal representation of externalized entities of personal knowledge and resources, whether in form of static information, programmed computing resources or connected human beings.

Participating in the construction of externalized knowledge has a highly motivational potential (Herczeg 2004; Melzer et al. 2006). It is driving the learners as they are receiving rewards for their contributions in many ways. Perhaps the most important award is the appreciation of others referencing and using their contributions. Another driving force it the incremental improvement of contributions by the long-term challenge of clarifying and enriching information. A similar effect can be found today in Web 2.0 applications like Wikipedia®, Flickr®, Second Life® or discourses in blogs and forums.

But how can a diffuse personal web be a regular part of our educational system? The principles are simple but the implementation seems to be difficult. We have to appraise and credit these personal heterogeneous information spaces that have been constructed by individuals. How can that be done? One way would be to markup content with socially accepted gradings. It is similar to checking and accepting new contents for a global encyclopedia or referring or even including contents into institutional or other personal webs. If the next generation of hypermedia is the *semantic web*, then its successor might be the *credited semantic web*. Content will receive credits and gradings by its community of users and contributors, perhaps large societies. So in the future it might be not so important to have some degree of some school, it might be much more important to be the author or co-author of relevant, i.e. highly ranked and intensively used contributions in the global information space.

Individual E-Learning in this sense does not only mean to guide the learning process by the individual learning history and goals, it will as well be validating and crediting the *traces* somebody leaves behind through his or her personal knowledge building process. So finally even the difference between learning and teaching will vanish. It is not needed any more since learning in this sense means teaching others by providing your traces. This would be a real process of *life-long learning* by using, enhancing and creating available information *mashups* to build up knowledge within a community. Or to say it with McLuhan & Fiore (1967) again:

> *"The Others: The shock of recognition! In an electric information environment, minority groups can no longer be contained - ignored. Too many people know too much about each other. Our new environment compels commitment and participation. We have become irrevocably involved with, and responsible for, each other."*

Summary and Conclusions

When we look back to the generations of educational computer-based applications, we can see that we transformed not only the educational content but also the didactic methods to adapt to new media forms. But these changes did not affect the basic principles how we learn and teach. Learning and teaching has still been based on the *canned brain food* approach: highly fragmented and decontextualized knowledge brought to the learners being generalized consumers.

Knowledge has always been a social construct. In the age of computer systems and the internet we should not regard it as our task to produce new forms of canned brain food. Instead we should find ways to create, use, and credit *individual knowledge traces* in common information spaces to value and use each other's externalized knowledge to construct new knowledge.

The new internet services and applications, summarized as *Web 2.0*, provide new platforms as starting points to practice participatory, social learning on a global scale. However, we still have to adapt our current educational system to these new opportunities, to appraise personal knowledge and contributions and make use of the full potential of these theories, technologies, methods, and applications. The result can be a kind of socially controlled *mashup* of externalized credited individual knowledge.

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