Electronic Education and its Utilization at the Czech Technical University in Prague

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Abstract—This article deals with the current problem of the electronic education, and it is centered on a research of the Internet support of education in the Czech Republic and at the Czech Technical University in Prague. Another main topic of this article is animation – a multimedia fundament of e-learning.

Index Terms — animation, education, e-learning.

I. INTRODUCTION

Electronic education

E-learning is in the present school system an often used term which could contribute to the improvement especially of distance learning but also of full-time study. It concerns a manner of education which enables one, to complement and support the standard education with employment of modern computer technology (in most cases of web technologies). E-learning is changing the view on current education and it influenced even the most important pedagogical-psychological theories of learning connected with technologies. If proper procedures are observed while preparing a course, then its application in education corresponds to modern conceptions of cognition: constructivism and connectivism. To the concepts of remembering, recalling, and learning are added the concepts of thinking, creating, and forming.

A proper e-learning course should also pay attention to gradually changing outer motivation of a student into inner motivation, and to accompany individual learning with learning cooperation. Its main attributes should be:

• Open learning materials connected to a number of expanding and elaborating texts.
• Methodological candor.
• Problematic approach with propounding of alternative views and theories, and consequently emphasis on critical and divergent thinking.
• Students can be included in preparing of the content

History

Electronic education as it is known today is a relatively new way of education, its history of which started to be written only in the 90’s of the last century alongside with the development of the Internet. Nevertheless, if we choose the broader definition of this notion, then as the first e-learning (in the sense of learning through technology) could be considered learning machines, first of which was constructed already in the 20’s by psychologist S. L. Pressey. But this machine did not come into its own. The next attempt at program learning appeared in the 50’s and even came to the Czechoslovak Republic where educational automaton Unitutor was created. However not even these automatons were successful, most probably as a result of their expenses.

The next milestone of e-learning was during the period of 1984 and 1993. An idea to support education by the use of personal computers arose with their development. It consisted mostly of distribution of educational content by floppy disks or CD-ROM, this manner of application is often called CBT (Computer Based Training). From the current point of view, this way of education has many problems, such as the inability to update the content of learning materials, or the fact that the student has no contact with a teacher or other students.

The history of the true e-learning starts after the year 1993 (although the term itself was not coined until 1999) alongside with the development of the web. At first there were only static sites, where learning materials were available, and communication with the teacher either did not take place at all, or only through e-mail. This phase is often called WBT (Web Based Training). Later, alongside with the development of Internet technologies, more elaborate courses have begun to appear, which enable better cooperation, contact with a teacher, and feedback. Moreover, also the content could stay up-to-date, due to easy updating of the sites, and become more and more multimedia.

Nowadays, e-learning has found its application not only in the educational system, but also in commercial firms, which use it in lifelong learning of their employees. As a result, there are thousands so-called Corporate Universities, which are one of the main driving forces of this method of learning.

Finally, the current situation in our country will be presented. First attempts to introduce e-learning appeared around the year 1999, and since then the number of projects dealing with this topic is increasing. Within the CTU the well-known conference Belcom also takes place. This conference is focused on monitoring of the new trends in the area of e-learning.

Course creation

Creating an e-learning course can prove rather difficult for many teachers. In order to create such a course it is necessary to be able to create a website. This requires knowledge of creation of html documents and in a case of websites with some active components also knowledge of programming e.g. in PHP. This is a big problem, because it cannot be expected that every teacher will be knowledgeable in the area of web technologies. Fortunately, so-called web content management systems (WCMS) can be used for creating of e-learning courses.
WCMS are nowadays one of the basic means used for website creation. They are mostly web applications (programs running on the Internet, which are approached through the browser) which enable almost anybody, even without any programming skills, to create and maintain websites. Their main purpose is to enable a visitor to log in and to add some text or other content, which will be saved and subsequently available for other users for viewing as a website (e.g. Wikipedia). However, they often involve advanced functions which would not be easy to create even for a skilled programmer. This includes various forums, discussions, inquiries and others (like e.g. on Facebook, which is a web application but not exactly WCMS). All these functions are moreover very well secured and debugged. For example Drupal, Joomla, or other systems on the basis of Wiki belong among popular management systems.

From that it was just a small step to utilize such systems for education-oriented website creation, and thus developed so-called LCMS (Learning Content Management Systems). They differ from ordinary WCMS by their specialization on creation of specific sites (educational online courses) and by adding some functions specific for education. Besides LCMS there exist LMS (Learning Management Systems). These systems do not serve to creating e-learning courses but to their operating and management. LMS thus enable to for example, follow results of individual students, appointing homework, or making available parts of courses created in advance in LCMS. It should be noted that many applications fulfill both roles. The best known LMS/LCMS in the Czech Republic is probably Moodle (see [1]).

II. UTILIZATION OF E-LEARNING AT UNIVERSITIES

- E-learning is being integrated as a part of education at many Czech universities and is created and run by LCMS/LMS systems. This integration of electronic education is at the present time of three types: (see [2])
- Electronic support of full-time study, classic education is mixed with elements of individual work of a student with electronic sources.
- Interactive elements are added to electronic support, classic education is in some cases limited
- Student gets access to electronic courses, and whole educational cycles. Classic education is limited to minimum, or it is omitted completely. Electronic support is highly interactive and even tests of knowledge are often realized this way.

Electronic education in the Czech Republic

An electronic survey was conducted at 12 universities, both public and private. Each university elected a competent person. It is evident from the results that all approached universities employ e-learning. The universities can be divided into those, which have just started with e-learning (0-1 year), those, which have medium term experience (2-5 years), and those, which have experience longer than 5 years (see fig. 1).

It is evident from the graph that majority of the universities is not in the initial phase. Distribution of information via the Internet prevails as information and communication means used by the universities in e-learning. Use of educational CD/DVDs is regressing and courses on the Internet prevail. This trend has a major advantage in updating the content of educational materials. Rising of the trend of using of video-conference is also evident. There is number of reasons why universities employ e-learning. The highest priority and profit of the e-learning has the student, which is also one of the right trends of the European e-learning.

An interesting finding was that the greatest obstacle in implementing e-learning at universities is a lack of interest among the staff. The cost of setting it in operation, technical problems in implementing, motivation and interest of students and other elements were not considered by the universities to be of problem while implementing e-learning.

The distribution in what form of study the e-learning is offered is very significant. Most of the universities directs the offer to the area of part-time, full-time and lifelong education. The offer by universities in the area of part-time education is very low. The main advantage of e-learning is independent study time. The offer of universities in this area is insufficient and should be at least comparable or better then in other forms of study. The main reason could be seen in a higher difficulty of implementing a purely e-learning form of study in part-time education.

Let us have a look at which systems do the universities use. The results show that the open source LMS Moodle achieved significantly higher representation than other LMS.

The ratio of e-learning and standard education at average is at Czech universities 17% to 83%.

Conclusion

The situation in the area of e-learning at our universities is diverse and commensurable only with difficulty. The concept of e-learning is very broad and generally includes various way of use of information and communication technologies for the education support. This makes difficult not only the orientation in the problem, but also any deeper comparison and evaluation. Various approaches exist for implementation of the ICT to education and for use of e-learning. The approach to this problem differs at the level of university, faculty, department, and even among the academic staff. The result of which is i.a. the fact that there is a very little communication even at the level of individual institutions of the same university. Various approaches for implementation of e-learning and incommensurable levels of universities result in isolation of universities from one another, i.e. the opposite of what the implementation of e-learning should help – interconnection of activities of the
universities, establishment of inter-university study, enabling the students to widen the mobility study. Little attention is still paid to the encouragement of staff motivation for this activity and to the development of their skills in the area of use of the ICT in education. Use of these technologies for the process of education and for communication with students is not always sufficiently supported and is thus concern of the more active members of the staff, the persons interested in these technologies, those who want to improve things. A disincentive in the further development of e-learning at universities is a use of a great number of types of SW for e-learning and their low compatibility, which prevents inter-connecting of the universities in this area. In this respect the massive implementation of LMS Moodle in the past few years seems very promising.

Current state of LMS at the faculties of CTU in Prague

The author was dealing with the project “Current state of LMS at the faculties of CTU in Prague and a preparation of a common methodology for creation of courses via LMS” Within this project a survey was conducted whether the so-called Learning Management systems (LMS) such as MOODLE, CLASERVER and others are used at CTU. The survey yielded extensive results. It was conducted at all faculties of CTU and it targeted both staff and students. A fraction of results is presented in this paper. Another important output is the common methodology for creation of courses in LMS and training of teachers.

Results of the questionnaire survey of the staff of CTU.

183 university teachers from CTU participated in the survey. Are teachers technically able to create e-materials for courses organized by LMS? 20% of teachers believe that they are able to technically create e-materials for courses organized by LMS and have no problem with it. They claim that they can create even technically demanding applications. 18% is able to create a common (simple) course. 9% is able to create an e-course only with help of the IT department or of a colleague. Majority of 53% states that they have never had an opportunity to try something like this and have never created any course.

What is the experience of teachers with creation of e-courses? Only 5% has a positive feedback from students, who praise the course, and the course is constantly improved on the basis of their suggestions and comments. 24% stated that a course has been once uploaded into the system and since then they have been rarely modifying it or adding new materials and have no information about its utilization. 5% stated that they are at loss how to create such a thing, although they are specialists in their respective fields of study. They do not know how to transform a curriculum into an electronic form; the methodological support for creation of these courses is lacking. The remaining 62% stated that they have no previous experience.

64% of teachers believe that they do not have sufficient information about the option of using LMS. Only 36% thinks that they have sufficient information.

52% of teachers thinks that a strategy for application and development of LMS does not exist at their institution/department. 32% stated that the strategy of development existed at their institution, but that it depends on individual teachers if it suits them and if they are interested in using these systems as a support of the classes they teach. 16% stated that they are informed about basic trends and requirements, and that they follow these rules.

Regarding personal opinions on the subject, 23% think that including of LMS into the education is important, meaningful and beneficial. 56% think that it is a suitable supplementation for the contact form of teaching. 19% do not know and only 2% stated that it rather hinders their
work, and that they do not see a clear benefit in implementation of such system into practice.

70% stated that they have not actively used LMS in their classes yet. 30% actively use LMS in their classes.

This partial survey confirmed main hypothesis that teachers do not have required technological and methodological knowledge for creation of e-courses in LMS. This situation is further reinforced by the fact that teachers at individual departments do not feel sufficient support from the administration for implementing LMS. Another important fact is that the teachers who are running e-courses do not fully utilize options of LMS. With respect to application of LMS to their classes, they are content just with distribution of files.

III. ANIMATION – A MULTIMEDIA FUNDAMENT OF E-LEARNING

Animation

For teaching a technical subject at high schools and universities, it is necessary, for example in constructive geometry classes, but also in number of others, for a student to have a spatial imagination. Also vividness is often crucial for understanding the discussed topic. The creation of a system of ideas and notions on the basis of a direct perception of real objects is heavily utilized by teachers of technical subjects, but it has its limits. Technical diagrams or photos are also an excellent aid.

However, from the previous lines it is obvious, that utilization of just verbally-illustrative vividness based on verbal description of phenomena can prove difficult for the students. Especially, if we cannot rely on the experience of the students. Thanks to the huge development of the computer technology, new options to support vividness are now available. This new type of vividness could be called “media vividness” (its main representative is an animation).

The animation with its conception belongs to the illustrative-demonstrative methods (see [3]), while combining demonstrations of visual information with dynamic projection. Reasons for use of visual information come from the findings of cognitive psychology. From the point of view of human psyche, an image is perceived differently then text information. We can say that an image has a closer relation to the physical world than a verbal description, because its structure preserves the structure of the world (see [4]). A student, while watching an animation, undergoes a process of indirect observation (he/she observes a mediated model) and purposefully perceives presented facts, from which he/she creates notions about the phenomenon or technology. However, the animation should also motivate a student for other activities and encourage his/her interest in the subject. The already mentioned option of publishing the animations on the Internet is closely linked with the didactic principle of continuity and permanency. A student thus has an option to come back to the animation during home preparation. Respecting an individual pace of a student is another advantage. The animation is thus a continuation of a usual classwork and fulfills especially a consolidative function.

Historical development of animation

The idea of using animations in education is not new. It builds on basic knowledge of J. A. Comenius, that a man easily remembers and acquires new knowledge through visual information, or even better through all senses. A correctly conceived animation can come very close to this statement.

If we looked into the past for a moment, we would learn that animated presentation of the curriculum was realized by various means. In times of nonavailability of electronic media, the animations were made with a paper, translucent foil, or special lighted show cases with electromechanical drive. Further development was based on electronics and mass spread TV broadcast, which enabled to include television educational programs into the traditional classwork. These already included some animated elements, but they were made by classic techniques known e.g. from the film industry. Subsequent development did not take long and was connected with the expansion of the VCR. It become possible to tape programs from the broadcast or to play bought educational programs distributed on the VHS cassettes.

Along with the development of the computer technology, its use in pedagogic and didactic practice also changes. Times, when a computer served only for teaching of programming techniques, is long gone. In the process we learned the advantage of using computers not only as a tool for a specific course, but also as a tool testing and evaluating the knowledge of pupils and students. With the rise of the Internet, other important changes in the methods of education support have occurred. Teachers created for their students supporting webpages for the classes, where they e.g. published study materials. Thus an option to study “long distance” (do not confuse with part-time study!) appeared, i.e. studying via the still expanding worldwide computer network. Nowadays, we can see development of whole electronic educational systems with the Internet support and of other conveniences such as e.g. animations, simulations, or electronic learning.

IV. UTILIZATION OF THE ANIMATION

Utilization of the animation as a didactic tool in education can be justified in several ways which usually originate from the following notions:

• Displaying of a simulated model
• Displaying of phenomena which cannot be properly processed by other didactic tools
• Equipment which because of its size or hazardousness cannot be demonstrated by other model
• Displaying of technologies which are costly (money-, time-, or otherwise) or inaccessible
• Utilization as a didactic tool

However, it is also necessary to deal with the other side of the problem, specifically to note negative aspects of animations. Some of them were summarized by J. Skalková (see [5]). The primary examples are lesser contact with reality and reduction of a first-hand experience of students. Young people can thus get the idea that they have learned everything through the animation and that they do not need to come in contact with actual objects or phenomena. That is clearly fatal mistake, consequences of which could be immense. Negative aspects can also be seen from the point of view of health, where continuous sitting in front of a computer limits
optimal physical development of young people. By utilization of such modern means, several other problems regarding teachers come forth. One of them could be a transfer of control of an educational process from a teacher to a student which could lead to an elimination of an influence of knowledge and experience of a teacher. That could be a source of ineffective learning of a student and of a loss of orientation in a discussed topic. Moreover, the student’s ability to gain information from a teacher about relevance e.g. to other fields of study is dramatically suppressed. We can also notice an indispensable pressure on a continual self-education of a teacher who should be well acquainted with new conditions in education.

Classification of Computer Animations – Taxonomy of the Technical Animation

Computer animations designed for pedagogic purposes can be divided into several categories according to the way of looking at them. From didactic point of view the animations can be divided:

According to the student’s activity:

- Passive, where a student only observes what is presented to him/her.
- Active – a student actively participates in running and displaying of the animation. The student can manipulate with certain constituents of the animation. If the student is not active enough, the animation does not run and becomes only a static picture.

Classification of Computer Animations – Taxonomy according to Didactic Function:

- Motivational – a motivational animation is usually applied by a teacher at the beginning of a class during an introduction to the discussed topic. The goal is to get students’ attention and to get them engaged in the presented problem.

An example of the motivational animation:
Electric power generation (see fig. 5).

Illustrative – they are designed to provide insight to the patterns of the presented phenomena, technologies, or processes. They aim to explain studied phenomenon, technology, or process in great detail with emphasis on illustration, clearness, and intelligibility. A student has a passive role of an observer and creates basic notions about given problem on the basis of the observation.

Examples of the illustrative animation:
- soldering of components by SMD remelting process (see fig. 6)
- principle of an extruder for cable production (see fig. 7)
- 2 and 4 stroke engine (see fig. 8)
- thermal treatment (direct bainite transformation) (see fig. 9)

Here, it is important to note that the line between the motivational and illustrative animation is not clear-cut. Often we can encounter the combination of both. In such cases we will talk about the illustrative-motivational animation.
Demonstrative-interactive animation – a student actively participates and can affect components of the animation (e.g. to change parameters of the presented phenomenon, technology, or process). The animation is usually made of a programmed simplified in most cases physical model, which corresponds with the patterns of the real world.

Examples of the demonstrative-interactive animation:
- Presentation of Snell law (see fig. 10)
- Laboratory devices for introduction of impregnating processes (see fig. 11)

Diagnostic, practicing of the subject, examination, where a student affects the animation and tests acquired knowledge. Here, it is necessary for some form of feedback to be incorporated to inform the student about correctness or incorrectness of the answer. As an example can serve dividing of electronic components into correct categories, creation of a correct network schema, creation of a cycle of the heat pump, etc.

An example for practicing the subject:
- The principle of the heat pump – example of the practice part, creation of the cycle of the heat pump (see fig. 12)

According to the way of displaying with regards to the representation in space:
- Two-dimensional (2D), where plane geometric figures are used symbolizing specific parts of the technology. Isometric view can be also used (so-called 2,5D) for emphasizing possible dimensional configuration of the presented symbols.

An example of the two-dimensional (2D) animation: Characteristics of a silicon diode (see fig. 13)
Three-dimensional (3D) – all objects in the animation are represented by three-dimensional depiction and are also displayed in such manner on the screen. Some of the modeling tools are necessary for their creation.

An example of the three-dimensional (3D) animation: Witness program – presentation of an industrial process (see fig. 14)

Figure 14. Witness program – presentation of an industrial process

According to the availability:

- Generally available, e.g. on the internet, commercially available educational CD-ROM
- Restrictively available, only within specific educational facilities

It is obvious that these basic categories can be combined with each other. The classification could be further specified, e.g. on the basis of specific specialized subjects, but that would be beyond the frame of this paper.

A simulation can be understood as a specific case of the animation. Simulation – it is a visualization of a specific mathematical model, which requires setting of input parameters. The mathematical model generates form the parameters output data. Input data are usually in the form of specific physical quantities (e.g. tension, temperature, pressure, force). The difference between a simulation and an animation is an incorporation of random phenomena, which exist in the real world and affect final behavior of the presented model. As an example can serve a simulation of an industrial process, a proposition of an interior lighting, a proposition of a traffic operation, etc.

An example of the simulation: A simulation of a cutting process in AdvantEdge program – thermal stratification (see fig. 15).

From the practical point of view, a number of partial animations are being created without consideration of didactic aspects, which in our opinion is not entirely appropriate approach. Therefore, our aspiration was to bring to the issue some theoretical order, which could be a fundament for a subsequent research of theoretical bases for the creation of the educational animations.

One of the goals was an attempt to work out certain categorization, description, and explanation of specific variants of the didactic animations, which pedagogic staff can encounter in their profession. An emphasis was mainly laid on the didactic aspects of the animations.

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