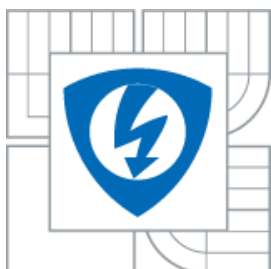




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## NEW TECHNOLOGIES IN EDUCATION

NOVÉ TECHNOLOGIE VE VZDĚLÁVÁNÍ

BAKALÁŘSKÁ PRÁCE

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## **ABSTRACT**

The aim of this work is to explore, summarize, and organise the most influential educational technologies. Furthermore, compare these technologies with each other and divide them into specific categories, such as educational software, websites with learning tools, electronic encyclopaedias, mobile devices, and devices whose main purpose are solely educational. Summarizing these technologies and putting them in an order will help other students to decide what could suit them most and what, on the other hand, has no use for them. It is also the aim to underline the most useful technologies, help to understand their basic functions and their main purposes, and most importantly show their advantages and weaknesses.

## **KEYWORDS**

Educational technologies, learning tool, teaching tool, typewriter, overhead projector, carousel slide projector, educational software, educational application, website specializing in education, electronic encyclopaedia, Wikipedia, TED, Khan Academy, Study Blue, Celly, LessonCast, Zotero, phablet, smart board, document camera, digital projector, process of learning, cloud computing, e-learning, virtual classroom, synchronous learning, asynchronous learning.

## **ABSTRAKT**

Cílem této práce je prozkoumat, shrnout a uspořádat nejvýznamnějším vzdělávací technologie. Porovnat a rozdělit tyto technologie do konkrétních skupin, jako například výukový software, internetové stránky s výukovými nástroji, elektronické encyklopedie, mobilní zařízení a zařízení, jež mají pomáhat s výukou a také ji ulehčovat. Pokusit se tyto technologie uspořádat a vytvořit tak systém, který by pomohl ostatním studentům rozhodnout co je pro ně nejlepší a co by naopak byla ztráta času. Dále je také cílem vyzvednout nejužitečnější technologie a pomoci pochopit jejich účel a význam, a hlavně poukázat na jejich největší přednosti a slabosti.

## **KLÍČOVÁ SLOVA**

Vzdělávací technologie, výukové nástroje, učební nástroje, psací stroj, zpětný projektor, kolotočový diaprojektor, vzdělávací software, vzdělávací aplikace, internetové stránky specializující se na vzdělávání, elektronická encyklopedie, Wikipedie, TED, Khan Academy, Study Blue, Celly, LessonCast, Zotero, phablet, chytrá tabule, snímací kamera, digitální projektor, proces učení, cloud computing, e-learning, virtuální učebna, synchronní učení, asynchronní učení.

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V Brně dne .....

.....

(podpis autora)

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Děkuji vedoucímu bakalářské práce PhDr. Milanu Smutnému, Ph.D. za účinnou metodickou, pedagogickou a odbornou pomoc a další cenné rady při zpracování mé bakalářské práce.

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# INTRODUCTION

‘New technologies in education’ is a very broad term which contains numbers of tools and ways that allow people to learn or teach, usually much easier and faster. It was the intention to use the Internet as one of these technologies to write a chapter that describes and compares this powerful tool with other technologies, but the vast majority of these technologies work through the Internet and therefore it would be very difficult to organise them by using Internet as the point of origin. To prevent this it is necessary to use the Internet for comparing and explaining other technologies, although not as one of these technologies.

As was mentioned before, the vast majority of technologies that are described in this work are directly using the Internet and therefore this work focuses on certain type of technologies, as social networks (either specializing in education and not), websites that provide knowledge (*Wikipedia*, *TED*, *Khan Academy* etc.), educational software, and other tools working through network and based on sharing. Naturally, it would not be possible to use these technologies without computers which are nowadays in every school. The main part of this study is divided into three parts that deal with non-material technologies (programs, websites etc.), material technologies (laptops, tablets, smart phones, projectors, smart boards etc.) and e-learning (one of the most influential phenomenon of educational technologies).

The aim of this work is to study and summarize the most influential educational technologies and help to understand their functioning, main purposes, integration into an educational process, their influence (beneficial and detrimental) upon students and teachers, and most importantly show their advantages and weaknesses. Following chapters try to achieve these goals by describing and acquainting both old technologies, primarily from the last century, and new modern technologies. It means that, besides a short history of all important technologies and technological means in education, the chapter *Educational technologies of yesterday* represents a history of this work and provides a better insight into the main topic. Among others, this chapter examines technologies such as typewriter, overhead projector, slide projector, or radio, and it serves as an introducing part.

# **1 EDUCATIONAL TECHNOLOGIES OF YESTERDAY**

## **1.1 Introduction**

The purpose of this chapter is to introduce, properly explore and describe technologies that were, and some of them still are, prior to those which are used nowadays and they could be called new. Technologies that have much longer history of serving to educational purposes, and thus have been incomparably more verified and improved. Now they can help on the way to better understand not only present technologies themselves, from a technical point of view, but also to their role in an education process or their impact on students and teachers. Therefore, one could say that this chapter is a history of the new technologies in education, because it is necessary to firstly establish some basics (in this case old technologies) in order to better understand the main topic.

Arguably, from already written, one can object that even a blackboard or a desk can be considered as an educational technology and in that case it would take a lot of time (through a few centuries) to get from the blackboard to technologies we use nowadays, and even than it would not have to be enough. For this reason, the chapter deals only with the most influential technologies of the last century, such as typewriter, different types of projectors, tape recorder, television, video player, or radio.

## **1.2 History**

The first principal change caused by technological development applied into education in 15<sup>th</sup> century was typography, but as was mentioned above, it is desirable to start later. Therefore, from historical point of view, if one focuses only on technologies that were considered to change or replace standard educational processes, only computers accomplished that (partially so far). In all previous cases (all major inventions) predictions were the same: this will revolutionize education; it will replace all study materials and delivery of knowledge as we know it. However, none of these predictions were fulfilled, as Brdička recapitulated, “At the beginning of the 20<sup>th</sup>

century the invention of film evoked ideas of replacing traditional educational processes. Similar expectations arose when the radio, tape recorder, television or video player appeared. None of the technological means succeeded in replacing traditional textbooks and changing traditional educational processes. In 1970s and 80s another period of enthusiasm started when personal computers were launched and spread widely.” [1] (*Role internetu ve vzdělávání*, 89). This time expectations were much stronger and computers seemed to be able to replace both textbooks and teachers.

The next paragraph describes an overview of the last century. The beginning of the 20<sup>th</sup> century is usually connected with the use of photography materials and introduction of devices presenting static projection to schools. In the 1920s, traditional teaching processes were expected to be replaced, or at least influenced by the use of cine technology in education. The radio broadcasting development came in consideration in the 1930s. Great expectations were placed upon 8mm cine loops and the development of recording a sound (tape recorder). In the 1960s, it was language laboratory, telecasting development, and some other new technologies that lead to programmed instruction (technology invented by the behaviourist B. F. Skinner based on his theory of verbal behaviour to improve teaching). In the 1970s it was video technology, distance education, and computer assisted teaching, mainly thanks to rapid technological development in these fields. The development of interactive video technology started in the 1980s and in the 1990s, it was the global expansion of computer networks and satellite technology.

## **1.3 Examples**

### **1.3.1 Typewriter**

According to American Heritage Dictionary, “A typewriter is a writing machine that produces characters similar to typeset print by means of a manually operated keyboard that actuates a set of raised types, which strike the paper through an inked ribbon.”[2] (*The American heritage dictionary of the English language*). It is a piece of technology that was, in its time, used rather by teachers than students, although before

computers (and even a long time after) the typewriter was the only way how to write a thesis or any academic work, therefore indispensable for gaining an academic degree.

As regards educational purposes, typewriters, especially old models, were not intended for educating and before this tool managed to fully utilized in schools it was displaced by computer, although in words of Mark Magnier, “...word processors and personal computers had largely displaced typewriters in most of these uses in the Western world, but as of the 2010s the typewriter is still prominent in many parts of the world, including India.” [3] (*Typewriters live on in India*). However, thanks to them learning and teaching became brisker without interfering with educational processes (which is something that cannot be said about computers).

### **1.3.2 Overhead projector**

Overhead projector is a projector that throws an enlarged image of a transparency onto a surface above and behind the person using it. Alterations and additions can be made to the material on the transparency while the projector is in use [4]. This tool is broadly used even nowadays, in particular in old lecture rooms or halls without modern digital cameras and by teachers who are accustomed to delivery their lectures in this manner (sometimes simply because of many study materials prepared for overhead projectors). It can be said that overhead projectors were, and somewhere still are, predecessors of document cameras or boards which are not used nearly in such a number as their predecessors.

The possibility to project pictures and text that was easy to create and interact with it, as explaining some principle on it, was a huge step for both teachers and students. From their adoption in the late 1950s they were widely used in schools for almost half a century.

### **1.3.3 Carousel slide projector**

For the vast majority of younger students is this technology simply something historical, however, from technological point of view, it is a newer technology than, for example, previously mentioned overhead projector. A carousel slide projector is a common form of slide projector, used to project slide photographs and to create slide shows. It was first patented on May 11, 1965, by David E. Hansen of Fairport, NY. Mr. Hansen was an engineer at the Eastman Kodak Company [5].

This technology was very straight forward. It used images on a 35mm slide placed in a circular tray that contains 140 slides, and therefore it was able to project an instant slideshow. This form of technology is not used in the classrooms anymore since a slideshow can be run from a computer connected to a digital projector (however, many photographers still adhere to the carousel projector for their slideshows).

### **1.3.4 Radio**

Radio had been used in education for the period of more than 80 years and in its time it has been used in many different ways, such as school broadcasting, informal general education, adult basic education, or literacy. In the 1945, William Levenson, school radio principal claimed that, “The time maybe comes when a portable radio is so common in the classroom as the blackboard today.” It was one of the many predictions that stated that the revolution of education caused by using the radio, for example distant learning where students are taught by a teacher through a radio signal. All these predictions failed, however, even though the radio is not used in schools anymore (at least not directly), it still serves to educational purposes. For example, one can listen to lectures or discussions on the required topic on various radio channels.

### **1.3.5 Television**

In the 1960s, when the television was introduced to wider population, it competed with the radio, both in the entertainment and the educational field. From today's point of view it appears that the television won, although, the radio had the upper hand from the beginning. Television was, and at some schools still is, used mostly for showing educational movies. Nowadays, the television is being replaced by digital projectors in the schools and the Internet in an entertainment field. It is safe to say that the *BBC* or *Discovery* channels are the most educational features that one can encounter.

## **1.4 Conclusion**

In the same way, in which one can argue that these technologies are only from a short period of long educational history, one can also object that computers should be considered as an old technology too. It is true that computers and with them information technologies firstly appeared in education in the 1960s, but it is also true that computers are still under development and, for example, a tablet cannot be considered as an old educational technology. For this reason, computers are not a part of this chapter, but instead, their history is described in the following chapters.

From a long history of educational tools and technologies it is obvious that the main advantage, in comparison to modern technologies, was their slow inclusion into the educational process. Each of these technologies had enough time to integrate itself into the way of learning and teaching, and thus not to interfere with the process of learning. Moreover, teachers and students had time to accustom to new technologies and perhaps even improve them.

## **2 IMMATERIAL TECHNOLOGIES**

### **2.1 Introduction**

This chapter is focusing on the type of technologies which are in the form of ones and zeros. Even though these technologies are basically virtual, one cannot use them without computers and with so many computing devices that are every day more and more mobile, the number of applications, programs, or simple supportive software is rapidly increasing. This software is usually different from each other depending on what area of learning is focusing on (memorizing and practising gained knowledge, learning how certain technology or machine works, or simple providing valuable knowledge).

In this chapter, this software is divided into two parts. The first part includes all software that can be considered as an educational (from very sophisticated educational programs to only supportive ones), except for websites which are included in the second part. Furthermore, websites can be divided into other parts; websites that have educational features and show one's progress and improvement, websites that are strictly informative, such as encyclopaedias, dictionaries, or glossaries, or social networks that have to be considered as a special part of websites, since they are widely used by academic community.

### **2.2 Educational software**

#### **2.2.1 History**

The use of computer software in education dates to the early 1940s, when American researchers developed flight simulators which used analogue computers. As the history is concerned, it is necessary to mention a software phase that had a huge impact on the integration of software in educational processes. However, as was mentioned above, software needs hardware, and therefore a hardware phase was the one that started the evolution of educational technologies. That led to a need of software

and the software phase can started, as Gadušová described, “In general concentrating on the hardware aspects means to deal with the development of effective instructional equipment – overhead projectors, slide projectors, tape recorders, CD players, television equipment, computers, multimedia systems, which should be reliable, serviceable and within the budgets of schools. When such hardware became generally available, it was found that there was a shortage of suitable software to use with it.” [6] (*Technology of education: terminology in use*, 17). This triggered off the software phase. In the software phase the educational technology became associated with psychology and learning processes, since the main thrust changed to the development of suitable software.

Programming languages from the 1970s, particularly *BASIC* or *LOGO* can also be considered educational. These languages were specifically targeted to students and beginning computer users. By the early 1980s, the availability of personal computers, including the Apple II and all types of the Commodore computer, lead to the creation of companies specializing in educational software.

Nevertheless, major developments in educational software happened in the 1990s, and they were made possible thanks to advances in computer hardware, such as multimedia graphics and sound whose application in educational programs rapidly increased in this decade. CD-ROMs became the preferred method for content delivery with several digital encyclopaedias released as Multimedia application CD-ROMs. With the spread of the internet in the second half of the 1990s, new methods of educational software delivery appeared. The 1990s were a time of growth for educational software and virtual learning environments, especially due to an increasing number of affordable computers and of the Internet. Today, educational institutions use virtual learning environments to provide better accessibility to learners.

### **2.2.2 Power of the open source**

The new trend of these days is an open source. The open source dates back to 1970s when first programming languages were created, and since the ICT was integrated into an educational system it took a very important part in it. Then, in the last decade, the Android system arose and changed approach of software developers. It is true, if one talks about the open source, that this system cannot be considered to be the one, but the possibility to develop fully supported applications and programs for this platform by independent developers is a huge step forward (and to an idea of the open source). Not to mention that all today's technological development has financial purposes in the first place.

In the time of smart phones and independent developers is this approach very important, since it is usual for today's student to have a phone that can handle many variations of learning applications that are available for free. Therefore, every student can educate himself through a large number of these applications. If one wants to use one of these programs he can find applications based on the flashcard principal, mobile electronic encyclopaedias and dictionaries, wordfind applications, or applications with test based questions, and many more.

This is not the main stream, when it comes to schools, universities, or educational institutes, but it is very accessible, free (mostly), and in the time when the educational process is much more individual than in the past has every extracurricular education great importance.

### **2.2.3 Media as an educational tool**

Nowadays, it is very fashionable to put media and media features into everything, mostly because of their entertaining properties. That means one can use, for example a computer, smart phone, or tablet to either educate or entertain himself. When these two activities occur at the same time, then media serves to educational purposes. Social media can be very useful, for instance many students and even teachers use *YouTube* videos in their presentation to explain and describe certain functions or

behaviour. If one wants to improve his second language but does not have money or time to invest into a journey abroad, there is no better way to learn desired language than to chat or speak online with foreigners. On the other hand, the reliability of this type of learning can be very poor, as Šabatová stated, “In today’s perspective of modern ICT we have realized that multimedia processing and access to source are far from the heart of high-quality education.” [7] (*On contribution of modern technologies towards developing key competences*, 66).

#### **2.2.4 Examples of software**

*Study Blue* is accessible in the form of a website, however, it is downloadable as an application into a smart phone. Libraries of online study materials, study guides, flashcards, and similar educational tools can be found in this software. This features make of this application perfect educational tool for the smartphone, therefore one can access it everywhere and anywhere.

*Celly* is a text-messaging network that allows to create the network anywhere, for example in a classroom. That brings opportunities to express everyone’s ideas, although it can be easily misused. Teachers that have used this in their classrooms have noted that those who normally never speak up, do. It forces students to write their thoughts clearly and concisely. Rather than fighting the tide against texting, instructors are using it for academic purposes [8].

*LessonCast* allows teachers to submit their lesson plan strategy, ideas, or resources using video, documents, and presentations and share it with other instructors or students. Its main goal is to provide information and proper instruction tools (for example the most suitable explanations and descriptions, quotes, or references) to help inexperienced teachers, but it can be also used as a teaching tool.

*Zotero* is reference management software whose main purpose is to manage bibliographic data and related research materials. As other software of this type, it is very desirable to manage easily references to other sources, especially in the time of the Internet and electronic materials. It is free and open source. This software offers

features such as web browser integration, generation of in-text citations, online syncing, footnotes and bibliographies, as well as integration with the word processors.

These were just some examples of educational software, since there are so many different types of programs for all age groups. For example, software to practice dictations, math, physics, typing capabilities, or even software with preschool games that prepares children for their school age. If one wants to put his hand on this type of software, there are companies which focusing on developing these programs, such as *LangMaster* or *Terasoft*. Problem of these companies is that with so many free and open source programs their demand is low, which does not change the fact that their reliability, in compare to free software, is very high. That is their biggest advantage.

## **2.3 Websites**

### **2.3.1 Educational websites**

As was mentioned in the introduction, these are websites specializing in education which means that they offer not only information and explanation but also some educational tools and functions (for example provide tests or show achievements and success). These are called interactive websites for education.

These websites work with a simple fact, “Object teaching is a way of knowledge acquisition based on the fact that the beginning of real knowledge must come through the appropriate exercise of the sense. In this method of instruction illustrative objects are employed to accompany new words, facts, ideas, processes and so on to bring them closer to learners.” [9] (*Technology of education: terminology in use*, 23). According to this statement, interactive websites engage students by providing them information and resources along with practice, simulations, and other learning activities. Some websites go even further and give participants a reward in form of points or unlocking new features which is another good aspect that motivates to more and more practise. The disadvantage is, paradoxically, their large number. Therefore, one has to devote great

amount of time to find a suitable one. Examples of these websites will be given in the following chapter.

### **2.3.2 Informative websites (encyclopaedias)**

Since the first appearance of computers, there was a great desire to transform all materials (academic texts, study materials, laws, or a fiction literature) to an electronic form. Invention of electronic ink, along with e-books and e-book readers, just expedites this desire and it seems that many schools and universities have already adapted to this trend, since the number of just printed materials is decreasing.

The term of information literacy, which takes a very important place in our society, is associated with this trend. The term, as Hašková wrote, "...has become part of our vocabulary in 1970s. It defines an individual's ability to identify the necessity of gaining information, specify which information is required for solving a task, find it, consider its reliability and adequacy, organize it and apply to effective solving of the problem. Despite the information literacy phenomenon did not arise in the period relating to transformation of the post industrial society to information one, but just in this period it has been more and more important, it is even considered a characteristic feature of this period." [10] (*Technológia vydelávania*, 7-10).

The main advantage of electronic encyclopaedias and dictionaries is the search engine and updateable properties, thus one can find very quickly up-to-date information on desired topic. On the other hand, lack of references and links to reliable sources is still problematic.

### **2.3.3 Social networks**

Social networking sites are very attractive environments for today's students, as well as for adults. Such sites present opportunities for a self-expression and a friendship building, and can help build skills that will be a foundation for career success in this

century. Many young people are safely and responsibly engaged in, for instance according to their career, communities.

If one speaks about social networking, the *Facebook* is the first thing that crosses people's mind, but this social network has not exactly educational goals. However, there are various networks that focusing on these purposes and educational development. These networks are certain type of virtual classes which is enormously suitable for distant learning. These websites also offer most of the features that were mentioned in previous chapters.

The problem of social networks is obvious, unsafe disclosure of personal information, addiction, cyber bullying, or possibility to get involved into dangerous communities. Plus many students devote their time to social networking and that at the expense of the proper educating.

### **2.3.4 Examples**

*Khan Academy* can be the first and a perfect example of an educational website where students can take tests and exercises from many subjects and be rewarded with points and an access to higher levels, thus it also motivates learners. This website focuses on all basic educational topics and delivery of information through videos. According to their sites, Khan Academy is a non-profit educational organization created in 2006 by educator Salman Khan to provide a free, world-class education for anyone, anywhere. The organization produces micro lectures in the form of YouTube videos [11].

*English Me* is another example of an educational website that, as the name implies, is focusing on the English learning. One can find on this websites customizable learning schedules, a vocabulary trainer, smart tests, completion of sentences, listening, grammatical drills, or tests based on a description of pictures. All this after choosing a proper difficulty level, plus with detailed response to all mistakes. Moreover, one can see his full progress, for instance a number of words that he encountered so far, divided between already known and forgotten words showed in detailed graphs.

*TED* is an example of the informative website. This website is using videos to deliver information and knowledge. All these videos are in the form of lectures lead by thinkers and doers and their uniqueness is that they are not strictly informative. In every video, one can encounter interesting ideas. Even though the main purpose is to deliver information, *TED* is not exactly an encyclopaedia type, thus it is rather for gaining knowledge or interesting facts and ideas on chosen topic, than for searching information.

*Wikipedia* has to be mentioned here, since it is the biggest and most used electronic encyclopaedia in the world. The reason for that is its open source principle which, on the one hand, allows it to be comprehensive; on the other hand, it downgrades reliability of significant amount of information. That it is the biggest disadvantage of this encyclopaedia.

*Computing++* is a social network that is focusing on a certain educational topic. This platform helps teachers and students learn computing and computational thinking. The goal, according to the website, is to increase the amount and level of computing education in schools [12]. This web-based portal tries to unite as many people skilled in computational thinking as possible and offers them to collaborate with each other, therefore when one has a problem he can post it on this portal and solve it with help of others, and vice versa.

*Epic Ed* community is designed to empower educators such as teachers, instructional technology facilitators, administrators, or technology officers as they make the digital transition in their schools. *Epic Ed* offers opportunities for collaboration (for example a lesson planning), access to specific content, or classroom management strategies, It helps using technology for ongoing assessments and connect with colleagues to discuss or elaborate lessons [13].

*aPLANET* (Autonomous ‘personal learning networks’ for language teachers) is a social networking website for language teachers. Members get to meet educators from all around the world discussing issues dealing with language teaching and other problems. It is based on the same principal as *Computing++*, but it focuses on a different topic. The purpose is, as in case many similar web platforms, to offer engaging the right community.

## 2.4 The cloud, the future of educational technologies

The purpose of this chapter is to provide a brief insight into the following years and state some predictions.

Many predictions that deal with this problem strongly agree with one thing, the cloud. As Matt Britland, head of ICT at Kingston Grammar School, said, “Forget devices, the future of education technology is all about the cloud and anywhere access. In the future, teaching and learning is going to be social.” [14] (*What is the future of technology in education?*). Technology can be a barrier between teaching and learning and the cloud is trying to remove this barrier. No one can certainly know what the new computing devices will be in the future, but it is certain that they will need the cloud. Therefore schools will only need one thing to be prepared for the future. They will not need installed software, servers or data storage. They will only need a fast and solid internet connection. If the network is slow and things are not working properly learning and teaching will be problematic. Teachers can use the cloud to set, collect and grade work online and students have instant access to grades, comments and work, by using computers, smartphones or tablets.

“With the cloud, the world will be our classroom. E-learning will change teaching and learning. Students can learn from anywhere and teachers can teach from anywhere.” [14] (*What is the future of technology in education?*).

## 2.5 Conclusion

The disadvantage of applications or websites that provide knowledge is their reliability, since merely everybody has an access to them. On the other hand, their biggest advantage is accessibility and mobility. Furthermore, there are programmes for everything, however that could be a disadvantage as well as an advantage.

As regarding software aspects of education, one cannot properly examine them without encountering hardware. Although after a period of electronic equipment development, the attention was turned to the development of suitable learning materials

based on the currently dominant theories of learning and perception. In general, the software aspects of educational technologies are connected with various things that are used with hardware devices, such as overhead transparencies, slides, audiotapes, CDs, videotapes, computers and so on. Development of educational software became much more associated with psychology and learning theory.

As was already mentioned, a problem of today's society is not to find information, but to find proper and reliable information. As Poulová mentioned, "Learning skills are not merely based just on reading ready-made materials. One of the leaning skills of the third millennium is 'smart googling', which means the ability to find key words; define and redefine the most important information; and find; evaluate and organise resources." [15] (*On contribution of modern technologies towards developing key competences*, 82). One of the currently most encouraged tendencies in education is to promote students' responsibility for their own studying results and weaken the role of teachers as the main source of knowledge [9].

## **3 MATERIAL TECHNOLOGIES**

### **3.1 Introduction**

In the past was very fashionable to bring a laptop in a classroom and typewriting on it, nowadays, tablets and smart phones are preferred, or as it is called ‘phablet’ (blending of words phone and tablet; stands for a smart phone with a very large screen). Almost every student brings his study materials on his mobile device since they are broadly used, as the results of the last year show. Sixty percent of students are using mobile devices for anytime research, 43 percent for educational games and 40 percent for collaboration with their peers. Thirty-three percent of students surveyed use mobile devices for reminders and alerts related to their academic lives, 24 percent for taking photos of their assignments, and 18 percent for in-class polling [16].

The most used devices are personal mobile computing devices, such as laptops, tablets, and smart phones, although they are usually misused for other activities. In addition, there are smart boards, document cameras, and digital projectors, which are examples of what student can find in his school, and of course wifi capabilities, without which almost no technology mentioned above would work, are integral part of the vast majority of today’s schools.

### **3.2 Computers in the process of education**

#### **3.2.1 History**

The first step of information technologies applied in education started in the second half of 1960s and computers have been considered to be used in the process of education since this first appearance [17]. But not too high effectiveness of the use of computers to teach was the main reason why information technologies did not spread on in the real life. That happened in the 1990s, when personal computers had been introduced, followed by mass development of the Internet. Only then the electronic

instruction became available to the wide public and information technologies were ready to be integrated into educational processes.

In the 1967, high-level programming languages, for example Fortran, were being taught at universities and school vocational programs begin to include computer maintenance. At the beginning of this decade, Apple computers started to gain popularity in small businesses, and to the end, first Apple computers, specifically Apple II and Mecintosh (because this phenomenon first appeared in the US), were being donated to schools. That could be considered the first bigger step of information technologies into an education, where this technology had actually an influence upon educational processes.

According to Cuban, by the 1974, over two million students used computers in their classrooms, and by the 1986, 25 percent of schools used computers for college and career guidance, and for instruction [18]. It is necessary to mention that these computers form 1970s were not as today's computers, they were actually an analogue (used punched cards), but even though, they managed to make their way into schools and universities.

Of course, the major boom (or one could say revolution) started in the 1990s, when the Internet took its part in this world. By the 1997, it linked over 1500 networks, over 100 thousand computers, over one million users all over the world. Universities took one the biggest part in this revolution.

### **3.2.2 ICT as an educational process**

Mikula defines a set of five pieces of knowledge and skills which form the crucial elements for successful being and living in the current society (to read, write, count, present, communicate). Thus two new types of literacy have arisen which influence competences of all other educational levels. Most of the new types of literacy are connected to the development and use of ICT in all spheres of education [19].

There are various different types of use of computers in an educational process. The following are the basic ones:

*Computer assisted learning (CAL)* and *Computer assisted instruction (CAI)*. By using these learning methods students conduct a “distant dialogue” with the authors of the educational courses, who, in a prepared plan, have considered the learning difficulties and therefore designed these studies in accordance to remedial adjustments. This allows students to progress at their own pace and either work individually or in a group. Computers provide immediate feedback and students know whether their answer is correct or wrong in which case the program helps students how to answer.

*Simulation and exploration* is a way for students to learn how to deal with a real complex system, explore its behaviour by using a computer model of the studied system. This means that students are not only passive recipients of information, because they are not provided a set of rules that describe the behaviour of the system. Students have to learn according to their own experience with the system. The perfect example of the simulation and exploration are educational games.

As *computational tools*, where both teachers and students use computer tools, such as text and graphic editors, presentation packages, databases, or spreadsheets. This includes rather the individual part of studying.

As *communication networks*, where instead of isolated classes, students can communicate with people out of their class and gather information from around the world, which increasing their motivation to use higher level analytical skills. This concerns the majority of social networks (educational).

In case of a *pedagogical administration*, individualizing or personalizing the processes of instruction was very difficult without computing devices. Through computers teachers can access student databases where information about each student’s knowledge background is stored. This information allows teachers to organize a more effective learning environment for each of the students.

### **3.2.3 Conclusion**

Despite their greatly wide application, not only at schools, computers' rapid technological boom is, as the education is concerned, their biggest disadvantage. Nowadays, computers interfere with once well established educational processes in the way that is very difficult to predict. What students learn has less to do with computers, and more with real instruction. If we remove computers, there is quality learning what must remain [20]. The main contribution of computers in education has become the provision of individualized interactivity.

On the other hand, computers helped to revolutionize, at least in certain way, education. Thanks to them, university students have much more freedom and time for themselves, but that could be sometimes considered also as disadvantage. In general, it means that there is more time to prepare for a business career or other post educational live, but also more time to waste, which is even enhanced by medial aspect of computers.

### **3.3 Small and mobile**

It is not possible to ignore smart phones or tablets, since they are the most common technology one can encounter. As tablets are concerned, their use to strictly educational purposes, especially at elementary and secondary schools, is increasing. The problem is that kids are prone to distraction, especially when you put mobile devices in their hands. Research from *Project Red* suggests these technologies can have the opposite effect in a classroom setting. They are helping young students engage with academic subjects and making them more eager to learn [21].

That is one of the reasons why educators are beginning to embrace tablets as learning tools. Elizabeth Crawford, who handles education marketing and strategy at Intel, presented her prediction that schools are definitely adopting mobile technology for students across the board. The concept of one-to-one computing, in which every student has their own device, and the bring-your-own-device-to-school models are at the centre of this. It's impacting how students learn today [22]. Integrating mobile devices

in the classroom means using the technology in new ways, to teach students digital literacy, how to navigate social media, and how to share content with others.

## **3.4 Other devices**

### **3.4.1 Smart board**

First smart boards were introduced in 1991 [23], and it was the first interactive whiteboard that provide touch control of computer applications and annotation over standard (usually of Microsoft Windows) applications. Typically, smart boards are used in lecture or classroom environments and they allows the user to write or draw on the surface, print off the image, save it to computer or distribute it over a network by using touch detection for user input (for example scrolling and right mouse click) in the same way as normal PC input devices. They are commonly used in post-secondary classrooms and in higher education.

Advantages of these boards are in a hands-on approach to classroom. They help students with learning disabilities, for example capability of making the keyboard larger on the touch screen for students with disabilities which makes it easier to see and manage independently. They also have the ability to save previous notes and can be used to refresh a student's memory of prior lessons. There are also some disadvantages, such as price, damageable surface, they can obscure for beginners, and so on, but these are no significant educational disadvantages.

Fully-functioning interactive whiteboards usually rely on four components: a computer, a projector, appropriate software and the display panel. The computer is connected to the projector (that displays the computer screen image onto the board) and whiteboard. Action on the surface of the display panel is communicated with the computer over either a cable or wireless connection and processed through the installed software that interprets these actions. Display panels can be either front or back projection.

### **3.4.2 Classroom projector**

In the past, projectors were used in classrooms for over a century, though if one talks about modern technologies, it is necessary to focus on digital projectors which, along with digital images, started to largely replace old projectors and slides in the early 2000s.

There are two main types of digital projection display systems. The older, less expensive type employs three transparent liquid crystal display (LCD) panels, one for each of the primary colours (red, green, and blue). Advantages of LCD technology include efficiency, ease of brightness and contrast adjustment, and high image resolution. A newer, more expensive technology is known as Digital Light Processing (DLP). In this system, small mirrors are used instead of transparent panels. Each mirror represents one pixel. The light, rather than passing through the panel, is reflected from it. Advantages of DLP technology include light weight, high contrast, and lack of pixelization.

Digital projectors are more and more used, not only in lecture halls, but also in smaller classrooms, since presentations of students became much more important education in the past few years.

### **3.4.3 Smart document camera**

Smart document camera is basically a successor of very well proved overhead projectors. These cameras allow teachers to place normal printed sheets underneath the camera and watch as an image of that page is projected onto a large screen. Document cameras can even project three dimensional objects, books, or photos onto the screen for the whole class to see. This means that teachers no longer have to convert pages into transparent slides before projecting them on the overhead, as in case of old overhead projectors. Document cameras are also compatible with smart boards which deepen the experience. There are many features, such as freezing and magnifying images, so it can serve as a magnifying glass. Due to flexible head, one can project images in variations of angles or, for example, project image of the one screen to the opposite one.

This cameras are much younger than smart boards and therefore they are not so widely used, in fact, in Czech republic, there are only a few schools that using them nowadays.

### **3.5 Conclusion**

For today's university student or teacher it is practically impossible to study or teach without using a computer and the web connection. The problem of these technologies is that they were not intended for educational purposes only, and therefore can be misused, even during a lesson. The serious problem, however, occurs in elementary schools where pupils are not to used writing and doing things by their hands, because they can do everything easily on a tablet and a development of their motoric functions suffers.

Another problem of these technologies is their rapid development. After each 10-year period 80% of technologies are obsolete, but in the course of the sometime there are 80% of employees who got qualification 10 - 40 years ago [24]. Nevertheless, contribution of computational devices is enormous and, in case of elementary schools, many of these previously mentioned problems can be solved by teachers, who provide guidance through these technologies and decide what is beneficial for their students and what is not.

## 4 E-LEARNING

### 4.1 Definition of e-learning

E-learning is a very broad and a quite new term that deals with various technologies and technological improvements used in an educational process. It is generally assumed that this term refers to the electronic learning where the electronic way means using the Internet or other mostly wireless connections, therefore, the e-learning could be said it means only a software technology and there are definitions that support this assumption. According to Květoň, "...e-learning covers a wide range of applications and processes like WBT (Web Based Training), creating virtual classes or digital co-operation. It includes delivering and transmitting course content via the Internet or Intranet (WAN/LAN), satellite transmission, interactive TV programmes and learning CD-ROMS." [25] (*Základy distančního a online vzdělávání*, 71). But according to Nocar, "e-learning, in general, means any of effective using electronic material and didactic means, so that the educational objectives were reached mainly, not only by computer networks." [26] (*E-learning (nejen) pro pedagogy*, 98). It means that e-learning refers not only to the technology but also to educational processes.

As regards the letter 'e', the origin and etymology is contested, and it does not necessarily mean electronic. For example, Luskin, an educational technology pioneer, presented an opinion that the 'e' of e-learning should be interpreted to mean exciting, energetic, enthusiastic, emotional, extended, excellent, and educational in addition to electronic [27]. Parks suggested that the "e" should refer to "everything, everyone, engaging, easy" [28].

The term of e-learning arose similarly to other terms, such as e-mail, e-banking, e-book, which appeared in the end of the last century and relate to the Internet in various fields of human activities, and that by adding prefix e- to the word learning. The word learning covers all activities concerning the process of education, instruction, cognition and forming knowledge. E-learning can be understood as a multimedia support of the educational process concerning modern communication and information technologies, a way of education which uses applications, linked texts, video-

recordings, animated sequences, own comments, communication with lecturers and other students, tests, electronic models of processes and other features.

## 4.2 History

The term of e-learning originated in the late 1990s, when the field of ICT developed quickly. In 2001, the European Commission announced e-learning to be a strategic plan of developing new trends in gradual and lifelong education. The strategic objective of this action was the integration of European Structural Funds and European Bank sources to further development and support of educational activities [29]. The integration of ICT into education, also with a pressure to better and more complex distant learning, helped dramatically to the e-learning development and its integration into learning and teaching processes. Although, according to Poulová, “The e-learning development has not stagnated, but it has been influenced by most modern trends which have appeared in this field recently. Instead of heading towards mobile technologies (m-learning) and using interactive digital television (t-learning), another phenomena have appeared – e-learning 2.0.” [30] (*On contribution of modern technologies towards developing key competences*, 23). That raises the question, what is e-learning 2.0.

The technological progress of e-learning in past two decades was divided into so called generations. There are four generations that distinguish technological means and ways of learning and teaching.

First generation, called *Generation 0*, contains classical distance study materials in digitalized form (usually in PDF) with no communication. The only way to communicate in this generation, for example between students and tutors, is an email. The advantage is that the distribution of the course is independent of distance or time, but on the other hand, there are many disadvantages, both technological and pedagogical, and also managing the teaching and learning processes. The problem is with copy right, since there are study materials that are only a simple scan of classical printed source, and the service given to tutors and students is not very fortunate. Even though the course of this generation looks very old-fashioned, it is still used.

*Generation 0.5* added more reliable study materials (distant study text of higher quality and with links).

In *Generation 2*, teaching and learning processes use all options of LMS (Learning Management System) tools, which regard software applications for the administration, documentation, reporting and delivery of electronic educational technology. The study materials are improved by adding more graphical elements as pictures, graphs, diagrams. In this generation also occur simple presentations, relevant links, or additional downloadable materials, and tutors and students can widely use all accessible tools for the communication. This generation is usually presented as a top of e-learning.

So far the last, and partially fictional, *Generation 4*, represents the future. According to Paulová, “It is expected that the technological development will help and support further highly sophisticated social communication as well as methods of teaching and learning. Also new findings from research in the field of social sciences will influence the field of e-learning.” [31] (*On contribution of modern technologies towards developing key competences*, 27).

### **4.3 Implementation**

The educational process in universities and schools environment is usually done in the form of interaction between teachers and students in classrooms or laboratories, according to the schedule. E-learning presents new ways of learning and teaching. Instead of this traditional, present form of study, the distance and combined form of study occurs. This development was slow at the beginning but as Šimonová wrote, “Despite the starting resistance the awareness of possibilities provided by e-learning was spreading slowly but steadily. Nowadays there exist university departments specialized in e-learning and its implementation into the process of instruction.” [32] (*On contribution of modern technologies towards developing key competences*, 56).

As for the implementation of e-learning into the educational process, e-learning can be either synchronous or asynchronous. Synchronous learning refers to the

exchange of ideas and information with one or more students (or teachers) during the same time. For example face-to-face discussion, online teacher instruction with students' feedbacks (in the real-time), *Skype* conversations, chat rooms or even virtual classrooms where everyone is online and working and collaborating with others at the same time. Because students have to work together and try to cooperate, synchronized learning helps students create an open mind since they need to understand and not to only listen. Synchronized learning also improves online awareness and students' writing skills.

Asynchronous learning may use technologies such as email, wikis, and discussion boards, as well as web-supported textbooks, hypertext documents, audio and video courses, and social networking. Asynchronous learning is particularly beneficial for students who have, for example health problems or have child care responsibilities and regularly leaving the home to attend lectures would be difficult for them. This is the opportunity to complete their studies in a low stress environment and within a much more flexible time frame. Students proceed at their own pace, if they need to listen to a lecture more than once, or need time to think about a question, they can do so without a time pressure or fearing that they will delay a progress of the class. Students can earn their diplomas faster, or repeat failed courses without the embarrassment of being in a class with younger students. Moreover, students have access to a very wide variety of courses in online learning, and can participate in college courses, sports, work or internships and still graduate with their class.

These improvements and e-learning itself also allowed another phenomenon that is worth mentioning. The term 'blended learning' nowadays describes the combination of various elements and forms of educational process aimed at highly effective learning. As blended learning arose from e-learning, it is generally considered as a combination of face-to-face instruction and e-learning [33]. Therefore the blended learning, which is nowadays present at every university, it can be found even at some elementary schools, allows to students much more smoother and timesaving way to pass their courses, for example electronic index.

## 4.4 Conclusion

As was mentioned above, e-learning has many advantages. Most of them are connected with advantages of blended learning, although as any type of instruction, blended learning has both pitfalls and potential. It is important to keep in mind that any new technology is efficient only to the point which can be reached by the user. Here comes the irreplaceable role of teachers, who have to consider where, when, and why to use the e-learning effectively. E-learning also improves distant learning and is incredibly helpful in case of an education of adults. Generally, with e-learning teaching and learning is, at least for older students, more individual which helps students to gain a certain level of independence (maybe even a self-recognition) by pushing them to make their own decisions and keeping them on guard. On the other hand, this system is very susceptible to cheating.

As Nichols wrote in one of his articles, “Lack of theory and theoretical principles of education supported by electronic means is a protection against tendentiousness in decision-making in this field based on various political, economic and social requirements, unfortunately in education in little extent only. In comparison to the field of the distance education, where the whole theory has been set, e-learning has considerable gaps in the theoretical background.” [34] (*Educational Technology & Society*). That is one of the main disadvantages of e-learning, rapid integration into education. Nowadays, e-learning interferes and replaces old and very well established educational processes without any deeper consideration. Traditional textbooks of excellent didactic quality are being replaced by electronic texts without interactive exercises, feedback, or multimedia tools.

Due to the fact that there have been too many studies comparing effectiveness of the e-learning, the blended learning, or the face-to-face instruction, others try to perform meta-analyses. One of the most extensive ones is the meta-analysis of Sitzmann. This study identifying 96 studies reporting data from 19331 students who took part in 168 courses. Across all of these reports, face-to-face learning was more effective than e-learning for gaining declarative knowledge, but students were equally satisfied with both delivery media [35]. These results strongly support the idea that content and methods determine learning results rather than delivery media.

## 5 CONCLUSION

Today's society lives in a digital world where computers, tablets, and mobile devices are predominant. People who are under the age of 31 grew up surrounded by digital media. Today's students are digital natives. They don't know anything else, this is their lifestyle [36]. Our society is called the "knowledge or information" society. Education, its content and objectives, must be adjusted to new requirements. As Paulová wrote, "The future, significant ones, lying in curricular reconstruction, defining a new proportion between studying facts and data, and developing analytical skills and creative thinking, are to be introduced." [37] (*On contribution of modern technologies towards developing key competence*, 9).

It is clear that only technology is not able to replace a human element in education at any level. Results prove that technology in the sense of technical learning means is not so important as the way of formulating questions, learners' characteristics, providing motivation, attracting teacher's and tutor's interest in students' results. "The effectiveness of the instructional process is still mostly influenced by teacher's professional skills, experience and respect." [38] (*On contribution of modern technologies towards developing key competences*, 53).

Technology has been changing the process of learning beyond recognition for the last two decades and once well established education methods are now changing without warning. Since the technology has started to interfere with education there are prognoses everybody will be studying from home and that schools will have lesser and lesser importance. As was already mentioned in the first chapter, these prognoses repeat themselves every time there is a new invention that may have an impact on the education. They also showed that most of them were very improbable. However, it is true that an approach of today's schools is much more individual than in the last century and prognoses concerning the computer integration into an academic life are being fulfilled (using tablets to enhance the educational process at elementary schools, computers becoming an inseparable part of university's life). Although many people forget the fundamental role of public schools and teachers which, as Derek Muller said in one of its videos is, "...not to deliver the information, it is to guide a social process of

learning. It is to inspire, to challenge, to excite their students to want to learn.” [39] (*This will revolutionize education*, 5:55).

Despite the efforts of education to keep pace with modern technologies, one must realize that most of today’s instructional programmes are trying to solve problems which occurred only after technology managed to spread into education. In general, this is the issue of all new technologies. They solve many problems but simultaneously they create many others and as new technologies take more and more important part in education, this phenomenon was brought to the educational process. More training for teachers is needed, bigger interest of students is required, and schools need more employees to manage all that technology, not to mention a technical support or operating backup systems. On the other hand, this is exactly what drives people and causes that today’s society is moving forward faster than ever in the past.

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