

# Innovative applications of digital solutions and tools in IT education

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**Abstract.** Currently, digital skills have become an important factor for the development and active participation in today's information society. The article describes innovative IT methods and tools used in the education process. New technologies and new methods of conducting classes form the basis of today's education. Traditional methods have been replaced by digital tools that are perfect at the stage of educating school students in IT profiles, preparing them for vocational exams. The article compares the results of school students from vocational exams at the Technical College of Lublin with the results from the entire Lubelskie Voivodeship.

**Keywords:** Information and Communication Technology, digital tools, IT education

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## Innowacyjne zastosowania rozwiązań i narzędzi cyfrowych w kształceniu uczniów szkół informatycznych

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**Streszczenie.** Aktualnie cyfrowe umiejętności stały się istotnym czynnikiem rozwoju i aktywnego uczestnictwa w dzisiejszym społeczeństwie informacyjnym. W artykule opisano innowacyjne metody oraz narzędzia informatyczne wykorzystywane w procesie kształcenia. Nowe technologie oraz nowe metody prowadzenia zajęć lekcyjnych stanowią podstawę dzisiejszej edukacji. Tradycyjne metody zostały zastąpione cyfrowymi narzędziami, które doskonale sprawdzają się na etapie kształcenia młodzieży szkolnej w szkołach o profilu informatycznym, przygotowujących młodzież do egzaminów zawodowych. W artykule porównano wyniki egzaminów zawodowych uczniów Technikum Informatycznego w Lublinie z wynikami uczniów z całego województwa lubelskiego.

**Słowa kluczowe:** Technologie informacyjne i komunikacyjne, narzędzia cyfrowe, edukacja informatyczna

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### 1. Introduction

It is very likely that within a dozen or so years, information technology will become an integral part of both private and professional life for most people. Without the skills related to use of this technology, it will soon be impossible to perform most lucrative professions, replenish one's qualifications or acquire new ones. Therefore the school must prepare its graduates for the proficient use of computer and telecommunication hardware and software. The article currently describes the use of IT tools in education in both high schools and colleges. The author further describes the methods he used in working with students to prepare them for qualification exams. The previously used traditional teaching methods resulted in unsatisfactory results. The implementation of new tools and methods of working with students confirms their beneficial impact on the achieved exam results. A modern school should make information technology a means to support the education of young people in the subjects of teaching. The tools offered by this technology should become typical didactic means. Currently, one of the many modern forms of education is e-learning. Many solutions derived from this form of education can successfully support traditional school lessons, one can safely state that people are dealing with blended learning, which combines the advantages of traditional teaching and e-learning. The key task of a modern teacher is the proper selection of work methods

based on the use of digital tools[5]. To facilitate the task of educators, Ruben Puentedura developed the Substitution Augmentation Modification (SAMR) model that defines the various stages of implementing new technologies into the learning process. The proposed model describes how a teacher can change the course of an educational process by using new information technologies as a substitute for traditional methods.

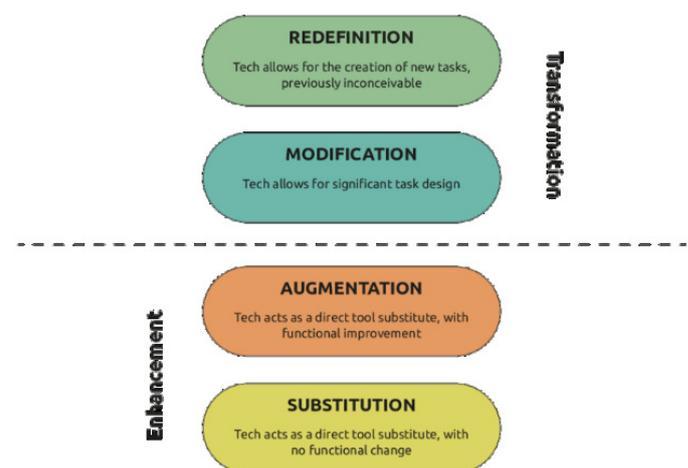


Fig. 1. Graphic presentation of the respective stages of implementing new technologies into the didactic process [5][5]

The first stage is substitution. At this stage new technologies are used for tasks that were previously performed without the presence of these tools. There is therefore no change in functionality. The next stage is augmentation. At this stage, we use IT tools (e. g. tests, educational games, quizzes to test the knowledge available on mobile devices) in a way that is attractive to the student. This method perfectly activates the student and speeds up the teaching process. The third stage is a modification. At this level of implementation, the use of new information technologies for educational purposes is becoming a necessary and irreplaceable element. A simple example is a creation by a student of a multimedia presentation on a topic specified by the teacher and sending it electronically. The last stage of implementing new technologies in the didactic process is called Redefinition. At this stage, we are dealing with a transformation of the education process, closely related to the degree to which new technologies have been implemented in the education process [11].

## 2. E-learning

The development of new technologies, and in particular, the dissemination of access to the Internet, is conducive to introducing new methods to the existing model of school education. Research conducted in schools shows that the activity of students in the classroom is usually limited to noting down information from the blackboard or textbook, listening to the teacher's long speeches or noting them down. It turns out that young people prefer to learn in groups by performing practical activities using a computer. New technologies can support the forms of education preferred by students, but traditional methods of education and development should not be abandoned[8]. According to the "E-learning trends 2019" report, e-learning is the most widely used educational tool in North America and Western Europe, less popular in the eastern countries of the European Union and Asia [2].

E-learning enables distance learning without having to leave home. It is enough to have a computer with Internet access and one can become a member of a virtual school. E-learning is today an educational norm, it fits in with the vision of an innovative school that meets the expectations of a student whose natural environment is the Internet. A feature that has significantly influenced the success of e-learning is the flexibility of teaching. It is possible to study at any place and time, to use up-to-date educational materials adapted to our own individual needs. It should be emphasized that e-education allows for equal educational opportunities for disabled students. The use of e-learning requires certain skills from the student, the student should be fluent in computer use and telecommunications techniques. In the case of e-learning, the student is forced to be more independent and disciplined at work, while the teacher has limited contact with a group of students. New technologies work well in primary schools, but traditional teaching should be continued in this stage of education [9].

## 3. M-learning

The key to modern education is not only the technology but also communication. According to research, people learn best in a group, a community, when they are connected in various ways. A community is created and strengthened when people cooperate, research and create together in a team. Therefore, any technological solution proposed to the university or school must include communication. If it does not, it becomes pedagogically useless. Currently, more and more is expected from educational methods using new technologies such as m-learning or e-learning. Mobile devices have become part of our everyday life, with their help one can learn and work. The dynamic development of mobile technologies means that these devices are increasingly becoming personal computers in terms of functionality and performance. With mobile devices, the necessary resources become available anywhere, allowing one to combine work with acquiring knowledge. It is possible to state unequivocally that the use of mobile devices in teaching responds to the educational needs of the modern world. The definition of mobile learning consists of all learning using mobile devices only, as well as learning on mobile devices in combination with other technologies. In m-learning, the most important aspect is learning in motion at any place and time. Unlike e-learning, m-learning is a dynamic way of learning. Mobile devices can be used literally anywhere: at home, at school, on public transport or on a walk. Bearing in mind that learning on a small smartphone screen can be exhausting after some time, it is necessary to develop teaching materials and content as concise and legible as possible so that the student can acquire the necessary knowledge quickly and efficiently. In m-learning, audio or video podcasts, quizzes, language learning applications, pdf files or audiobooks are most commonly used. Multifunctionality of mobile devices allows for communication and cooperation with other users, people learning through social networks, MMS or text messages. However, the most advanced form of m-learning is the use of functionalities such as mediascapes and QR codes to create context- and location-oriented training modules. QR codes, called Quick Response codes, are added to physical objects that are read by devices equipped with cameras. The developed teaching materials are made available through the automatic start of the web browser. Mediascapes are a form of media that creates interactive experiences by combining digital images, sounds, and interactions with the physical world. In education, however, m-learning can be treated as a complementary method of traditional teaching, but it works perfectly for learning specific competencies, as additional support for lessons, courses or large e-learning courses. However, it is necessary to remember that m-learning must be adapted to the capabilities of a mobile phone. It cannot take up too much memory and the courses should be divided into short thematic blocks. In Polish schools, m-learning is treated as a new source of supplementing and systematizing knowledge acquired in class.

Table 1 List of mobile devices used in m-learning[10],[11]

Device	Definition
PDA (personal data assistants)	PDA works as an individual digital secondary device which is generally small in size and able to play wide range of multimedia files
Cellular phone	It permits operators to converse with one another at anyplace and at any time. Access to the internet via WAP or GPRS technology may also be done through cellular phones
Smart phone	This device integrate mobile phone capabilities with the more common features of a handheld computer or PDA. It is furnished with internet usage and the capability to support multimedia files
3G phone	3rd generation of mobile phone that has the capability to transmit four times better than the normal cellular phones
4G phone	4G is the original and enhanced version of 3G. Internet speeds are five times faster, and the internet linking are and solid
Tablet Pc	Tablet Pc is the utmost common computer of our time which is a transportable personal computer classically smaller than a notepad
Notebooks	Notebook computers normally thinner design and weigh less than the laptop
Netbook	Is a device that may perform the most of the purposes of a desktop or laptop, It looks like tiny laptops, with screens infrequently beyond 10 or 12 inches
Laptop	The laptop is small and light sufficient to be used sitting in your lap
MP3 player	Is a digital audio player which plays music and audio files
iPod	A transportable media player that allows an operator to download materials such as: audio books, music, podcasts, and other video

The use of m-learning in education has several benefits for both teachers and students. Traditional classrooms are replaced by computers and mobile devices, so one can always have access to educational materials. A great advantage of m-learning is the individualization of the process of education of a very talented or dysfunctional student. It enables the education of students from less affluent or disabled families, for whom the access to school is a significant impediment. M-learning systems cannot replace traditional teaching methods, but they can be used as an additional tool in the educational process both in primary schools and universities [8],[10].

#### 4. Analysis and evaluation of available electronic resources for m-learning

At present, there are many applications and services available on the market used in m-learning, which may cause some confusion when choosing a solution to achieve specific didactic goals. Based on research and analysis, an attempt was made to evaluate and classify the existing tools on the market, which allowed to identify more than 80 applications and services, whose functionalities and cases of use presented in the web and literature indicated their high usefulness for applications in the didactic process. The research focused mainly on the possibility of using applications and services

in such aspects as developing didactic content and interactive way of presenting didactic materials, cooperation and sharing knowledge as well as developing the ability to search, select and comment on available resources and content [9].

#### 5. Application of e-learning in primary and secondary schools

There are only a few primary and secondary schools in Poland that provide distance learning. Schools are implementing a project that focuses on full remote education. In practice, the student must work independently at home. The plan and the way of working for the whole week are written by the teachers. Tests and examinations at the end of the school year are held stationary in Poland in the school's headquarters or in examination centers in other countries, which are created after consultation with parents. The online school program is offered by private schools with therapeutic classes providing primary and secondary education. This project is aimed at children living in Poland, who have a certificate of psychological-educational counseling institutions because of autism disorders, as well as Polish children staying abroad with similar disorders, who want to pursue the Polish core curriculum. Therefore, this offer is dedicated mainly to children who, for health reasons, are unable to attend a stationary institution, also living abroad. Also parents who want to educate their children at the primary school level at home can benefit from the above mentioned educational project. Students have access to on-line lessons in the form of webinars, which are conducted by Polish teachers[7]. Remotely educating primary schools are usually bilingual in order to ensure a high level of the educational offer for Polish children living abroad. In the case of secondary schools, the distance education offer is much broader and focuses on general secondary schools. Secondary schools with modern methods of learning via the Internet mainly offer the preparation of adults to pass external exams. Many private schools provide e-learning services to people who cannot function in the school system, to people living outside the country and to people with disabilities. Secondary schools providing education via the Internet also provide opportunities for those who have decided to continue their interrupted education. They may also be used by people living in rural areas, where there are no appropriate schools or people involved in working and raising children. On-line schools provide students with access to teaching materials through various e-learning platforms, teaching aids in an interactive form make learning more enjoyable and faster [6].

#### 6. Digital competence of teachers

Currently, teachers in various types of schools use new technologies to deliver lessons. Analyzing the survey data of general school teachers and technicians in total of 300 people has demonstrated that teachers most often use multimedia presentations, websites, and videos during lessons. Over 60% of the surveyed teachers use educational computer programs. Also e-learning platforms and electronic textbooks are the leading tools used by teachers to implement the core curriculum. Teachers are also increasingly beginning to use computer games in classroom activities, which until now have

been mainly used by students mainly outside school. Detailed information on the conducted surveys is shown in the figure below.

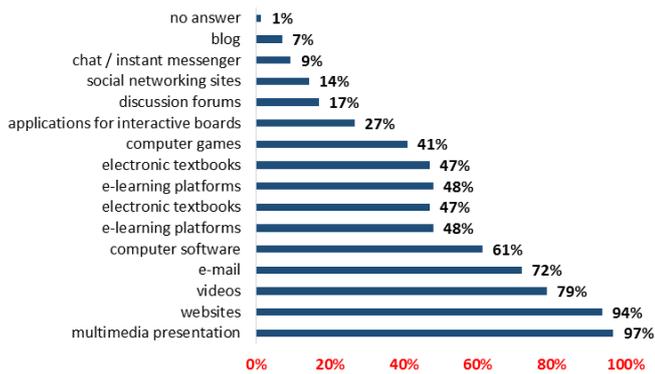


Fig. 2. Tools used in the education process [7]

### 7. New technologies in the process of education of IT schools students and the results of examinations confirming qualifications in the profession of IT technician

The legislation introducing changes in vocational education has entered into force in 2012. In the professions presented in the new classification, qualifications were distinguished. A qualification in the profession should be understood as a set of expected learning outcomes in a given profession, the achievement of which is confirmed by a certificate issued by the regional examination commission, after passing the exam confirming qualifications in the profession in the scope of one qualification. An examination confirming qualifications in a profession, also called a vocational examination, is a form of assessing the level of knowledge and skills within the scope of a given qualification established on the basis of curriculum of training in professions, achieved by a person passing the exam. The professional exam is an external exam and is assessed by external examiners[1]. In all vocational schools, teachers of vocational subjects prepare students for the exams of a given vocational qualification. In IT-oriented technical schools, three qualifications are tested:

- E.12. Installation and operation of personal computers and peripheral devices,
- E.13. Designing of local computer networks and network administration,
- E.14. Creating web applications and databases as well as database administration.

To prepare students for the above-mentioned professional qualifications teachers in class have been using new technologies to implement the core curriculum for many years. Traditional methods have been replaced by innovative methods of teaching lessons. The most frequently used educational methods and tools included online tests and examination tasks, multimedia presentations, instructional videos, google tools, educational blogs, and e-learning platforms.

The educational tools used by teachers allowed to obtain satisfactory exam results confirming qualifications in the profession of IT technician in three qualifications E.12, E.13, E14. The main reason for replacing traditional teaching methods with new IT tools was the rather poor results of in-school exams. Below are the results of the qualification exams for individual qualifications in 2017 and 2019 in the Lubelskie Voivodship and in the Technical College of Information Technology in Lublin[1].

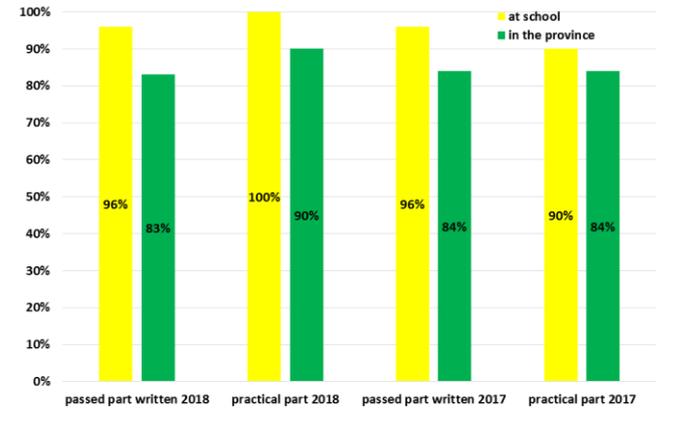


Fig. 3. Pass rate in the qualification 'Installation and operation of personal computers and peripheral devices' in 2017 and 2018[1]

Figure 3 presents the percentage results of practical and written exams from E. 12 qualification. The graph compares the examination results from Lubelskie Voivodship from the same qualification with the results of the Energy and Information Technology Technical School in Lublin. Analyzing the above results it is easy to notice that they are at a high level of pass rate in both the written and practical parts.

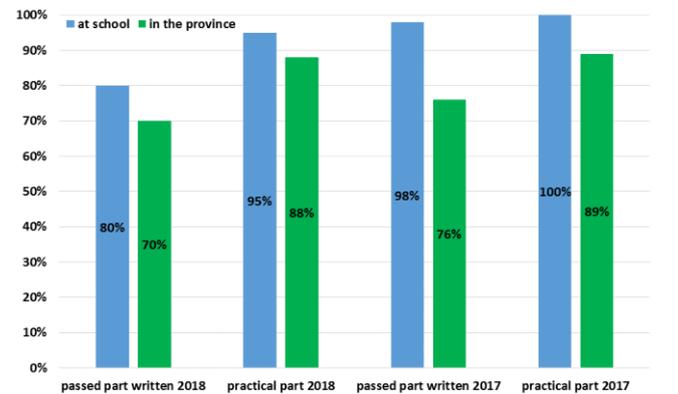


Fig. 4. Pass rate in the qualification 'Designing of local computer networks and administration of networks' in 2017 and 2018[1]

Figure 4 shows the percentage results of practical and written exams from E.13 qualifications. The graph compares the examination results from Lubelskie Voivodship from the same qualification with the results of the Energy and Information Technology Technical School in Lublin. Analyzing the above results it is easy to notice that they are also at a fairly high level of pass rate in both the written and

practical parts. In this qualification, about 2017 was slightly better in comparison to 2018. This does not change the fact that the examination results obtained in the technical secondary school are at a higher level than in the whole Lublin voivodeship.

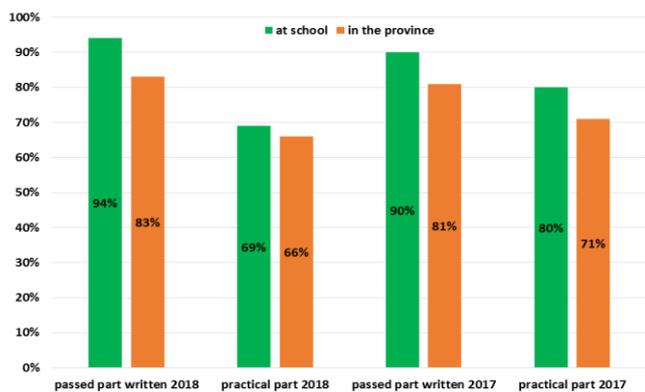


Fig. 5. Pass rate in the qualification 'Creating web applications and databases and administration of databases' in 2017 and 2018[1]

Figure 5 presents the percentage results of practical and written exams from E. 14 qualifications. The graph compares examination results from Lublin Province from the same qualification with the results of the Energy and Information Technology Technical School in Lublin. In this qualification, the written exam performed better than the practical exam in both 2017 and 2018[3].

Figure 6 presents the pass rate of exams in individual qualifications from both the practical and written part of the exams in a technical college. The presented results show that the written part is better than the practical part. Nevertheless, the results are at a rather high level. The annual qualification exams allow teachers to select appropriate methods and IT tools to work with students taking the exams in each qualification. The use of new technologies in the classroom allows mastering a wide range of materials in a relatively short period of time.

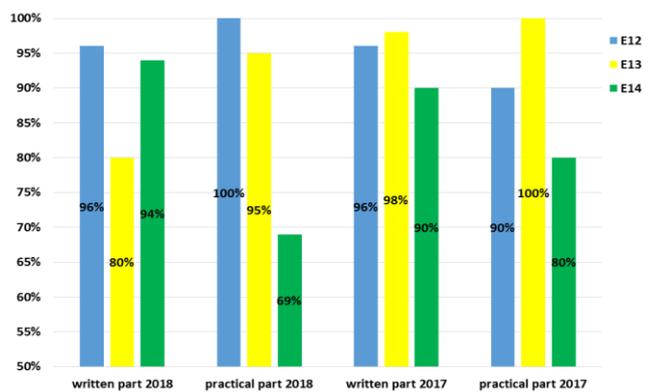


Fig. 6. School pass rate in 2017 and 2018[1]

### 8. Summary

The development of new media means that education is entering a new dimension. Knowledge began to be available to the public and transferred in an easily digestible form. Recent years have shown that content transmitted in the form of video lectures, online tests have become very popular among schoolchildren. Traditional methods of education are less effective and new technologies in the form of interactive educational platforms allow maximum facilitation of searching and assimilation of specialist knowledge from various fields of science. In-school examinations carried out by the author on various professional qualifications and their poor results were the main reason for the implementation of new technologies in education of young people. The new IT tools used by teachers, especially in IT classes, translated into good results of students taking qualification exams.

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