

The Role of E-Learning in the Implementation of Innovative Educational Technologies

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Abstract: *The article reveals the relevance of education reform stipulated by the global task of forming a digital economy. Modern education system involves the improvement of educational processes based on the widespread introduction of information and communication technologies (ICTs) and electronic educational resources (EERs).*

The definition of ICTs as a set of processes, methods and software and hardware tools integrated for the purpose of storing, collecting, displaying, using and distributing information has been proposed in the study.

The EERs as defined in the study refer to the means of information, software and program support of the educational process.

The results of the study allowed determining the main tasks that could be solved with modern EERs. It has been concluded that the use of the whole range of modern electronic tools and information technologies can give the maximum effect when used in combination with innovative teaching practices.

Of the variety of modern innovative educational technologies, those that are currently the most promising and practically applicable ones, have been highlighted and analyzed: mass open social education; personal educational trajectories based on data analytics; flipped classroom; BYOD technique (Bring-Your-Own-Device).

Index Terms: *electronic educational resources, information and communication technologies, innovative educational technologies.*

I. INTRODUCTION

Building a digital economy is considered to be the most important task of modern society with the education reforming being one of its key areas [1].

The education sector grows rapidly throughout the world being filled with various network resources, network services and innovative techniques. However, the whole diversity of the proposed e-learning tools can be divided into two large groups: information and communication technologies (ICTs) and electronic educational resources (EERs), which naturally complement each other.

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In the conditions of the information society, various ICTs are being more widely used [2] including first and foremost in the education sector.

II. PROPOSED METHODOLOGY

A. Icts And Eers As the Basis of The Modern Education System

In general, ICTs are understood as a set of processes, methods and software and hardware tools integrated for the purpose of storing, collecting, displaying, using and distributing information [3].

ICTs include various devices and software and hardware tools operating on the basis of modern systems and means of information exchange, as well as computer equipment to store, collect, accumulate, transmit and produce information [4].

The widespread use of modern ICTs in education is stipulated by several factors:

- The use of ICTs accelerates the transfer of centuries-old knowledge and social experience;
- ICTs significantly improve the quality of training and increase the rate of acquiring the necessary skills and competencies;
- ICTs increase the opportunities of the educational sector, both by various means of developing students' creativity and developed software products.

In the educational environment, the most frequently used software is comprised of search programs, simulators, intelligent tutorials, business and role-playing games, as well as expert systems.

The modern education strategy implies the development of creative thinking. To this end, modern textbooks offer tasks of a creative, heuristic nature, as well as ICTs provide new methods for the development of students' creative activity. They participate in various discussions held not only in the classroom, but also virtually on the relevant portals (sites) of various training centers [5], [6].

Students of various educational institutions can simultaneously participate in the implementation of creative tasks. The use of virtual laboratory equipment, for instance, allows demonstrating in real time mode experiments in physics or chemistry, which ensure significantly easier and faster assimilation and understanding of the subject under study.

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In order to increase the efficiency of ICT use in education, the following didactic requirements should be implied to it:

- Substantiated use of didactic materials;
- Clear definition of the place, role, time and purpose of the use of computer training resources;
- The decisive role of the teacher in the preparation and organization of the learning activity;
- The use of only those ICT tools that are aimed at improving the quality of education;
- Compliance of the applied computer methodology with the adopted learning activity strategy;
- Considering the fact that the use of modern ICT tools necessitates significant alterations in the general teaching methodology;
- Providing sustained feedback from students.

EERs are the means of information, program and organizational support of the educational process. These educational and teaching materials are based on the use of various electronic devices and include in the first place educational video and audio recordings played with a VCR or CD player. Currently, most modern EERs are reproduced on a computer [7]. Due to the fact that the computer utilizes digital technologies, this group of EERs is most often referred to as digital educational resources (DER). Thus, DER are comprised of digital video tutorials and video clips, photo, dynamic and static models, interactive simulation and virtual reality objects, cartographic and graphic materials, audio books, sound recordings, business graphics and various symbolic objects and other educational and teaching materials presented in the digital form and required in the educational process.

All the diversity of modern EERs can be classified according to several criteria:

1. By the usage environment:

- materials for electronic boards;
- offline resources;
- Internet resources.

2. By the type of content offered:

- textbooks;
- electronic reference books;
- electronic quizzes;
- electronic dictionaries and encyclopedias;
- hands-on workshops, etc.

3. By the principle of implementation:

- training systems;
- presentations;
- multimedia resources.

4. By the place of playback:

- intended for home, independent work of the student;
- aimed at the in-classroom usage.

5. By the purpose of the submitted content:

- hands-on material;
- lecture resources;
- testing and assessment materials;
- simulators (training systems).

Additionally, the EERs can be conditionally divided into three main groups: multimedia (interactive), textographic and textual (hypertextual).

The simplest EERs are represented by the textual materials in which the hard copy is transferred into electronic format. They, as a rule, have a developed system of tags: hyperlinks (hypertextual materials), content, glossary, etc. The usual book method of “sequential” immersion is more commonly applied for these resources rather than the original method of nonlinear narration. However, these EERs can also use nonlinear narration, i.e. principle of wikified technologies. In such EERs, references to familiar sections – a list of terms, glossary, content, and clarifications – are employed. In addition, these EERs apply transitions to other parts of the text related to the subject under study.

Multimedia EERs assume the use of multimedia content (animation, video, audio content, etc.). These materials also involve the interactivity mode, which allows for improved interaction with students [8].

The diverse range of multimedia EERs includes everything from multimedia dictionaries to educational interactive games.

Incorporation of modern EERs in the educational process provides for an entirely new level of efficient copying with the following tasks [7]:

- Managing the student's independent educational activities;
- Managing comprehensive individual educational support for each student;
- Managing group educational activities using modern ICT tools;
- Introduction of innovative educational methods into educational practice.

If the first three tasks are more or less clear, then the last task requires, in the authors’ opinion, more careful attention.

The use of the whole range of modern electronic tools and information technologies can give the maximum effect when applied in combination with the innovative teaching practices [9], [10].

Let us analyze those of them that are currently considered to be the most promising and practically applicable ones.

III. INNOVATIVE TECHNOLOGIES IN EDUCATION

A. Mass open social education

Mass open social education comprises application of open educational resources (OERs) created on the basis of an open, commonly shared license. It must be noted that an open license allows reuse, conversion and distribution of OER materials without restrictions.

In general, OERs include the following: programs, modules, educational materials, recommendations for teachers and students, scientific articles and textbooks, tools for assessing knowledge, training videos, databases, interactive materials, software and applications, etc.

OERs are intended for the use in teaching, instructing and research.



In recent decade, a number of world leading universities have organized collective online learning based on the implementation of Mass Open Online Courses (MOOCs) [11]. And it is only now that this innovative education technology is becoming widely spread. In fact, MOOCs represent one of the types of distance learning and are considered as any distance learning course utilizing e-learning technologies and offering open access to it via the Internet [12].

While at present there is no generally accepted definition of the term “mass open online courses”, they can be specified as open, free, online courses that don't let earning a degree but are characterized by unlimited mass coverage and are intended for everyone who wants to study, regardless of the level of education.

The MOOCs feature the following: students review the materials presented in the public domain (most often video lectures) and then discuss them with other students. Some courses require students to pass assessment tests and complete assignments. Having successfully passed the tests, a MOOC learner can get a certificate of completion.

Unlike the broad concept of OERs, MOOC resources are completed training modules that allow mastering a specific area of knowledge. Herewith, the training is aimed at not getting a diploma, but acquiring certain knowledge that a person needs for professional or career growth.

The following MOOC tools are the most common ones: various video services, sites, platforms, forums, etc. presented on the Internet [13].

The principles of building MOOCs and participation in them are as follows:

- Registration for the MOOCs is always open, regardless of the courses' start and end dates;
- Unlimited number of participants;
- The roles of the teacher and the learner are largely leveled. The teacher becomes more like a mediator acquiring the role of a person providing technical assistance;
- After the MOOCs are completed, information remains on the network;
- The student must have a high level of self-control and motivation;
- It is assumed that the listener can independently form the trajectory of his or her training.

B. Personal educational trajectories based on data analytics

Unlike traditional technologies, this innovative educational technique allows developing individual learning paths based on the step-by-step educational activities of students, which ultimately leads to the achievement of the best results.

The considered technology differs from the classical one mainly by its complex implementation and the maximum use of didactics, modern information technologies and media. It has a process (cyclical) character: at the end of each lesson or course as a whole, relevant changes and additions are supposed to be made based on the analysis of big data and new statistics.

In modern education, big data analysis technology can be

applied for taking management decisions. In this regard, the educational trajectories of the future will be built individually with the use of a tutor presented in the form of artificial intelligence. It must be noted that for the digital economy, a promising model of future staff training is considered to be a model in which every student has a “mentor” presented in the form of artificial intelligence, which, based on the student's level of knowledge, psychophysiology, experience and abilities, selects a purely individual learning path for him/her. Already today, there are information technologies allowing automated collection of big data and their analysis. Herewith, the big data are a modern technology that allows analyzing and extracting new knowledge from large arrays of unstructured data [14], [15].

Due to the use of new statistical and mathematical tools, modern technology of big data makes it possible to compile the optimal data structure and obtain the necessary information from previously useless arrays for various fields of activity, including, first of all, the field of education.

In addition, reduction in the cost of storing a unit of information will also contribute to the mass use of big data in the educational process.

The various databases that have been compiled up to now, will, therefore, be not only repositories of data but will become a tool for acquiring new relevant knowledge. The adaptation process will be more efficient, and solutions that are made in the real time mode will be more personalized.

In the near future it will be possible to find out in real time the need for this or that content and its relevance to a specific individual due to the inclusion of this innovative technology into the educational process. In addition, based on the analysis of big data on the interaction of the individual with social and educational platforms, the trajectory of education will be adapted for him/her, thus, becoming totally individual.

Open data collected at present by the organizations and being based on big data technology will allow in the future ensuring effective real-time interaction between the student and the teacher. This process, in turn, will provide an opportunity to conduct an in-depth analysis of the applied teaching models that are used by educational institutions, as well as to reform them in the light of new knowledge.

The widespread use of this technology will also result in finding the hidden relationships among the subjects, phenomena and objects. This will, in turn, allow finding hidden links between the individual characteristics of students and their achievements in education, which will make education more personal and eventually lead to new academic success, as well as advancements in professional and social activities [16].

Big data analytics will allow:

- Coming up with new individual educational technologies;
- Ensuring timely professional orientation;
- Carrying out real-time monitoring of individual professional learning trajectories;

- Providing transparency and openness of education in general.

C. Flipped classroom

In contrast to the traditional concept of learning, the flipped classroom technology implies the student's initial self-determined introduction to the new theoretical material at home using ICTs. For these purposes, the whole range of modern ICTs and EERs can be used: video lectures, multimedia, presentations, etc.

The learning process assumes that students remotely, at home, view and listen to the EERs available to them, as well as study additional materials with the help of ICTs.

Thus, the students come to the lesson being already prepared in a certain way and the task of the teacher in this case consists in the management of practical learning assignments, bringing up such qualities necessary for a modern person as cooperation, the ability to apply the knowledge in a new situation and, as a result, more effectively develop necessary skills and competencies. Among the forms most frequently used in the second part of the flipped classroom are discussion, analysis of practical situations, as well as the presentation of projects [17].

The main advantage of the flipped classroom is that the teacher has more time for getting in closer contact with the students. This is achieved through the preliminary autonomous independent work of students with high-quality educational materials. Application of flipped classroom technology results in development of the most important qualities of the 21st century specialist which are as follows:

- Initiativity, independence and activity;
- Development of skills for working with modern ICTs;
- Pioneering work and creative mindset;
- Teamplay and social skills;
- Ability to solve emerging problems;
- Critical thinking;
- Adaptability and flexibility;
- Ability to work with relevant information.

Thus, implementation of this innovative educational technology allows creating a situation of open communication in the classroom, i.e. applying to a greater degree an individual approach. At the same time, students show more independence and initiative.

IV. RESULTS AND DISCUSSION

A. BYOD

The BYOD technique (Bring-Your-Own-Device) was born in the business community. Intel employees in 2009 were allowed to use their personal devices at their workplaces. This concept later spread abroad to many organizations, including the state institutions. Statistics shows that, on average, 50% of staff currently use their own devices at their work [18].

The main advantages of the BYOD technology include an increase in the comfort of the working environment, as well as in the productivity and innovative activity level of employees. In the companies where the concept of BYOD is

being implemented, staff significantly save their working time [19]. Due to the use of personal devices, employees manage to harmoniously balance the personal and professional life [20], [21].

Educational institutions have also begun to use BYOD trends. However, in order for these trends not to be random, appropriate changes need to be done in the educational process. Using BYOD in education changes the personal learning environment, as well as OERs and social networks significantly expand the traditional learning environment. Due to the use of new technologies, the relationships between the student and the teacher go through dramatic alterations. If at present the teacher mainly plays the role of a source of knowledge and information, in the future this role will change to that of an administrator of network resources available to students [22], [23].

The following approaches to the introduction of BYOD in the educational process can be considered.

First, to prohibit the use of own devices in the classroom both for the students and the teachers. This is the simplest approach that does not require any changes in the access to the educational institution network, as well as in the accepted teaching methods. However, given the current trend, this approach will adversely affect the future professional career of a graduate student.

Secondly, to gradually introduce this concept into the educational process. This approach requires modifications in the telecommunications network of an educational institution for ensuring stable and smooth operation of all personal devices applied in the educational process. For said purpose, the utilized software must be supported by various operating systems.

The BYOD can be implemented in practice by way of four options.

Option 1. In the educational process, it is allowed to use only one model of the entire set of devices. This option significantly simplifies the learning process management and does not imply significant changes. Moreover, it complies to a large extent with the standard model currently used in computer labs.

Option 2. Own devices allowed for use in the educational institution should correspond to a number of established technical requirements. This option is considered to be more flexible than the previous one. Option 3. Own devices allowed for use should comply with a number of requirements to their software and applications. Option 4. No special requirements are set to the own devices allowed for use in the educational institution except for the possibility of accessing the Internet. This BYOD implementation option is considered to be the most flexible one, however, it must be noted that it requires high-speed local networks and a large number of wireless access points in an educational institution. Another requirement that this option can also be based on is the introduction of cloud services to the educational process.



In this case, the technical issues of the BYOD implementation in practice come down to cloud management.

V. CONCLUSION

Thus, the efficiency of education can be significantly increased today by means of introduction of modern ICTs and EERs into the educational process [24]. Innovative educational technologies that are emerging will have prominent positive impact on education when being introduced in it in the coming years.

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