THE USE OF ICT (INFORMATION AND COMMUNICATION TECHNOLOGY) IN THE STUDY OF NATURAL SCIENCES BY MASTERS OF HIGHER EDUCATIONAL INSTITUTIONS

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Abstract

One of the leading tendencies in the development of contemporary education is the informatization of society. The informatization process requires a constant improvement of the professional level of both an individual and a team, encourages being able to work with information and communication devices, requires further training of masters of natural sciences, new content and quality of education. It is important to have a system where the sections of natural sciences, ICT, areas of technological progress and various issues of applied biology, chemistry and physics are interconnected. It is STEM education that can be used as such a system. This article is dedicated to using ICT at the classes of natural sciences at higher educational institutions. The main problems on the way to the implementation of STEM education have been analyzed.

Keywords: ICT; STEM education; classes of natural sciences; STEM literacy.

The development of fundamental sciences steadily encourages to develop new tools, methods for modelling, reproduction, interpretation of scientific results. The scale of the study of natural objects goes far beyond nano and mega dimensions. Under such conditions, natural sciences can develop well only in combination with contemporary information technology. Being the link between man and nature, technical sciences combined with innovative technologies reflect the laws of motion of the material means of human activity and testify the materiality of the means of human activity with the help of which nature is studied and transformed. This approach makes it possible to apply in the future an integrated approach to the study of fundamental sciences. There is a wide possibility of using information and communication technologies in the teaching of natural sciences, such as physics, chemistry, astronomy, biology, due to the improvement of teaching aids and the development of new methods of their use. The study of the basic concepts of a natural science can be shown approximately as follows: results of observations → hypothetical probability → theoretical aspects → practical research. In this case, there is a need to build a learning environment for the study of natural sciences where the use of ICT will be reflected at every stage. Therefore, the creation and use of curriculums, electronic textbooks, pedagogical software, mobile applications, is of great importance for the teaching of natural sciences, because computer-oriented technologies promote the emergence and implementation of innovations in real educational activity. The use of information and communication technology in the study of natural sciences will be efficient only when the innovator is a trained teacher. In the context of contemporary requirements, it is no longer sufficient for a teacher to have knowledge only in his/her discipline. There are currently a number of requirements: computer literacy, elementary programming skills in order to use programs for modelling, free navigation in the media space, ability to use the Internet technologies. Contemporary ICTs open a wide access to non-traditional sources of information: electronic hypertext textbooks, general-education websites, large-scale virtual portals, distance learning systems, etc. The use of ICT in studying fundamental natural phenomena and processes provides better quality to the interdisciplinary links of integrated nature, which are based on the acquisition of natural science knowledge by mastering basic techniques and technologies. Not only does this approach help study the structure of various natural objects and establish causal relationships between phenomena, but it also makes it possible to optimize the educational process, taking into account the possibilities of using information and computer technology. It is indisputable that the process of formation and acquisition of knowledge is directly related to the

transformation in the minds of students of some models to others, with a certain approximation to the absolute truth. Any computer models used in the process of studying natural sciences should not only be a formal copy of some real physical objects and processes, but it should be also possible to create some additional components in order to acquire new possibilities to study the features of an object or phenomenon. Any new features of the model will help further explore unknown properties and patterns and find ways to solve scientific problems.

Statement of the problem. One of the key competences of the new Ukrainian school is information and digital competence, which means the confident but critical use of information and communication technologies (ICT) to create, search, process, exchange information at work, in public space and in private communication. Information and media literacy, basics of programming, algorithmic thinking, working with databases, Internet security and cybersecurity skills. Understanding the ethics of working with information (copyright, intellectual property, etc.). The main purpose of information and communication technologies is to increase the efficiency and to achieve the quality of school education, its modernization. Analysis of relevant studies. The following Ukrainian scientists worked on the issues of introduction of information and communication technologies in education: M. Holovan, Y. Horoshko, A. Ershov, M. Zhaldak, Y. Mashbyts, V. Monakhov, T. Cheprasova, M. Shkil and others. The following scientists dedicated their works to the problems of creative thinking development: H. Altschuller, D. Bohoyavlenska, O. Klepikov, M. Meerovych, Y. Ponomariov and others. The problems of psychological and pedagogical formation of creative personality were studied by: S. Rubinstein, O. Leontiev, A. Ershov, V. Monakhov, M. Moiseev. The problems of STEM education are studied by such foreign scholars as Heather Gonzalez, Jeffrey Cuenzi, David Langdon, Kate Nichols and others. However, the efficiency of the use of information and communication technologies, the selection of appropriate research and applied tasks at the classes of natural sciences, which will lead to the introduction of STEM education, have not been studied enough.

Purpose of the article. The purpose is to demonstrate the need to implement elements of STEM education in the classes of natural sciences. Theoretical and empirical research methods were used in the article.

Main material. The ability to work with information and communication technologies (ICT) is necessary for success in life and competition in the job market [ ]. In the literature, a teacher's information and communication competence is presented as a system of

competences: – technological competence (realizing that the computer is a universal automated workplace for any profession); – algorithmic competence (realizing that the computer is a universal performer of algorithms and a universal means of creating algorithms); – model competence (realizing that the computer is a universal means of information modelling); – research competence (realizing that the computer is a universal technical means for the automation of educational research); methodological competence (realizing that the computer is the basis of an intelligent technological environment) [2]. The observations conducted during the study confirm that: - if a teacher has technological competence, he/she uses software and hardware most efficiently (knows how to work in various software environments, knows the capabilities of hardware, works with programs to create presentations, uses hardware: scanner, web-camera, interactive whiteboard); - having algorithmic competence, he/she can use modern software development systems, create algorithms (class scenarios and training managers - using content management systems); - having modelling competence, he/she can use professional packages for computer modelling and models of electronic training aids; - having research competence, a teacher can use technical means for automated research (laboratory and practical work, work on the materials of research projects); - having methodological competence, a teacher can use ICT to resolve production issues (participate in forums, write e-mails, prepare electronic materials taking into account the legal aspect of submission and use of information) [2]. The informatization in the teaching of natural sciences requires from a university teacher a high level of IT competence, which is one of the key competences in the process of professional growth and is manifested mainly in solving various problems with the use of computers, ICT and the Internet [2]. Teachers of the new generation should be able to competently select and apply the technologies that would fully contribute to the achievement of the goal, in particular, to the harmonious development of masters, depending on their individual characteristics. We should also remember that the rapid evolution of technology is leading to the point when the most popular and promising professionals on the planet are programmers, IT professionals, etc. STEM education focuses on natural sciences combined with IT. So, what is STEM education? The abbreviation STEM stands for Science, Technology, Engineering and Mathematics. And these disciplines are taught not separately (as we are used to) but in combination. It should be noted that STEM education can be provided only by the teachers who have obtained special training or further training and are ready to work in a unified system of natural sciences and technologies [4]. In order to achieve positive results, it is first

necessary to improve the teachers' qualification, because there is a certain problem, as it was stated above. In the current educational system of Ukraine, teachers have a narrow area of expertise, which results in mainly fragmentary knowledge of school graduates. The analysis has shown that the development of information and communication technologies requires to change educational approaches and pedagogical technologies substantially. STEM classes will be gradually forming for the students the foundation of understanding the unity of information principles of structure and functioning of systems of different nature, management processes in nature, technology, society. STEM education in general and each class in particular are aimed at forming the following 5 main competences: 1. conceptual understanding - understanding of concepts, operations and relationships; 2. operational freedom - skills of flexible and accurate performance of operations; 3. strategic competence - ability to state, present and solve problems; 4. adaptive thinking - logical thinking, reflection, explanation and argumentation; 5. productive consciousness - ability to consider an object as reasonable, useful and valuable and to believe in one's efficiency [9]. The teacher should develop his/her methodological and teaching materials according to the above postulates. Thus, STEM education is one of the efficient tools allowing to meet the demand of the society for experienced specialists in natural sciences under the conditions of developing IT, robotics, nanotechnology. STEM teaching requires a variety of technically complex skills with the use of mathematical knowledge and scientific concepts.

The use of ICT in the study of natural sciences will allow to show the fundamental unity of the laws of nature, to greatly increase students' interest in studying these natural disciplines, will intensify the learning process, ensuring a high level of results in the form of key competences.

References

1. Suchasni informatsiini tekhnolohii [Modern information technology]. Retrieved from http://it-tehnolog.com/statti/suchasni-informatsiyni-tehnologiyi [in Ukrainian].

2. Rozvytok informatsiinykh tekhnolohii [The development of information technology]. Retrieved from http://it-tehnolog.com/statti/rozvitok-informatsiynih-tehnologiy [in Ukrainian].

3. Veb-tekhnolohii v bibliotekakh: novi mozhlyvosti [Web technologies in libraries: new opportunities].Retrieved from http://bo0 k.net/index.php?p=achapter&bid=13586&chapter=1 [in Ukrainian].

4. Onyshchenko, O. S., Horovyi, V. M., Popyk, V. I. (2014). Natsionalni informatsiini resursy yak intehratyvnyi chynnyk vitchyznianoho sotsiokulturnoho seredovyshcha [National information resources as an integrative factor of national socio-cultural environment]. Kyiv [in Ukrainian].

5. Stratehiia rozvytku bibliotechnoi spravy na period do 2025 roku «Iakisni zminy bibliotek dlia zabezpechennia staloho rozvytku Ukrainy» [The development strategy of library for the period up to 2025 «Qualitative changes in libraries for the Sustainable Development of Ukraine»] (2016). kmu.gov.ua Retrieved from http://www.kmu.gov.ua/control/ru/cardnpd?docid=248924865 [in Ukrainian].

6. Zakon Ukrainy «Pro naukovo-tekhnichnu informatsiiu» [The Law of Ukraine «On the scientific and technical information»] (2012). Informatsiine zakonodavstvo. Osnovni normatyvni akty, part 3, 13–19. Donetsk : Natsionalnyi hirnychyi universytet.n].

7. Innovatsiini tekhnolohii [Innovative technologies]. Retrieved from http://uk.wikipedia.org/wiki.

8. Natsionalna biblioteka Ukrainy im. V. I. Vernadskoho [V. I. Vernadsky National Library of Ukraine: website]. Retrieved from http://www.nbuv.gov.ua/node/125 [in Ukrainian].