

# Application of Information and Communication Technologies in the Study of Natural Disciplines

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**Abstract:** Socio-cultural reality of the present time is marked by quite significant events. First, the active penetration into society of the latest information and communication technologies (ICT) arose as a result of the rapid development of electronics. And secondly, a special type of worldview under the general name of "contemporary" was formed and spread. It is the need for a philosophical understanding of these two events and determined the main idea of this article. The article also shows the role of information technology in the transformation of the cultural reality of contemporary. Also, the main directions of application of information systems and innovative technologies in the field of education and science in general, and at studying of disciplines of a natural cycle in particular are covered. Peculiarities of studying natural sciences by students are revealed, didactic potential of ICT and its realization in the process of studying natural disciplines is considered, methodical analysis of the problem of application of information technologies in natural education is carried out. The principle of integration, multimedia clarity, and interaction of participants of educational process at application of new information technologies at studying of natural disciplines is allocated. It is determined that ICT in the teaching of natural sciences can intensify the educational process, accelerate the transfer of knowledge and experience, as well as improve the quality of teaching and education.

**Keywords:** *Contemporary philosophical thought, students, information society, natural cycle disciplines, visualization of the educational process.*

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## 1. Introduction

The impact of contemporary information technology on society is quite huge, so it is impossible to stay away or abstract in the study of any recent process. It is this consumption of information takes place in the context of computer science, consumerism, postmodernism and enormous changes in information technology in recent decades (Taylor, 2014). Technology occupies the most important place in the life of man of today, because almost all processes in society are accompanied by them. They also determine sustainable development of contemporary civilization due to the importance of the information and communication component. Therefore, the rapid development of this component is a determining factor in the information globalization of current times. Philosophical and methodological bases of innovative development of education; organizational-pedagogical and psychological application of innovative development in education; innovations in the training of specialists in various fields and fields are revealed in the works of many scientists (Modern Technologies in the Education System; (Bakhmat, et.al. 2019; Sheremet, et.al 2019).

Information technology is now not considered a product of technological progress, they have penetrated quite deeply into all spheres of human life. Indeed, a quality educational process is now impossible without the use of information and communication technologies. These technologies are constantly changing, improving, so there is always the question of analysis of new information and communication technologies through the prism of the dynamics of world thought. This approach reflects contemporary philosophical thought, because new principles of worldview are formed through the information society (Nerubasska & Maksymchuk, 2020; Nerubasska, Palshkov, & Maksymchuk, 2020). Information technologies create a new vision and perception of the real world, and the concept of contemporary allows to form the specifics of the perception of this reality. Therefore, it is quite logical to think that contemporary is a worldview that reveals the essence of the information society. To analyse real processes in the information society, it is necessary to use such categories of contemporary philosophy as fragmentation, pluralism, simulation, and virtuality. This makes it possible to consider society as information- contemporary in the XXI century.

Harland G. Bloland (2005) notes that the terms and prospects of postmodernism are useful for tracking and interpreting the state of higher education in the contemporary era of rapid social change. The author

indicates that in response to the risks and uncertainty faced by higher education, it is proposed to maintain constant and serious reflexivity.

Also, another author states that postmodern ideas may affect the educational process in various ways. Regarding postmodernism, the goals of education are learning critical thinking, producing knowledge, development of individual and social identity, self-realization. In postmodern education, teachers simply lead students to discover new things. They enable discussions on different topics and creation of original ways (Hossieni & Khalili, 2011).

Accordingly, in scientific approaches there is a complex and contradictory process of reassessment of axiological orientations of a man of today. The intensification of the search for the meaning of life at the individual level is a characteristic feature of the development of society not only in the West, but also in societies with the preservation of traditional specificity. The effectiveness of the search for the meaning of life in the real world directly depends on the development of new islands of freedom, life forms and areas of creativity that correspond to the realities of the turn of the millennium. Despite the painful clashes of this process, in the contemporary creative man today receives unprecedented freedom based on a constructive basis of spirituality, through which a person acquires the ability to distance himself from society and independently critically comprehend all aspects and areas of his life (Salnikova, 2020; Melnyk, 2019; Onishchuk, 2020).

Recognizing the value of postmodern thought in the discovery of a new understanding of the educational process, Young (1997) reveals that postmodernism causes difficulties when trying to figure out differences and interaction between cultures. He rejects the extreme of both relativism and universalism and claims that comparative studies should be based on the balance between them. Also, Standish (1995) notes that in some recent discussions, the implications of postmodernism for education have been misunderstood. An alternative approach is proposed, which is used as a means to challenge any grandiose plan in the provision of school education and the concept of education. This calls into question the ideas of the whole person, which are hidden in many educational theories and practices (including personal and social education).

Information and communication technologies (ICT) in the philosophical sense of contemporary is a reconstruction of traditional perception and the dispersal of stagnant phenomena in society. Because, on the one hand, ICTs are created by man, and on the other hand, they are an integral part of human life, ie embedded in human existence. Such a unique

situation radically includes a person in the socio-cultural environment of society. Therefore, since the 60s of the twentieth century, it is customary to consider society in a new version, as informational or post-industrial. This fact indicates that information and communication technologies have begun to dominate in all spheres of life. Subsequently, the means of communication, electronic equipment and digital technologies, etc. were improved, which gave rise to radical changes in society and bringing information technologies to the forefront of all activities. This transformed and complicated society as a whole, made it possible to find new ideas and ways of understanding different from the traditional approach.

Yue & Yuen (2005) believe that the potential of ICT can be best estimated from the postmodern point of view, which, contrary to the generally accepted representation, does not advocate the general denial of technology as a whole.

There are very few works that reflect the use of information and communication technologies in the study of the disciplines of the natural cycle through the prism of the worldview of contemporary.

## **2. Contemporary information and communication technologies in science and education**

The prosperous of information dissemination and the penetration of digital technologies dates back to the end of the XX century. It is noted that information processes aimed at collecting, processing and transmitting information have always played an important role in science, technology and society. Thanks to the emergence of new information technologies, views and perceptions regarding exclusive opportunities for access to a high-quality educational environment are radically changing. The use of information technology in education leads to the fact that a person begins to own a huge amount of new information. This fact expands the boundaries of knowledge and leads to changes in the social and cultural order of development of our civilization.

At the present stage, the works of Bystrova (2015), Onyshko (2018), Vasylieva (2020) and many others are devoted to the disclosure of the problem of the application of information technologies in higher education. The main idea of these works is that one of the global problems of the contemporary world is the problem of informatization of society and computerization of all spheres of human activity.

The issue of scientific, technical and information independence of the country is a priority in the political sphere of any state. But on the other hand, the political and intellectual status of any state is determined by the

level of knowledge of its citizens and information in general. The state needs citizens - highly qualified specialists who meet the highest requirements of today. Education becomes a source of the most valuable strategic resources - human capital and knowledge. These resources determine the overall level of development of society. Informatization of society is its main accelerator of development. In turn, the informatization of society is impossible without the computerization of the education system. This approach focuses on the formation and development of intellectual potential, improving the forms and content of the educational process, the introduction of computer-based teaching methods and the use of contemporary information technology in teaching, Nishanova (2013).

The advantages of ICT are flexibility, the ability to adapt to different methods and algorithms of learning and individual response to the actions of each individual participant in the educational process. Also, the use of ICT can make the learning process more active, and it becomes a research or search. The main vectors of the use of information and communication technologies in education are: organization and management of the educational process, assessment of the quality of education and monitoring of the learning process. Each such vector is associated with the solution of many educational problems.

Management of the educational process is determined by solving problems of supporting the learning process and qualification of teachers. In this case, the full range of computer technologies is used, which are aimed at intensifying and individualizing the learning process from the usual demonstrations and presentations to multimedia electronic teaching materials and virtual environment. Innovative teaching methods are aimed at finding and making decisions as a result of independent creative activity and determine completely different requirements for the qualification of the teaching staff of the educational institution. The teacher must independently determine the didactic content of a particular communication technology in the educational process. Therefore, retraining is one of the tasks associated with the use of new information and communication technologies in the educational process.

The use of ICT requires a different form of presentation of material, the organization of cognitive activity and the choice of teaching methods. The use of such technologies allows the student to master a particular discipline through interactive or intelligent training programs. At the same time, it is possible to access remote databases or electronic libraries using Internet resources and communicate through conferences.

There are the following methods of application of information and communication technologies in the educational process:

- development of information technologies of developmental learning;
- information models of virtual reality;
- game methods of active learning;
- construction of computer and information models based on integrated application packages;
- creation of electronic libraries, databases, etc .;
- monitoring of the learning process using information and telecommunication technologies.

The main task of ICT is to reduce the complexity of the processes of using the information resource, as well as increase its reliability and efficiency. In present-day conditions, with the help of various communication systems, access to the necessary information is instantaneous. Therefore, without the use of information technology, it is difficult to imagine the existence of a contemporary man. It is established that ICT in primary school lessons today is a powerful didactic tool that attracts children to active work, develops their cognitive interest, promotes better learning and increases learning efficiency, Lavrenova (2020).

With the development of information and communication technologies, the possibilities of current science for conducting multifaceted research have expanded. In the modern institution of higher education with the spread of ICT in recent years, hypertext principles of transmission of educational and scientific information are more often used. This approach allows you to supplement the materials studied in lectures and workshops. Use visual aids for better perception and understanding, including the use of audio and video content. On the basis of hypertext in the learning process is the transfer of the necessary information. Additional digital resources can be applications, software modules, databases, tables, charts, calculation tasks, etc. Bulletin boards, forums, electronic simulators and electronic libraries are used as hypertext.

Thus, the emergence and spread of new information technologies is seen as an information revolution. But there are also ethical problems in the application of information technology in the educational process (Mățã & Boghian, 2019). Current information technologies have an impact on the formation of personality, family and lifestyle. New ICTs are the beginning of a new type of social and cultural environment for people with disabilities, regardless of place of residence and state borders (Utesov, et al, 2020).

Recent information technologies can change the education system itself. Based on them and innovative technologies, education should become the structure that forms the knowledge of future generations living in the information society.

An example of the use of innovative technologies in the educational process can be the use of intelligent training programs. For example, computer diagnostic technologies are widely used in the study of physiological processes in the human body (Vasylieva & Shmaley, 2013). For students, it is possible to simulate a controlled experiment on a computer. First, it allows you to monitor the result, collect and process data during the experiment without significant time spent on the technical organization of the experience and without the use of special tools. Second, the learner can reproduce real-world experiments of varying complexity and manage complex objects through the use of multimedia technologies.

### **3. The use of information and communication technologies in natural history lessons**

At present, the teaching methodology is going through a difficult period, which is associated with rethinking the purpose of the educational process and the development of a state standard, which is based on a competency-based approach. Difficulties arise at the same time that in the curriculum the number of hours for studying of separate subjects, including disciplines of a natural cycle is reduced. All these circumstances require new pedagogical research in the field of teaching methods, the search for innovative tools, forms and methods of teaching and education, development and implementation in the educational process of information technology.

The introduction of relevant information and communication technologies in the educational process will allow the teacher:

- work out the depth and strength of knowledge, consolidate skills and abilities in various activities;
- to develop technological thinking, the ability to independently plan their educational activities;
- follow the requirements of technological discipline in the organization of training sessions.

To date, ICT in the educational process has been recognized not long ago, as well as any innovation that gradually reveals its advantages and disadvantages. The introduction of ICT in the educational process was preceded by the following problems:

- lack of proper material base in many schools, which is necessary for the acquisition of equipment and experience with it in the teaching staff;
- insufficient awareness of ICT in the educational process.

Different approaches to the use of ICT are not so much a need of the time, as a need to fill the learning process with fresh ideas and expand the student's understanding of the possibilities of the educational process. The first steps in the use of ICT were aimed at making it easier for students to master the material. At the same time, they allowed to reveal creative abilities of the teacher, gave him more freedom in expression of own individuality in work.

According to some scholars, innovation in teaching technologies is a type of professional and pedagogical interaction between technology teachers and students in technological training, based on current educational, information and production technologies, which have recently formed a readiness to successfully enter independent life in society, Perinsky (2017).

Social tendencies of humanization of educational process make high demands on the teacher of biology, Butenko (2020). In the process of preparation for classes, teachers try to create a set of various multimedia presentations, author's materials that fill the lesson instead of the lesson plan. Also, teachers in the study of natural sciences, in particular, biology should implement active and interactive forms and methods of educational technologies in the formation of health knowledge, organization of health projects and the use of information and health technologies (Diachenko-Bogun, et al 2019).

In a study by Hursen & Beyoğlu (2020) the impact of the curriculum in geography was studied, enriched with virtual reality programs, on the interest of teachers in the course, academic achievement and propensity to use information technology. In the study, which used both personal and online learning environments, classroom activities were conducted with virtual reality (VR) programs, and extracurricular activities were conducted with Google Classroom (Hursen & Beyoğlu, 2020). In the conditions of independent work of the student at home, it is quite difficult to do without such electronic textbooks. For example, in geography lessons the use of visual aids is of great importance: maps, diagrams, posters, videos, etc. In this situation, the teacher will be helped by an electronic textbook.

The use of multimedia opens up greater opportunities to illustrate the phenomena and processes being studied. This improves the quality of education and helps to keep the student's attention. Current technology allows you to create a visual aid in the form of computer animation or



games. Multimedia promotes the active use of graphics, colour, animation and sound.

Therefore, the use of e-textbook has the following advantages:

- facilitates the understanding of the material being studied due to different from the printed literature ways of presenting the material;
- develops an inductive way of thinking, acts on visual and emotional memory;
- allows adaptation according to the educational needs of participants in the educational process, their level of training and intellectual abilities.

Natural science is an integrated discipline. Its content is a system of concepts and ideas from different natural sciences, based on the idea of the integrity of nature.

The relevance of the problem of the effective use of computer technologies in teaching natural sciences in the context of the modernization of the educational process at the socio-pedagogical level is determined by the search for new pedagogical means of the educational process. This problem is one of the demands of society, since the presence of motivation for obtaining knowledge by applicants for education in many aspects depends on success in reforming the educational process as a whole.

At present, the amount of knowledge in the natural sciences has grown significantly, and the role of the natural sciences in society has changed. This has led to the problem of forming natural knowledge, selecting and structuring natural material.

The process of learning science is a holistic system of interconnected elements that form a stable unity. Natural science is an integrated discipline. Its content is a system of concepts and ideas from different natural sciences, based on the idea of the integrity of nature. Therefore, the process of teaching science provides participants in the educational process with the necessary general natural knowledge, skills and abilities that allow you to successfully continue your studies in the future.

Also, the process of teaching science by means of information and communication technologies will be more effective in the case when the following didactic conditions are implemented:

1. The selection of the content of natural competencies, which allows the most optimal use of ICT in the educational process.
2. The implementation of technical support for students in the study of natural sciences is implemented on the basis of the principle of

integration of natural education, the principle of multimedia clarity and the principle of interactive interaction with the objects being studied.

3. Developed and used educational and methodological complex, which includes a program of holistic study in the classroom and outside classroom time, practical tasks for applicants, software and guidelines for teachers to use them.

#### **4. Didactic aspects of application of information and communication technologies in the process of studying natural sciences**

Analysis of the literature on the development and formation of methods of teaching natural sciences (Bida, 2003; Smolyanchuk, 2009; Groshovenko, 2014) shows that the cycle of such disciplines should not only acquaint with the classification of natural objects and geographical nomenclature, but also provide knowledge about their nature connections and dependencies. This indicates the importance of natural sciences in the education and development of students.

For example, primary school students perceive the world as a whole, do not divide its manifestations into biological, physical or chemical phenomena. The integration of natural knowledge at this stage of learning allows you to form a correct, holistic view of the manifestations of nature and creates a basis for further differentiated study of natural sciences. The study of natural sciences lays the foundations for understanding materiality and knowledge of the world, the relationship of phenomena, the idea of regularity and evolution. This approach facilitates the implementation of interdisciplinary links.

At present, the level of visibility is increasing in the process of teaching natural sciences, so new information and communication technologies have become widely used. They are now simply necessary, because much of the material studied in the course of natural sciences cannot be presented in its real or natural form.

The application of an innovative approach, based on the development of new ICT in the study of natural sciences, expands the range of educational activities and leads to qualitative changes in didactic requirements for teaching aids.

In psychological research it is noted that information technology influences the formation of theoretical, creative and modular-reflexive thinking of students. But at the same time, in present-day conditions, the relationship between human health and information technologies, disorders of somatic and mental health of the population caused by information and psycho-emotional loads (Shynkaruk, 2018).

Visualization of educational information on the basis of ICT has an impact on the formation of ideas, occupies a central place in the formation of thinking, enriches the perception of educational material and promotes scientific understanding. The main condition for the development of the applicant in a situation with the use of information technology are game moments, novelty, which stimulate interest, and all this leads to the mobilization of psychophysiological functions. The use of computer technology puts the student in a completely new, high-quality situation. Activation of thinking, the desire for new knowledge lead to the formation of such personal qualities as independence, initiative, attentiveness and concentration. ICT also influences self-organization and personal development (Vynoslavskaya, 2014). The most complete and strong ideas and natural knowledge are formed in students when the means of visualization are used in a certain combination. For example, when studying a specific natural object, it is necessary to combine natural textbooks with multimedia ones. The principle of multimedia clarity in the study of natural sciences acquires a new quality. The combination of multimedia with ICT improves the quality of the visual information itself and changes the very ways of forming visual information. It becomes possible to create a "visual abstraction", i.e. a variety of models, processes and phenomena of nature in the conditional-graphic interpretation.

The use of multimedia technologies in the study of natural sciences makes it possible to talk about a new powerful tool of cognition - cognitive computer graphics. It represents natural knowledge in the form of images-pictures and text, and also allows to visualize that knowledge for which text descriptions are not found yet and which demand abstraction of the highest degree. With the use of information and communication technologies, objects can perform various actions, study not only their statistical image, but also development in different conditions. Working with computer models helps the applicant to consider the structure of natural objects, to establish relationships between components, to identify stages of various processes.

Analysis of the experience of using new information and communication technologies in the study of natural sciences allows us to determine the following main results:

1. ICT significantly expands the possibilities of presenting the content of natural information. The use of multimedia visualization, animation, sound, all contemporary means of video equipment and interactive learning allows you to provide information in a fuller volume and promotes its better assimilation.

2. The use of ICT increases the motivation to learn natural sciences through the visualization of objects, object management, the ability to independently choose forms and methods of learning, the introduction of game situations, reveals the applied value of science, allows participants in the educational process to show originality.

3. ICT significantly expands the educational and cognitive activities of participants in the educational process in the study of natural sciences through modelling, creating projects, working with multimedia programs, searching for information on the Internet.

4. ICTs open wide opportunities for individualization and differentiation of the learning process of natural sciences through the realization of the possibility of interactive dialogue, independent choice of educational activities and organizational forms of learning.

5. ICT can completely eliminate one of the important reasons for the negative attitude to learning - failure, which is due to misunderstanding, significant gaps in knowledge. Because, using these technologies, students get the opportunity to complete the task, relying on the necessary assistance.

6. ICT allows to qualitatively change the control over the activities of students, while ensuring the flexibility of management of educational and cognitive processes.

## **5. Conclusions**

The transition to the information society objectively expands the range of educational technologies, initiates the creation, testing and implementation of fundamentally new information and communication technologies. The degree of their spread in the educational sphere is an indicator of the level of development of the information society of any state.

The analysis of the introduction of new information and communication technologies in the educational process showed that the audio-visualization of society is at the same time a reflection of the contemporary era.

The use of current information and communication technologies allows to make the educational process more interesting, dynamic and convincing. Also, a large flow of information is made easily accessible, which improves the quality of education and opens new ways to intensify the educational process.

Contemporary ICTs play an important role in shaping a new way of thinking and serve as a reliable tool for the transformation of social cognition. At the same time, the possibilities of cognition on the basis of epistemological forms of dialectics expand. Therefore, due to the active use

of information and communication technologies in the field of science and education, it is possible to increase the criteria of knowledge, their nature and limits.

The use of new information and communication technologies in the study of natural sciences is quite natural from the point of view of the learner and is one of the effective ways to increase motivation and individualization of learning, development of creative abilities and create a favourable emotional background.

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