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ICT in primary school students' activities as a component of the methodological system for the formation of knowledge about nature

The problem of the effective use of ICT tools in the formation of the nature knowledge among primary school students is a current task of modern education, as it helps to form the concept of natural science knowledge and modern technology in an inextricable connection. The acquisition of information and communication technologies by primary school students in natural science education and using them in everyday learning activities, project and research practices, the presentation of their results becomes a necessity. The systematic ICT application in teaching a subject makes it possible to develop the creative activities of students, to discover new properties of the subject-matter situation, and to expand the zone of students' independence. However, today the methodology for the use of ICT in the natural science education of schoolchildren covers to a greater extent the middle, rather than primary school, and most of the work is devoted to the use of ICT by the teacher. The article discusses the system of using ICT in teaching natural science, oriented to project and research activities and based on the competency approach which will promote the competence of primary school students in solving the problems with the use of natural science knowledge, ICT competence, communicative competence.

Keywords: ICT competence, tools of information and communication technology, competencies in the communication, information technology competence, competence-based approach, research activities, information culture, natural science thinking.

Introduction

Information technology progress has a significant impact on all human activities, including the expansion of traditional methods in scientific research and the scientific knowledge transmission. The expansion of traditional methods of scientific research helps to the formation of an innovative, creative approach to solving problems. It leads to a redefinition of the natural science education values and requires changes in the educational process, technology, content, and criteria for assessing its impact.

At the present time, the strategic objective of school development is to update its content and achieve a new quality of its results. Human activities are becoming innovative, the range of reproductive activities is narrowing, and innovation is increasing. The modern education system is oriented towards new educational outcomes. The State Program for the Development of Education and Science in the Republic of Kazakhstan for the period 2020–2025 aims to bring up and educate the individual on the basis of universal human values and to increase the global competitiveness of Kazakhstani education and science [1]. The tasks based on the objective are to equip educational organizations with digital infrastructure, modernize and digitize scientific infrastructure, etc. Taking into account these objectives in the State Compulsory Primary Education Standard the student should have a wide range of knowledge including the use of information and communication technologies [2].

One of the fundamental changes in natural science education in modern schools is its methodological orientation. At the same time, the acquisition of information and communication technologies by primary schoolchildren and their use in everyday educational activities, project activities, research, presentation of the results of such activities become a necessity.

A systematic approach to the use of information and communication technologies is advisable in the context of the reorientation of the educational process from a knowledge system provided to students in a ready-made form to the development of the student's personality by the means of the academic subject. With this approach, to form nature knowledge among primary schoolchildren, it is necessary to use the situations that encourage schoolchildren to pursue their self-study, project, research activities using ICT, which will expand the boundaries of students' creativity.

The State Compulsory Primary Education Standard in the educational field «Natural Science» states: «A student must synthesize information material in the form of schemes, graphs, diagrams, tables, simulation and graphic models of objects, micro- and macroworld phenomena and processes». However, an analysis of existing practices in the «Natural Science» educational field has shown that insufficient attention is paid to the use of information technologies by students.

Experimental

The research methodology includes theoretical methods: analysis and synthesis of scientific research on the use of ICT in natural science education; empirical methods: questionnaires. The current methodology for using ICT in natural science education for schoolchildren is more focused on basic school level than on primary school one. In addition, most of the work is devoted to the ICT use by teachers rather than students. Thus, there is a contradiction between the objective of learning information and communication technologies for students to apply in natural science educational activities and the present methodology for natural science education in primary schools. It makes the research topic relevant and raises the question of how to teach natural science in the primary school grades in a modern school taking into account the need for students to learn and use information and communication technologies in their subject-related activities.

The main goals of studying school subjects in the «Natural Science» educational field in primary school are the development of students' natural curiosity, research skills, the formation of scientific understanding and the surrounding world vision. These goals are being achieved gradually. The course «Natural Science» in primary school precedes the systematic study of such academic subjects as «Biology», «Physics», «Geography», «Chemistry». It is the study of this course that lays the foundation for the value concept of the world and the methods of natural science knowledge.

A holistic approach to the study of nature in relation to human activities forms the students' environmental education and upbringing. However, it is necessary to remember about the role of information and communication technology in modern education. The development of knowledge about nature in close connection with ICT allows students to form an idea of natural science and modern technology inextricably.

The State Compulsory Educational Standard defining the main strategic directions in education, is founded on a competency-based approach according to which the entire educational system is aimed at forming the students' readiness to use knowledge, real-life skills and abilities to solve practical tasks [2].

Consequently, a project-oriented and research-oriented natural science education system, including an ICT component, forms the primary schoolchildren's competence to solve problems using natural science knowledge, ICT competence and communication competence.

A competency-based approach to learning requires the creation of a special educational environment that influences all areas of student's personality. In this regard, the development of ICT-enabled knowledge about the nature among primary school students should be based on the research and practice of students. It emphasizes the relevance of the ICT use as a component of the methodological system for the formation of natural science knowledge among primary schoolchildren in accordance with the requirements of the educational modernization.

The formation of an individual's information culture including information technology competence is a basic socio-cultural and pedagogical task in the information society. In the education system, it should be solved in the direction of a systematic ICT application in subject-based teaching which allows the students' creative activities. The use of computer technology makes it possible to reveal new properties of a subject situation and to expand the independence zone.

The analysis of primary school textbooks on the «Natural Science» subject illustrates that they do not pay enough attention to the integration of informatics elements to prepare students to work with specific ICT tools and to use them in the study of natural science. At the same time, the problem of informatization of natural science education among primary schoolchildren is an urgent one.

Informatization of education is defined as the purposeful ICT development and introduction: to the learning process; to the management of the educational system; to the methodical and scientific-pedagogical activities [3; 89].

Information technology education for primary schoolchildren is possible through integration at the intersubject level. Natural science subjects have a great potential in this direction. A particular type of thinking is being developed, information skills are being acquired, and a modern integral scientific picture of the world is being created through such integration.

The goals of ICT education for primary schoolchildren are compared with «Natural Science» ones (Table 1).

Table 1

Comparison of goals of «Mathematics and Informatics» and «Natural Science» educational fields on the basis of the State Compulsory Primary Education Standard

«Mathematics and Informatics» educational area «Digital Literacy» academic subject	«Natural Science» educational area «Natural Science» academic subject
Development of skills in using elementary ICT tools, the ability to search, select, transmit information, design objects and processes.	Comprehension of causes and understanding of the relationship between living and non-living nature phenomena and processes, awareness of the surrounding world diversity and complexity, broadening students' horizons.

It shows that the objectives of the «Digital Literacy» and «Natural Science» academic subjects create favourable conditions for both the process of subject integration and solving the issues of using ICT in the formation of knowledge about nature.

Due to the intersection of Natural Science and Informatics, the goals can be seen in the following ways:

– the unity of scientific cognition methods, new general scientific and particular scientific methods which can be introduced studying the «Natural Science» subject appear through the development of information technologies;

– the study of the «Natural Science» course in the primary school gives students a scientific picture of the world including an information component;

– modern primary school students are actively interested in technological innovations, i.e. their research behaviour is being intensified.

Thus, at the present stage of the educational modernization, the formation of knowledge about nature using ICT occurs through:

1) the initial knowledge about the natural science picture of the world including information processes;

2) mastering the initial natural science skills (observations, experiments, measurements, using ICT tools);

3) mastering the ability to work with different types of information using a computer and other ICT tools and to organize their own information activities;

4) development of natural scientific thinking;

5) development of cognitive interests and communicative skills;

6) development of ecological thinking;

7) formation of skills to be selective in the received information;

8) development of skills for practical tasks in everyday and educational activities.

The students' mastery of ICT for use in educational subject activity influences all educational goals in the system of nature knowledge formation revealing its systemic importance.

The creation of a methodological system and the organization of the learning process among primary schoolchildren and their use of information technologies are impossible without studying the psychological and pedagogical characteristics of primary school students. The research of psychologists (J.Piaget [4; 89], V.V. Davydov [5; 147]) confirms that the development of the child's thinking is from visual-efficient to visual-figurative, and from figurative to logical one, the formation of each type of thinking at a certain age depends on the child's living conditions, activities and forms of communication.

Primary schoolchildren are actively developing cognitive processes and are forming the ability of making conclusions and hypothesizing. The child's reflection and self-awareness are developed through the formation of thinking.

Individual differences related to the independence of thinking, creativity, and mental activity are beginning to develop in the intellectual activity of primary schoolchildren. At this time, primary school students express an emotional attitude to the educational process. Students are interested in the world around them, in natural processes and phenomena, and in the achievements of science and technology, i.e. there is a period of activation of research behaviour.

Research behaviour is is aimed at finding and acquiring new information; it is an integral part of human activity. Research behaviour contributes to the acquisition of social experience and personal development [3; 147].

The main factors of research behaviour are: novelty of the object; complexity; uncertainty of information; information conflict related to contradiction or inconsistency of the available information.

Research behaviour is most clearly manifested and formed in different activities and subject areas. Enriching and broadening the experience, the connection with the surrounding world among some primary schoolchildren leads to a tendency toward mental activity, independence; and among others to decrease interest in learning. Therefore, the young school age is important for all subsequent schooling. The interest in the study of the environment among primary schoolchildren can be achieved through the inclusion of a large number of experiments and observations including ones carried out by children themselves into the «Natural Science» subject. Children's interest in modeling, drawing and games should be actively exploited.

An analysis of the priorities in teaching natural science leads to the conclusion that the most effective system of ICT-enabled natural science education in the primary school grades can become a research activity.

The practical activity of a nature researcher is the basis for transforming educational information into practical skills used in everyday life. The personal experiences of students play an important role in forming knowledge about nature. Successful achievement of the goal is possible only when students act as researchers who are in close contact with the environment.

A modern schoolchild has to live and work in the world of information technology, so it is paramount for the school to teach them how to work in a rapidly changing information environment and how to use their own information space effectively.

Students' mastering of methods of working with information can be divided into two parts: mastering the process of searching, understanding, transferring information; acquisition of ICT skills.

The modern child lives in an information world, where ICT tools are being rapidly upgraded. The number of primary school children with computer skills which they mostly use for leisure activities is constantly increasing. Children, at this age, have a special interest in the study of the environment and in the development of technological innovations. This interest should be used productively and should encourage primary schoolchildren to self-study new ICT tools for educational purposes. The level of students' computer skills can vary greatly, so it is necessary to take an individual approach to teaching.

The self-study and use of ICT in forming individual students' knowledge about nature can encourage others to successfully learn computer technologies.

A lesson for primary schoolchildren is not only learning but also communicating with teachers and classmates. Therefore, the teacher should actively use group and collective forms of educational activities such as student conferences, travel games.

For example, during the 4th grade lesson under the section «Environmental Protection», primary schoolchildren were members of a scientific research expedition consisting of groups of specialists-scientists: geographers, botanists, ecologists. The expedition included such employees as an artist, photographer, driver, etc. The teacher coordinated the activities of all participants of the expedition, helped to solve problems during the journey thus maintaining the game interest throughout the lesson. Such lessons contribute to the development of basic skills among primary schoolchildren to monitor and evaluate their own activities while working together creatively. At the same time, the teacher should act as an explorer of nature, the same as students, only more experienced. Both the teacher and student should have ICT skills and use them for productive work in learning the world around them.

Psychological and pedagogical research by scientists such as M.S. Tsvetkova [6; 69], T.V. Drozdova [7; 257] shows that the use of ICT in subject teaching is an effective way of developing creative abilities of schoolchildren. The pedagogical objective of using ICT should be aimed at developing the personal aspects that children need in a modern information society.

The social impact of the ICT introduction to the formation of nature knowledge among primary schoolchildren consists of various aspects: the development of digital and computer literacy; the formation of skills and abilities of using ICT in teaching tasks; the development of skills and abilities, competences intended for application and use in the professional field.

Modern researchers such as Y.D. Babayeva examines that information technologies allow the implementation of an individual approach to gifted children, that is an important component for realizing their potential [8; 11].

An analysis of human interaction and ICT research reveals the impact on the development of the child's personality. The main factors in this influence are: personality type, gender, age of the child, as well as pedagogical and ICT technology.

The main task of the teacher is to create the conditions in which students need for independent activity so that the teacher should create the situations that stimulate: the independent formulation of cognitive tasks; development of ICT-enabled cognitive problem-solving methods; problem solving and validation.

The creation of problem research situations makes it possible to use the research method as one of the most effective for achieving educational results.

The use of the research method allows to organize research and creative activities, where primary school students solve new problems for them and participate in pedagogically adapted scientific creativity. As a result, students learn how to conduct scientific research.

The main stages of the research, problem-solving tasks can be: observation of facts and phenomena; problem-setting, hypothesis; elaboration of the research plan; implementation of the plan, formulation of the solution; verification of the solution, conclusions.

The student can perform research and problem tasks either independently or in a group. Comparing the results of their activities is the foundation of reflection, and reveals the capabilities of the individual. The motivation of the activity is more clearly expressed in group work, the activity is more emotional, meaningful, productive. The teacher plays the role of project and research leader for the students, where: the teacher prepares tasks taking into account the possibilities and tendencies of the students; he organizes and supervises the students' work.

The use of project and research methods requires the application of innovative teaching technologies including ICT. The formation of nature knowledge in the «Natural Science» educational field ensures the functioning of the system of natural science education for primary schoolchildren including the application of information teaching technologies.

The use of ICT as a modern means of obtaining and processing information is an indispensable tool for the study of environmental phenomena. Moreover, the cognitive aspect of the activity is basic and the technical competence is subsidiary.

The use of ICT in the formation of nature knowledge for primary schoolchildren provides: a creative approach; mastering the methods of self-study; a demand for self-learning.

Thus, ICT as an important teaching means contributes to increase its quality and efficiency and on the other hand the formation of an information culture is an important target of modern natural science education.

The formation of nature knowledge among primary schoolchildren lays the foundation for the development of a value-based view of the world, the unity of methods of scientific nature knowledge which is a step towards the fundamentalization of education.

Information technologies expand the methods of scientific knowledge. Therefore, it is appropriate to build a methodological system for ICT applications which is closely related to the natural science education for primary school children.

The development of the primary schoolchildren's competence in the natural science field should include research, computer (ICT) and communication skills.

Research skills: formulating the problem, analyzing the research results; knowledge of the basic measurement methods and how to present the results in the form of tables, graphs, diagrams; skills in systematizing the obtained data; skills in working with additional literature.

Computer (ICT) skills: working with a text editor; skills in working with a photo and video camera; skills in working with a browser; skills of searching and storing information on Internet.

Communicative skills: ability to select and analyse information from different sources; ability to present information; ability to apply natural and scientific terminology in oral communication; ability to participate in discussions; ability to speak to an audience.

Implementing the goals of formating ICT-enabled knowledge about nature, it is necessary to form primary schoolchildren to be prepared for information and educational activities expressed in their desire to use ICT in Natural Science and other subjects for educational and self-development purposes.

A competency-based approach to the organization of the educational process involves the use of different methods and forms of working with students which can be classified on different bases: number of participants in the interaction; leading pedagogical goal; level of students' productivity; way of perception; structure of activities [3; 123].

On the basis of these aspects, the following leading methods and forms of work can be identified: individual, group, collective; information, organizational, developmental; productive, reproductive; verbal, illustrative, practical; motivational, educational, providing reflection.

According to variety of teaching methods and forms, they should satisfy certain requirements: adequacy of the goals and objectives; variety of methods; adequacy of the student population; adequacy of the teacher's pedagogical and methodological attitudes; the predominance of productive methods and group forms of work; the combination of learning individualization with the development of communicative skills.

All of the above define the main objectives of the lesson: the study of new objects and phenomena; the formation of research skills; the acquisition of experience in creative activity; the formation of communicative skills; the systematization and generalization of material; reflection of the activity results.

The elements of natural science knowledge acquired by primary schoolchildren in the process of forming nature knowledge are aimed at developing a holistic perception of the world around them.

The following types of tasks should be used to achieve the objectives: research tasks; design tasks; training conference tasks; computer tasks.

All of these types of tasks are interconnected, have a complex structure and contribute to the achievement of ICT-enabled goals in the natural science education system of primary school students.

Thus, the ICT system for natural science education which is project-oriented and research-oriented will help to develop the primary schoolchildren's competence to solve problems using natural science knowledge, ICT competence, communicative competence.

The implementation of a competency-based approach in the learning process requires the creation of educational situations that can be realized in special learning environments which allow the teacher to model and control the students' activities. This solution can be done with the help of including students in various activities. Constantly and rapidly evolving, ICT tools need to be applied quickly and flexibly to the learning process.

A system of teaching natural science, including an ICT application system, will provide an understanding of scientific methods of learning for primary schoolchildren and will contribute to the development of their natural scientific thinking, will form competence in solving problems using natural science knowledge, computer technology and scientific communication. Accordingly, the learning process should be oriented towards the acquisition of cognitive skills through involving the student in active, independent, successful activities and creating the necessary conditions for the development of all spheres of his personality, developing general educational skills and preparing primary schoolchildren for systematic mastery of natural science subjects.

Results and Discussion

The author conducted a study in three schools of Karaganda, to verify the proposed conclusions in practice, and to find an answer to the question of how to teach natural science education in primary schools taking into account the requirements of informatization (MPI «Gymnasium named after K.Satpayev», MPI «GS 82», MPI «GS 74»).

It was established through a survey of primary school students and parents, monitoring of school tasks and analysis of homework results: 75 % of students use computer tools with parental support for their fourth-grade natural science homework. Only 25 % of students do it by themselves. All students with basic computer skills have received it at home.

A survey of fourth-grade students and their parents showed that computer games were the predominant type of computer activity for fourth-grade students (90 %). The time spent by fourth graders at the computer is controlled by parents.

To clarify the teachers' attitude to the problem of using ICT technologies in natural science education, the author conducted a questionnaire for 23 teachers in Karaganda primary schools. To determine the level of teacher's ICT knowledge, teachers' attitudes towards students' ICT-enabled natural science tasks, a questionnaire was offered to the teachers.

An analysis of the questionnaires revealed that 96 % of the teachers surveyed consider themselves to be skilled users and actively use computer tools and technologies in the preparation and implementation of natural science lessons. 81 % of teachers responded positively, 2 % replied negatively and 17 % found it difficult to answer when they were asked about the appropriateness of using the computer technology in Natural Science in fourth grade. A teacher interview revealed that difficulties were caused by the lack of fourth-graders' ICT knowledge. All the teachers who responded to the questionnaire indicated that it is necessary to have a

coordinated approach with a computer science teacher to solve this problem. They also considered the motivation and level of computer literacy of primary school teachers are important.

A survey of 38 fourth-grader students and 42 students' parent was conducted to identify the preferences of primary schoolchildren for home computer activities and the interest of students in ICT for use in education. 93 % of students said that they could play, draw, write on a computer, 75 % of fourth graders could search on the Internet, 25 % of primary schoolchildren reported that they could create documents and folders.

The study showed that the school science and practice conferences and students' project activities have a significant influence on the motivation of primary schoolchildren to use ICT in natural science education. 95 % of fourth graders enjoyed attending school conferences, competitions of which 68 % of students would like to speak at the conference.

Conclusions

The study confirmed that the use of ICT in the natural science education of primary schoolchildren based on a task system has a positive impact on the development of motivational and reflexive areas of students' personality.

The use of a computer as a research tool by primary school students, encouragement of students to study and use ICT independently, the application of tasks motivating students' scientific, research and project activities contribute to the formation of natural scientific thinking among primary schoolchildren and the development of competence in solving natural science problems, ICT competence.

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Е.С. Бандалетова, Ж.Е. Сарсекеева

Табиғат туралы білімді қалыптастырудың әдістемелік жүйесінің құрамдас бөлігі ретінде бастауыш сынып оқушыларының іс-әрекетіндегі АКТ

Бастауыш мектеп оқушылары арасында табиғат туралы білімді қалыптастыруда ақпараттық-коммуникациялық технологиялар (АКТ) құралдарын тиімді пайдалану проблемасы қазіргі білім берудің өзекті міндеті болып табылады, өйткені бұл ажырамас байланыста жаратылыстану мен қазіргі заманғы технологиялар туралы түсініктердің қалыптасуына ықпал етеді. Қазіргі бастауыш мектепте жаратылыстану біліміндегі түбегейлі өзгерістердің бірі — оның әдістемелік бағыты. Табиғи білім беруде бастауыш сынып оқушыларының ақпараттық-коммуникациялық технологияларды меңгеруі және оларды күнделікті оқу іс-әрекетінде, жобалау мен зерттеу практикасында қолдануы, олардың нәтижелерін ұсынуы қажеттілікке айналды. Пәнді оқытуда ақпараттық-коммуникациялық технологияларды жүйелі түрде пайдалану бастауыш мектепте оқушылардың шығармашылық белсенділігін дамытуға, пәндік жағдайдың жаңа қасиеттерін ашуға және бастауыш сынып оқушыларының дербестік аймағын кеңейтуге мүмкіндік береді. Алайда, бүгінгі күнге дейін мектеп оқушыларына жаратылыстану білім беруде АКТ-ны қолдану әдістемесі көп дәрежеде бастауыш мектеп емес, негізгі базаны

қамтиды және жұмыстың көп бөлігі мұғалімнің АКТ-ны қолдануына арналған. Мақалада жаратылыстану ғылымдарын оқытуда АКТ-ны қолдану жүйесі ұсынылған, бұл құзыреттілікке негізделген жобалық-зерттеу қызметіне бағытталған, АКТ-құзыреттілігі және коммуникативті құзыреттілікті, жаратылыстану ғылымдарындағы білімді қолдану арқылы проблемаларды шешу саласында кіші жастағы оқушылардың құзыреттілігін қалыптастыруға ықпал етеді.

Кілт сөздер: АКТ-құзыреттілігі, ақпараттық коммуникациялық технологиялар құралдары, коммуникация саласындағы құзыреттер, ақпараттық технологиялар құзыреттілігі, құзыреттілік тәсіл, зерттеу қызметі, ақпараттық мәдениет, табиғығылыми ойлар.

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Информационно-коммуникационные технологии в деятельности младших школьников как компонент методической системы формирования знаний о природе

Проблема эффективного использования средств информационно-коммуникационных технологий (ИКТ) в формировании знаний о природе у младших школьников является актуальной задачей современного образования, так как способствует формированию представлений о естественнонаучных знаниях и современной технике в неразрывной связи. Одним из кардинальных изменений естественнонаучного образования в современной школе становится его методологическая направленность. Освоение информационных и коммуникационных технологий учащимися начальной школы в естественнонаучном образовании, использование их в повседневной учебной деятельности, проектной и исследовательской практике представление их результатов становятся необходимостью. Систематическое применение ИКТ в преподавании предмета позволяет развивать творческую активность учащихся в начальной школе, открывать новые свойства предметной ситуации и расширять зону самостоятельности учеников младших классов. Однако на сегодняшний день методика применения ИКТ в естественнонаучном образовании школьников охватывает в большей степени основную, а не начальную школу, и большая часть работ посвящена использованию ИКТ учителем. В статье представлена система применения ИКТ при обучении естествознанию, ориентированная на проектную и исследовательскую деятельность, основанная на компетентностном подходе, которая будет способствовать формированию компетентности учащихся младших классов в области решения задач с применением естественнонаучных знаний, ИКТ-компетентности, коммуникативной компетентности.

Ключевые слова: ИКТ-компетентность, средства информационных коммуникационных технологий, компетенции в сфере коммуникативной деятельности, информационно-технологическая компетентность, компетентностный подход, исследовательская деятельность, информационная культура, естественнонаучное мышление.

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