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## Formation of ICT-Competence of Future University School Teachers

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### ABSTRACT

The relevance of this research is due to the problem of modern society informatization, the need to form a single information space, the emergence of new competencies, which the modern teacher should master, increase in requirements for the qualifications and professional activity of the teacher; the need to set a strategic goal of transforming the country into a world intellectual State with the predominant development of disincarnate intellectual and knowledge-based material industries. The purpose of this research is to identify the specificity of formation of future university school teachers' ICT competence. Research methods. The leading method to investigate this problem is the pedagogical experiment (ascertaining, forming and control), and the method of statistical processing of quantitative results of research. 146 future university school teachers took part in the experiment. During the process of formation of ICT competence of future university school teachers, the phenomena of society informatization, the need to improve the information culture, and computer literacy were taken into account. Educational quest-technologies, tasks, exercises which form a unified system for the formation of ICT competence of future university school teachers were developed. Specificity of the author's method of formation of ICT competence of future university school teachers is that this process is based on the simultaneous formation of media literacy and informational culture. Relevance of the research. The research proved the effectiveness of the proposed methodology for the formation of ICT competence of future university school teachers, the results of implementation of which mainly identified a sufficient level of the ICT competence formation of future university school teachers. The materials of the article can be useful for university school teachers, parents, teachers of higher education institutions while using this method of formation of ICT competence.

**Keywords:** ICT competence, future university school teachers, methodology

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### **State of the literature**

- Despite the importance and urgency of the problem of informatization of education in the scientific and methodological literature, the issues of the formation of ICT competence of future university school teachers have been little studied.
- Analysis of scientific research shows that, despite significant progress in the implementation of computer technologies in training, the potential of information technologies is not fully implemented in the teaching and educational process due to a small number of multimedia training complexes in various disciplines and methodological recommendations for their effective application in the educational process.
- There is a persistent contradiction between the need for the formation of ICT competence of future university school teachers and insufficient attention to the theoretical and methodological support of this area of vocational training from the developers of the standards and curriculum.

### **Contribution of this paper to the literature**

- The methodology of formation of ICT competence of future university school teachers is proposed, which includes means for the development of the personality of students, means of information and methodical support and management of teaching and educational process by educational institutions, the system of educational institutions, means of communication for the dissemination of advanced pedagogical technologies and ICT technologies; means of automation of processes of control, correction of learning activity results, computer pedagogical testing; means of automation of processing processes of results of the experiment; means of organization of intellectual leisure, developing games.
- It is proposed to implement the capabilities of software and methodical support for modern computers in the process of formation of ICT competence of future university school teachers, in order to communicate knowledge, simulate training situations for training, monitor learning outcomes; to use object-oriented software tools or systems for the purpose of formation of learning activity culture; to realize the possibilities of artificial intelligence systems in the process of application of educational intellectual systems.
- Educational quest-technologies, tasks and exercises were used in work with future university school teachers.

## **INTRODUCTION**

XXI century is the age of nano- and computer technologies. Nowadays, from a specialist in any field of activity, knowledge is required not only in the sphere of proper qualification, but also the ability to navigate, to extract the necessary information from an immense source called mass communication.

Modernization of the Russian education highlights the informatization of education as one of its priorities, the main task of which is the creation of a unified information and educational environment, which is regarded as one of the conditions for achieving a new quality of education. The use of the potential of modern information technologies in education will make it possible to train highly qualified specialists capable of finding and solving the social and economic problems of modern society. The main problem of education is not the assimilation of huge and ever-increasing volume of knowledge, or at least the orientation in a powerful stream of ever-increasing information, but the problem is exactly the opposite – obtaining, creating, producing knowledge in accordance with emerging needs.

Today, the most adequate means of realization of modern education is the information and computer technologies that enable information at any time and in any amount, and thus the formation of ICT competence.

The use of information and communication technologies in higher education presupposes the use of information technologies in order to change what to teach and how to teach, i.e. content and methods of teaching within the traditional face-to-face form.

The need of formation of ICT competence of future university school teachers is conditioned by the processes of globalization and internationalization, the development of intercultural ties, the integration of the Russian Federation into the world social and economic space. This, in turn, determines the urgent need for future professionals' training with a high level of knowledge of information and communication technologies, capable of carrying out international professional activity in the information society. Along with mastering the knowledge and technologies that provide professional growth in the field of a particular specialty, only a specialist who has communication skills and the ability to work with modern ICT technologies can be considered competitive in the world labor market.

### **Purposes and Objectives of the Research**

The purpose of this article was to develop a methodology for the formation of ICT competence of future university school teachers. The main objectives were: to study the content and methodology of the formation of ICT competence of future university school teachers; to create an informational educational environment; to include educational quest-technologies using information and communication technologies in the system of vocational training of future university school teachers.

### **LITERATURES REVIEWING**

#### **Analysis of Russian Scientific and Pedagogical Literature**

Analysis of works of O.A. Artemyeva, M.N. Makeev & R.P. Milrud (2005), M.M. Komar (2007), A.I. Oleinik (2008), M.V. Onoprienko (2006), S.S. Rybinskaya (2013) testified that a key tendency of social development now and in the near future will be informatization of society which has an objective character and a social essence. Reciprocal dependence of social and information processes is expressed in the fact that social processes are information and informatization in its turn is not technical but a social phenomenon which involves intensification of creation, expansion, storage, processing, delivery of information. Social character of informatization of society is also expressed in that speed, content, various manifestations of the mentioned process, its efficiency, character and trend are in organic dependency from social circumstances. Finally, we come to the conclusion that social transformations have greater influence on the process of informatization of society than technical inventions and innovations but on the other hand informatization is one of the dominant factors of social development.

Scientific papers focused on understanding peculiarities of philosophy of education under the conditions of information society (Andrushenko, 2005; Boyko, 2010; Fomicheva, 2004; Furkin, 2005; Gao et al., 2017), allowed to outline a range of questions solution for which requires immediate reaction from all pedagogues namely: informatization of education; enhancement of renovation of IT-technologies and knowledge in different spheres of life-sustaining activity; interdisciplinarity of modern education; search for new approaches in teaching; identification of aims of modern education; new role of the teacher; integration of education.

V.D. Shadrikov (2014), I.S. Shemet (2010) examine strong and weak sides of the process of informatization of education from the perspective of learner psychology and psychology of educational process. Possibilities of realization of key principles of didactics from the point of view of new information technologies are revealed. The authors also determine negative consequences of influence of information and communication technologies in education. The necessity of careful examination of the process of informatization is emphasized taking into account the fact that it is inevitable.

Information technologies, as marked by M.I. Zhaldak (2003), are considered as an aggregate of methods and technical means of collection, organization, storage, processing, delivery and presentation of information that extends human knowledge and develops their opportunities to control technical and social processes. Sometimes computer and information technologies are identified and are interchangeable. In the author's opinion (Ragozina, Grineva & Malova, 2012; Gao & Wang, 2017), information technologies can use a computer only as one of the possible means not excluding the use of other technical means (audio-, video facilities, projectors).

As results of our scientific search testify the definition of the term “information and communication technologies” are not unambiguous in scientific and methodological literature. For example, A.A. Andreev (2001) defines ICT as a combination of procedures realizing functions of storage, processing, delivery of data in an organized structure using the chosen complex of technical means.

T.V. Volobueva (2010) considers the term ICT as an aggregate of different technological instruments and resources that are used to provide the process of communication and creation, extension, storage and management of information. By these technologies, they mean computers, Internet network, radio- and TV programs and also telephone communication. By ICT-competency of a subject teacher scientists mean not only the use of different information instruments but also effective use of them in his/her pedagogical activity. For the formation of the basic ICT-competence the following is necessary: to have the notion about the operation of PC and didactic opportunities of ICT; to acquire methodological foundations of preparation of visual and didactic materials using the means of Microsoft Office; to use Internet and digital educative resources in pedagogical activity; to form positive motivation to use ICT.

A range of modern researches are dedicated to the question of formation of ICT-competence of the participants of the educative process (Kurganskaya, 2013; Gavrish et al, 2012). New content of education of preschool-age children and junior children is oriented mainly to the formation of intellection of preschool-age children and junior children, their independence, learning activity using the means and methods of information technology and taking into account age peculiarities and capabilities of children, development of logic, intellection of a child for mastering and active perception of the laws of logic of the world of computers.

From the perspective of N.W. Baranova (2011) in “Planned results of primary general education” it is indicated that primary school students must form ICT-competence which means the ability of a person to solve learning, social, everyday, professional tasks using information and communication technologies. ICT-competence is shown in activity when solving different tasks with the help of computer, telecommunication facilities, Internet.

A. Elizarov (2012) considers ICT-competence of a pedagogue as an aggregate of knowledge, learning and experience of activity in the sphere of use of ICT in education. The structure of ICT-competence includes two components: general ict-competence and professional ICT-competence.

### **Analysis of Foreign Researches**

According to H.M. MacLuhan (2003) formation and development of electronic society gradually contributes to the confluence of individuals, nations and races into one whole communicative society. Besides, in the atmosphere of globalized processes, under the conditions of economic transformations and development of common education space, strategic tasks of state educational policy are: entry into the market of world educational services; enhancement of international cooperation; extension of participation of educational institutions, pedagogues, students and scientists in projects of international organizations and societies; provision of equal access to world information resources; opportunity to get qualitative education in native country and abroad. Under these circumstances learning foreign languages gains particular significance. Through the lens of tendencies of world society development key questions of foreign language education are viewed by us in the development of special models, technologies, means, methods, approaches to teaching foreign languages which should meet the following requirements: solution of psychological and pedagogical tasks with the use of ICT in teaching and learning process on the basis of striking the balance between the best methods of traditional education and information technologies; formation of didactically worthwhile information and educational environment.

T.A. Kaneyama, T.B. Goto, T.A. Nishino (2015) propose methodology of development of learning materials on the basis of ICT for children with a developmental disability. Syllabus for children with medical problems include ICT-technologies. Scientists proved that children demonstrate individual differences on the stage of development of cognitive capacity. In addition to learning materials in the sphere of ICT, scientists suggest to use a method of programming for innovative software on the basis of designing of systems (EPIZODE). Authors share the practice of development ICT-education.

D.J. Portelance, A.L. Strawhacker and M.U.Bers (2015) underline the importance of computer programming and focus on the language of programming for children from nursery school to children in the second grade of primary school. Children get acquainted with basic conceptions of programming and are taught to use these conceptions for creating individually significant projects with the help of programming application ScratchJr. The research revealed what ScratchJr programming blocs young children prefer to use in their projects after getting acquainted with them during the process of learning through a specially developed programming curriculum.

It has been proved that students experience problems in their introductory courses of programming. Along with difficulties concerning coping with abstract notions of programming, students, as a rule, experience fear and absence of motivation to learn programming. To make programming more interesting and make conceptions of programming easier it is helpful to use intelligent assistant which allows students to ask questions about programming classes in easy and usual way as well as a lecturer. Thus, the process of getting necessary information and answer becomes faster and also more interesting and attractive if compared with classical approach. Along with getting a desired answer faster such an approach increases motivation of students to spend more time in the process of learning programming because of new interesting technology which is used as a tool in programming of education (Konecki, Kadoić & Piltaver, 2015).

C.J. Park and J.S. Hyun (2014) mark that alongside with the tendency of computer technologies, programming skill becomes a key competence of the future in which the importance of programming of education is highlighted. Nevertheless, the greater part of relevant literature showed that programming is very difficult both for students who learn it and for teachers who teach it. Despite the importance, there are several cases when teachers accept the system which is made by way of programming to teach students to design and program. In this research with the help of online system of learning programming it was proposed to enhance progress in studies, self-regulating ability for learning through several functions on the basis of theory, in real-time mode, joint use of a screen, synchronous demonstration and learner's portfolio, monitoring.

As marked by J.M. Alberola and A. García-Fornes (2014) in the last few years we supervise decrease in number of students and educational wastage while learning university practice-oriented courses such as programming. One of the important questions of these courses is that to learn a new content previous skills must be united. Thus, to increase motivation of learners progressive and constant feedback is of great importance. The article presents experience which gets this feedback by means of online educational platform. The influence of this experience is evaluated in a group of learners.

The article of R. Al-Washmi et al. (2014) describes design of a game for teaching mathematics for primary school-aged children (7-9 years) in Great Britain. The work results from earlier researches during which scientists examined a collaborative play in a commercial play to determine key characteristics of the game which contribute to collaboration. In a mentioned work authors report how children who were involved in the process of designing create an attractive user age-appropriate interface on the following later stages. Primary school-age children learn pedagogy and game mechanics for designing a game in a class. Nevertheless, in themselves they can easily design and construct. Games designed for learning must be filled with a proper learning content which is coded in the mechanism of a game. They also must be designed according to the way of use.

Over the last years, we can supervise that more attention is paid to Robotics which offers a way of cooperation of children with technologies and engineering starting from an early age (Sullivan & Bers, 2016). Robotics program is designed for 8 weeks and is introduced starting from the nursery school and till the second grade of the primary school using KIWI robotic technology set in combination with programming language. After the completion of a program fundamental knowledge of children about robotics and programming was evaluated. The results showed that starting from the nursery school children could achieve mastery of robotic technology and programming skills while senior children were able to master more and more difficult conceptions using a set of robotic technology for the same period of time.

It is known that domain models designed for teaching programming have obvious disadvantages that limit the amount and quantity of information. In other countries, more information is achieved by means of including extensive authoring processes in activities. E.J.A. Castillo, L.G. Estada, B.E. Senti (2015) suggest a method

for designing a model of a subject area which uses static and dynamic methods of analysis to generate information which is useful for a student reducing significantly authoring time.

Information and communication technologies (ICT) became generally recognized in the world as an effective learning and teaching tool. Kenyan government committed itself to provide computers for using in learning in primary schools. This step as it is expected will allow teachers to integrate ICT in their teaching starting from the first grade. Teachers will directly realize ICT project on the class level. G. Wambiri & M.N. Ndani (2016) confirm that providing schools with computers and other infrastructure can automatically lead to the integration of ICT into schools if the government considers teachers' attitudes, views and beliefs, computer competence and their self-efficiency. The authors recommend to reconsider the curriculum and training practice of pre-service teachers in ICT pedagogy with the purpose to increase their level of preparation to integrate ICT into their teaching in primary school.

In a review written by J.S. Fu (2013), in National Institute of Education in Singapore, the author briefly presents relevant researches about the use of information and communication technologies (ICT) in education. Particularly it deals with researches which concentrate on the advantages of integration of ICT into schools, barriers and problems arising when using ICT, factors influencing the successful integration of ICT, teachers' attitude to work and before starting the work, perception and confidence in using ICT and also the importance of school culture for using ICT. This review discusses the gaps in literature and directions which can be taken in future studies to fill these gaps.

Thus, the problem of ICT-competence formation is connected with the process of informatization, properly built system of teacher's work with children, with teaching methods, with the provision of learning process with program and learning materials, teacher resource books about the use of ICT in teaching and learning process, programming, robotic technology.

## RESEARCH DESIGN

### Theoretical and Empirical Methods

A set of various methods that supplement each other was used to test the hypothesis:

- theoretical - analysis of psychological and pedagogical, educational and methodical literature on the research problem; theoretical analysis of the fundamental principles of the proposed methodology, on the basis of which the method of formation of ICT competence of future university school teachers is theoretically grounded;
- empirical - ascertaining, forming, control pedagogical experiment, observation, testing, questioning, analysis of the results of experimental work.

### Base of the Research

The research was carried out on the basis of Humanities and Pedagogics Academy (branch) of the Federal State Autonomous Educational Institution of Higher Education "Crimean V.I. Vernadsky Federal University" in Yalta, the Institute of Teacher Education and Management (branch) of the Federal State Autonomous Educational Institution of Higher Education "Crimean V.I. Vernadsky Federal University" in Armyansk, Evpatoria Institute of Social Sciences (branch) of the Federal State Autonomous Educational Institution of Higher Education "Crimean V.I. Vernadsky Federal University". 146 future university school teachers took part in the experiment.

### Stages of the Research

The research was conducted in three stages:

At the first stage, the contemporary state of the problem of the research was studied, psychological and pedagogical, educational and methodical literature on the studied problem was analyzed; the goal, tasks, methods

were defined, the methodology of formation of ICT competence of the future university school teachers was developed.

At the second stage, an ascertaining, forming and control experiment was conducted. At this stage, criteria and indicators were identified, a set of diagnostic survey methods was selected, the initial levels of the ICT competence of future university school teachers were characterized and revealed.

At the third stage, the results of the research were systematized, processed, summarized, tested and implemented; approbation of the topic of the research was carried out in the publications and author's speeches at scientific conferences.

### **Evaluation Criteria**

Diagnostics of the ICT competence level was conducted in accordance with the selected criteria and indicators:

- the motivational-value criterion with indicators: the existence of a steady interest of students in ICT technologies and the ambition for mastering them; the formation of a value attitude towards the future professional and pedagogical activity;
- the cognitive-contentive criterion with indicators: the knowledge of the future university school teachers of the peculiarities of using of ICT technologies in the educational process; knowledge of ICT technologies, forms, methods and methods of working with them;
- operational-technological criterion with indicators: knowledge how to use the ICT technology at lessons in primary school; the ability to select didactic and methodological material, appropriate means, forms and methods of work;
- reflexive-evaluation criterion with indicators: the formation of the reflection position; ability for self-esteem and self-analysis.

### **Progress and Description of the Experiment**

The research was carried out on the basis of Humanities and Pedagogics Academy (branch) of the Federal State Autonomous Educational Institution of Higher Education "Crimean V.I. Vernadsky Federal University" in Yalta, the Institute of Teacher Education and Management (branch) of the Federal State Autonomous Educational Institution of Higher Education "Crimean V.I. Vernadsky Federal University" in Armyansk, Evpatoria Institute of Social Sciences (branch) of the Federal State Autonomous Educational Institution of Higher Education "Crimean V.I. Vernadsky Federal University". 146 future university school teachers took part in the experiment. Observation and analysis of future university school teachers' activities showed the lack of systematic work on the use of ICT technologies in the primary school education process.

### **EVALUATED MEASUREMENTS**

#### **The Ascertaining Stage of the Experiment**

For carrying out the experiment two groups of students were selected and diagnostic tools were picked up. So, for the identification of levels of formation of indicators of a motivational and valuable criterion a questioning and a questionnaire "Pedagogical activity" were used; within cognitive and substantial criterion future teachers of the primary school fulfilled the diagnostic written work including testing and development of the abstract of a lesson with the use of ICT technologies; within operational and technological criterion they developed the presentation "Use of ICT technologies, forms, methods and working methods in educational process of primary school"; they selected didactic and methodical material to the lessons, appropriate means, forms and methods of work; within reflexive and estimated criterion they developed their own trajectory of professional development with a self-assessment of pedagogical activity during the practical training at primary school; they also conducted introspection and a self-assessment of the conducted lesson with the use of ICT technologies.

**Table 1.** The level of formation of ICT competence of future university school teachers at the ascertaining stage of experiment

Groups	Sufficient level	Average level	Satisfactory level	Elementary level
Motivation-value criterion				
Experimental group	9,8	29,7	50	10,5
Control group	8,4	28,4	51,7	11,5
Cognitive-contentive criterion				
Experimental group	6,6	28,7	51,8	12,9
Control group	7,2	27,4	53,9	11,5
Operational-technological criterion				
Experimental group	4,3	27,7	55,2	12,8
Control group	5,3	26,4	56,7	11,6
Reflexive-evaluation criterion				
Experimental group	2,5	23,4	57	17,1
Control group	2,1	21,1	57,9	18,9
General level				
Experimental group	5,8	27,3	53,3	13,6
Control group	5,8	25,8	55,2	13,2

The results of the ascertaining stage of the experiment are conveniently given in the **Table 1**.

The analysis of quantitative results demonstrates that within motivational and valuable criterion a sufficient level is revealed at 9,8% of future university school teachers of the experimental group and 8,4% of respondents of a control one; the average level is at 29,7% of students of experimental and 28,4% of future teachers of control groups; 50% of respondents of experimental and 51,7% of students of control groups have a satisfactory level; 10,5% of students of experimental and 11,5% of respondents of control groups have the initial level.

Within cognitive and substantial criterion sufficient level was shown by 6,6% of future teachers of the experimental group and 7,2% of students the control one; 28,7% of respondents of experimental group and 27,4% of future university school teachers of the control one have the average level; 51,8% of future teachers of experimental and 53,9% of students control groups are at the satisfactory level; initial level was shown by 12,9% of respondents of the experimental group and 11,5% of students of the control one.

The sufficient level within operational and technological criterion is recorded at 4,3% of future university school teachers of the experimental group and 5,3% of students of the control one; 27,7% of future teachers of experimental and 26,4% of respondents control groups have the average level; satisfactory level was achieved by 55,2% of students of experimental and 56,7% of respondents of control groups; 12,8% of future university school teachers of experimental and 11,6% of respondents of control groups have the initial level.

Within reflexive and estimated criterion the sufficient level was shown by 2,5% of future university school teachers of experimental and 2,1% of respondents of control groups; 23,4% of students of experimental and 21,1% of respondents of control groups have the average level; the satisfactory level was represented by 57% of future teachers of experimental and 57,9% of students of control groups; 17,1% of respondents of experimental and 18,9% of future elementary school teachers of control groups have the initial level.

It is visible from the table that the sufficient level of readiness has been diagnosed at 5,8% of students of experimental and control groups. 27,3% of respondents of experimental and 25,8% of future teachers of control groups has been revealed at the average level. 53,3% of future university school teachers of experimental group and 55,2% of respondents of the control one demonstrated the satisfactory level of the corresponding readiness. The initial level was shown by 13,6% of students in experimental group, and 13,2% of future university school teachers in the control one.



Thus, having analyzed the results of the ascertaining stage of experiment it is possible to claim that the level of formation of ICT competence of future university school teachers is close to satisfactory and initial. The received results mainstream the need of the search of effective forms, technologies, methods and working methods, creation of the pedagogical conditions promoting efficiency of this process.

### **The Forming Stage of the Experiment**

The approbation of a technique of formation of ICT competence of future university school teachers which was implemented in three stages – cognitive and searching; activity and practical; independent and creative – was the purpose of the forming phase of the experiment.

The following abilities were developed during the formation of ICT competence at future university school teachers:

- to be guided freely in the list of the main existing electronic (digital) manuals in a subject (on disks and in the Internet): electronic textbooks, atlases, collections of digital educational resources in the Internet;
- to find, estimate, select and show information, using materials of electronic textbooks and other manuals on the disks and in the Internet according to the set of educational tasks;
- to install the needed program onto the demonstration computer, to use the projective equipment, to dispose techniques of creation of own electronic didactic material;
- to transform and provide information for the solution of educational tasks, to make own training material of the available sources, generalizing, comparing, opposing, transforming various data;
- to choose and use the software (text and tabular editors, programs for creation the booklets, the websites, presentation programs (Power Point, Flash)) for optimum representation of the different materials that are necessary for educational process: materials for a lesson, thematic planning, monitoring in the subject, various reports in a subject, the analysis of process of training;
- to apply NIT-techniques of carrying out the lessons united by one subject, with the use of ICT, containing the references to the electronic materials and websites that can be useful at carrying out the lessons in the definite subject;
- to use effectively the tools of the organization of pupil's educational activity (the program of testing, electronic workbooks, systems of the organization of educational activity of the pupil);
- to create own portfolio and the pupil's portfolio;
- to choose competently a form of information transfer to the pupil, parents, colleagues, administration of school: a school network, e-mail, a social network, a website (the section of the website), a letter of mailing, a forum, a blog (the network magazine or the diary of events), a RSS stream (it is intended for the description of news feeds, the newsletter); a podcast (the newsletter with audio-or video contents);
- to organize pupils' work within the network communication projects (the Olympiads, competitions, quizzes ...), to support educational process remotely (if necessary).

At the first stage – cognitive and searching – the future teachers seized elements of theoretical and methodical knowledge. Such disciplines as “ICT at primary school”, “A methodology of teaching informatics and ICT”, “A technique of training of computer literacy”, “Methods and tools for the multimedia presentations” were studied at this stage. Work with different sources of information, the selection and the presentation of information in active and interactive forms (a mathematical kaleidoscope, CFI, development of informative questions and tasks, introductory teaching practicum) was carried out.

The second stage – activity and practical – was a practically focused training on the future teachers to the organization of work on the use of ICT technologies in educational process of primary school. At the second stage the future university school teachers took part in educational quest technologies, preparation of a methodical bank, the development of abstracts of lessons with the use of ICT technologies, the viewing and the analysis of master classes, webinars in a section of different educational programs and also, they had a student teaching practicum. The educational quest provided the subgroup work connected with the choice of a topic of the lesson, information

search in a subject during the definite time from different sources – the Internet, books, magazines, the practices, publications, dictionaries. Each member of the team looks for information in his own direction. After work with information members of the team have to present a subject and the key idea of material; to pick up an aphorism to them, a quote, an epigraph; to define key concepts and to explain them; to allocate key scientific approaches, the principles; to present ten interesting forms of work on a subject; to make the dictionary of words -“assistants”; to transmit information schematically through schemes, models; to retell the content of all material in ten theses; to prepare the presentation and to present the material.

The future university school teachers’ ability to use independently in practice knowledge acquired in the course of training in a higher educational institution was formed on the third, independent and creative, stage. At this stage student created the projects with the use of ICT technologies, made bench reports and the presentations; developed and conducted the integrated lessons with use of ICT technologies; prepared a portfolio.

### **The Control Stage of the Experiment**

The purpose of a control stage is to carry out an assessment for the purpose of defining of efficiency of the developed technique of formation of ICT competence of future university school teachers.

At the stage of the control experiment future university school teachers have been given the tasks similar to the formative inspection.

Comparative results of the ascertaining and control experiment are presented in **Table 2**.

The results of control experiment have confirmed the efficiency of the developed and experimentally checked the technique of formation of ICT competence of future university school teachers.

Essential positive changes are recorded in EG. The number of respondents with sufficient (from 5,8% when ascertaining up to 13% at control inspection) and an average (from 27,3% at the ascertaining inspection to 40,9% during control experiment) and the number of future university school teachers with satisfactory (from 53,3% has decreased during the ascertaining inspection to 41,5% during control inspection) and initial (from 13,6% when ascertaining to 4,6% at control inspection) levels of formation of ICT competence has increased. Positive tendencies in CG, though not so considerable, were also observed. Quantitative and qualitative results of experimental work testify the efficiency of experimentally checked technique of formation of ICT competence of future university school teachers.

The qualitative results of performance of a series of tasks should be analyzed. Future primary school teacher have given the correct answers to the majority of test tasks. The developed abstracts of lessons were methodically competent and informationally efficient and answered accurately the goal and the problems of the lesson. The future university school teachers prepared and presented the approximate educational programs (section “Mathematics and Informatics”), innovative technologies, forms, methods and working methods.

The efficiency of the developed technique of formation of future university school teachers confirmed by data of statistical processing of results of the research, proves the expediency of use of a technique of formation of ICT competence of future university school teachers in educational process of higher education institution.

### **CONCLUSION AND RECOMMENDATION**

The study achieved the following indicators: the data obtained in the experiment shows that after the experimental work the students of the experimental group began to respond positively to the need for the formation of electronic competence, showing an interest in this problem, for them the high importance of this process. In addition, future teachers of primary classes are in need of improving electronic competence and training for effective and systematic use of Electronic means in their professional activities. The respondents of the experimental group got quite a holistic view about a certain methodical system of formation of electronic competence, mastering the basics of which, the teacher can further independently to improve their skills, acquiring the necessary

**Table 2.** Levels of formation of ICT competence of future university school teachers (the comparative analysis of results of the ascertaining and control experiment) in %

Stages of the experiment	Sufficient level	Average level	Satisfactory level	Elementary level
Experimental group				
Motivation-value criterion				
The ascertaining experiment	9,8	29,7	50	10,5
Control experiment	18,6	42,7	35,5	3,2
Cognitive-contentive criterion				
The ascertaining experiment	6,6	28,7	51,8	12,9
Control experiment	13,4	41,6	40,3	4,7
Operational and technological criteria				
The ascertaining experiment	4,3	27,7	55,2	12,8
Control experiment	10,2	40,3	44,6	4,9
Reflexive-evaluation criterion				
The ascertaining experiment	2,5	23,4	57	17,1
Control experiment	9,8	38,9	45,7	5,6
General level				
The ascertaining experiment	5,8	27,3	53,3	13,6
Control experiment	13	40,9	41,5	4,6
Control group				
Motivation-value criterion				
The ascertaining experiment	8,4	28,4	51,7	11,5
Control experiment	10,2	30,6	50,5	8,7
Cognitive-contentive criterion				
The ascertaining experiment	7,2	27,4	53,9	11,5
Control experiment	9,2	29,3	51,7	9,8
Operational-technological criterion				
The ascertaining experiment	5,3	26,4	56,7	11,6
Control experiment	6,2	27,3	55,7	10,8
Reflexive-evaluation criterion				
The ascertaining experiment	2,1	21,1	57,9	18,9
Control experiment	3,2	22,6	56,8	17,4
General level				
The ascertaining experiment	5,8	25,8	55,2	13,2
Control experiment	7,2	27,5	53,6	11,7

experience. Overall, in the experimental group, knowledge of the subjects in this area after carrying out the experimental work became more systematic and meaningful, and their level is significantly increased.

We concluded that work on the formation of electronic competence of future university school teachers need to build in stages: cognitive search, activity and practical, independently creative.

In the course of the study, a methodology was developed of forming the electronic competence of future university school teachers, which makes the possibility of using electronic technologies in the primary school education process.

We have developed educational quest technologies using electronic means, which include subgroup work related to the choice of the topic of the lesson, the search for information on the topic within a given time from different sources - the Internet, books, magazines, its developments, publications, dictionaries. After working with

the information, the team members must present the topic and the key idea of the material; To pick up to them an aphorism, a quotation, an epigraph; identify key concepts and clarify them; highlight key scientific approaches, principles; to present ten interesting forms of work on the topic; compile a dictionary of words-“assistants”; Schematically transfer information using schemes, models; to convey the content of all material in ten theses; prepare a presentation and present the material.

The materials of this article can be useful for teachers of higher education institutions and university school teachers when using electronic technologies in the educational process of the primary level of education.

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#### REFERENCES

- Alberola, J. M., & García-Fornes, A. (2014). Using feedback for improving the learning process in programming courses. *Revista Iberoamericana de Tecnologías del Aprendizaje*, 9(2), 49-56.
- Al-Washmi, R., Baines, M., Organ, S., Hopkins, G., & Blanchfield, P. (2014). Mathematics problem solving through collaboration: Game design and adventure. *Proceedings of the European Conference on Games-based Learning*, 1, 1-9.
- Andreev, A. A. (2001). Computer and telecommunication technologies in education. *School technologies*, 3, 154-169.
- Andrushenko, V. P. (2005). Philosophy of education in the 21st century. *Philosophy of education*, 1, 5-17.
- Artemyeva, O. A., Makeev, M. N., & Milrud, R. P. (2005). *The methodology of the organization of professional training on the basis of cross-cultural communication*. Tambov: Publishing house Tamb. GOS. tehn. University press.
- Baranova, N. W. (2011, January 18). *The formation of ICT-competence participants in the educational process*. Retrieved November 20, 2011 from <http://www.likt590.ru/resources>.
- Boyko, A. I. (2010). Philosophy of education modernization in the system of market transformation: a socio-philosophical analysis. PhD Thesis. Kiev: Kyiv National T. Shevchenko University.
- Castillo, E. J. A., Estrada, L. G., & Senti, V. E. (2015). Domain knowledge representation for programming teaching IEEE. *Latin America Transactions*, 13(5), 1528-1533.
- Elizarov, A. (2012, May 5). *ICT competence of a teacher*. Retrieved June 18, 2012 from <http://www.educh/system/files>.
- Fomicheva, I. G. (2004). *Philosophy of education: some approaches to the problem*. Novosibirsk: Publishing house SB RAS.
- Fu, J. S. (2013). ICT in Education: A Critical Literature Review and Its Implications. *International Journal of Education and Development using Information and Communication Technology (IJEDICT)*, 9, 112-125.
- Furkin, B. A. (2005). *Information technology in a global world: socio-philosophical analysis*. PhD Thesis. Naberezhnye Chelny: Naberezhnye Chelny State Pedagogical University.
- Gao, W., & Wang, W. F. (2017). The fifth geometric-arithmetic index of bridge graph and carbon nanocones. *Journal of Difference Equations and Applications*, 23(1-2SI), 100-109.
- Gao, W., Farahani, M. R., Aslam, A., & Hosamani, S. (2017). Distance learning techniques for ontology similarity measuring and ontology mapping. *Cluster Computing-The Journal of Networks Software Tools and Applications*, 20(2SI), 959-968.

- Gavrish, A. V., Lavrentyeva, K. V., Deleted, V. A., & Shmis, T. G. (2012, May 8). *ICT competence*. Retrieved June 8, 2012 from <http://www.edu-ach/system/files>.
- Kaneyama, T. A., Goto, T. B., & Nishino, T. A. (2015). Methodology for developing ICT based course material for children with a developmental disability based on EPISODE. *International Conference on Industrial Informatics*, 1654-1658. <http://www.scopus.com/inward/record.url?eid=2-s2.0>
- Komar, M. N. (2004). Informatization as a means of formation of information society. *Culture of the Black sea*, 52(2), 199-202.
- Konecki, M. A., Kadoić, N. A., & Piltaver, R. B. (2015). Intelligent assistant for helping students to learn programming. *38th International Convention on Information and Communication Technology, Electronics and Microelectronics*, 924-928. <http://www.scopus.com/inward/record.url?eid=2-s2.0-84946145037&partnerID=40&md5=58b5e45da9342f20605aa67b6f49d3e5>
- Kurganskaya, A. V. (2013). Training of future university school teachers and teachers of preschool educational institutions to the formation of ICT-competence of students. *Modern trends update training teachers of preschool and primary education: collective monograph*, 1, 178-198.
- McLuhan, G. M. (2003). *Understanding media: external expansion of human*. M.: Education.
- Oleinik, A. I. (2008). *Information technologies as the basis and means of implementation of innovative processes in modern education*. PhD Thesis. Kiev: Kyiv National T. Shevchenko University.
- Onoprienko, M. V. (2006). *Informatization in the context of the philosophical-methodological study of computer science*. PhD Thesis. Kiev: Kyiv National T. Shevchenko University.
- Park, C. J., & Hyun, J. S. (2015) Effects of abstract thinking and familiarity with programming languages on computer programming ability in high schools. *Proceedings of IEEE International Conference on Teaching, Assessment and Learning for Engineering: Learning for the Future*, 468-473. <http://www.scopus.com/inward/record.url?eid=2-s2.0-84928253933&partnerID=40&md5=505b4272d83b2399e3d3c7ff6b218cc4>.
- Portelance, D. J., Strawhacker, A. L., & Bers, M. U. (2015). Constructing the ScratchJr programming language in the early childhood classroom. *International Journal of Technology and Design Education*, 26(4), 489-504.
- Ragozina, T. M., Grineva, A. A., & Malova, I. B. (2012). *Technology*. Class 3. Moscow: Education.
- Rybinskaya, S. S. (2013). Informatization of society in Russia: peculiarities of formation and related threats. *Scientific-methodical electronic journal "Concept"*, 4, 276-280.
- Shadrikov, V. D. (2014). *Psychology of human activity*. Moscow: Publishing house of Institute of psychology RAS.
- Shemet, I. S. (2010). Birth and activities. *Journal of integrative psychology*, 1, 104-105.
- Sullivan, A., & Bers, M. U. (2016). Robotics in the early childhood classroom: learning outcomes from an 8-week robotics curriculum in pre-kindergarten through second grade. *International Journal of Technology and Design Education*, 26(1), 3-20.
- Volobueva, T. (2010). The training Levels of teachers in the system of postgraduate pedagogical education on the use of information and communication technologies. *Postgraduate pedagogical education in Ukraine*, 1, 30-35.
- Wambiri, G., & Ndani, M. N. (2016). Kenya University school teachers' Preparation in ICT Teaching: Teacher Beliefs, Attitudes, Self-Efficacy, Computer Competence, and Age. *African Journal of Teacher Education*, 5, 49-55.
- Zhaldak, M. I. (2003). *Computer in mathematics lessons: a Manual for teachers*. Moscow: RNC "DINIT".

<http://www.ejmste.com>