Formation and development of information and communication competencies of pedagogical universities students: experience of Ukraine

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Abstract. The content of information and communication competence (ICC) is defined by researchers differently. In Ukraine the investigation of its formation in pedagogical university students takes place in the process of studying, systematizing, and generalizing Ph.D. dissertations defended in specialized academic councils of Ukraine. The purpose of this article is to analyze dissertations for the degree of Candidate and Doctor of Sciences devoted to ICC of future teachers during their professional training at pedagogical universities of Ukraine. The research analysis is based on the overview of dissertations for 2010-2020 and is performed according to 5 identified criteria: general characteristics; theoretical framework; research significance; quantitative indicators of the experiment; tools of experimental research.
Using a set of methodological approaches, researchers developed proposals for the formation of future teachers' ICC, based on pedagogical experiment results. It is proved that the effectiveness of forming ICC is positively influenced by the following factors: the created innovative models considering the specifics of teacher training in the relevant field; author's methods based on the use of mobile, computer, cloud-based technologies; educational and methodical provision for special courses in the practical application of IC technologies, etc. Particular attention is paid to the justification of appropriate pedagogical conditions and the development and adaptation of diagnostic techniques for conducting the monitoring of components of ICC at different stages of the pedagogical experiment.

Keywords: Competence, Information and communication competence, Information and communication technologies, Future teacher, Pedagogical universities.

1 Introduction

The permanent transformations associated with the global processes of informatization of modern space have led to the intensive spread of information and communication technologies in all spheres of human activity. In the post-industrial era, informatization is becoming one of the basic components of social progress, and the

creation of adequate conditions for its development is one of the national priorities in the developed world. In this sense, Ukraine is no exception. Thus, the problems of ensuring access to information resources, forming information and communication competencies, developing media literacy among a wide range of citizens are of great importance.

According to the results of 2020, despite the fall of the total exports of Ukraine caused by the COVID-19 pandemic, the export of IT services increased by 20%. Moreover, for the first time, it exceeded 5 billion dollars per year, and the share of IT services in total exports was over 8%. In general, since 2013 Ukraine has increased the export of IT services almost by 4 times. However, the possibility of its further increase depends on the rate of increasing the number of IT professionals in the domestic labor market (BRDO 2021). According to the Minister of Digital Transformation M. Fedorov, it is planned to increase the share of the IT sector in Ukraine's GDP from 5% to 10% and to work out a package of solutions to develop partnerships between the state and the IT sector, support IT education and attract new staff (Мінцифри хоче підвищити 2020).

The importance of this issue is confirmed by Ukraine's signing of the Association Agreement with the European Union, which necessitates the harmonization of the basic principles and pace of development of the information society in Ukraine. In addition, the recent adoption of normative legal acts in the field of ICT by the Ukrainian government testifies to the intensification of the issue of digitalization in all spheres of life and the formation of relevant competencies. On the one hand, these normative documents are designed to bring Ukrainian legislation in line with European legislation, and on the other hand, they demonstrate the state's ever-increasing attention to the development of the digital industry.

In particular, there have been approved the following Laws of Ukraine: «Про Концепцію Національної програми інформатизації» (The Law of Ukraine on the Concept of National Informatization Program) (Закон України про Концепцію національної програми інформатизації 1998), «Про Національну програму інформатизації» (The Law of Ukraine on National Informatization Program) (Закон України про національну програму інформатизації 1998) and others. The latter one includes the Concept of the National Informatization Program, a set of other state informatization programs, sectoral programs and informatization projects, regional programs and informatization projects, programs and projects of local self-government bodies informatization.

Confirmation of the seriousness of the state's intentions in this area is the Concept for the Development of Digital Competences until 2025 that was then approved by the Cabinet of Ministers of Ukraine in 2021 and the corresponding action plan for its implementation (Концепція розвитку цифрових компетентностей 2021).

It should be added that the Ministry of Digital Transformation of Ukraine intends to significantly increase the digital literacy of 6 million Ukrainians by 2024. To achieve the goal, there was created the portal "Action. Digital Education" in 2020. It offers a variety of courses in the format of series, which teach digital skills in various spheres of life. In addition, in November 2020, the Ministry of Digital Transformation of Ukraine launched a national test "Цифрограм" to identify the level of digital liter-

acy of Ukrainians. Testing involves checking citizens' basic digital literacy knowledge and skills in 6 areas: basics of computer literacy; information and media literacy; creation of digital content; communication and interaction in the digital society; security in the digital environment;

solving technical problems.

With the powerful penetration of information technology in all spheres of life, the need for professionals who can quickly adapt to the growing demands of the information society is growing. This leads to the necessity of solving the problem of modernizing the national educational system related to its informatization and encourages higher education pedagogical institutions to train teachers who can implement radical changes in education.

Today it is especially important to achieve a qualitatively new level of information culture of students of higher education pedagogical institutions. They are expected to actively use their information and communication competence in their further professional, cultural, educational, and social activities with schoolchildren, parents, and other social and age groups of the population.

Analysis of modern state standards, as well as consideration of a wide range of scientific, pedagogical, and methodological sources, shows that the need to improve the professional training of future teachers is associated with the transition of the education system from knowledge (cognitive-informational) to competence paradigm. It means that the new content of education is based on forming competencies that are required forth the successful implementation of pedagogical activities in general secondary education in modern conditions.

The formation of future teachers' information and communication competence (ICC) and their preparation for the use of information and communication technologies (ICT) in education are the main aspects of technological transformations of the modern education system of Ukraine. The process of training new teachers should begin immediately, because their formation as digital professionals, according to experts, will take about 20 years. If the moment is missed, the creation of a knowledge economy in Ukraine may be postponed for an indefinite time (Гуревич 2011)..

2. The theoretical framework of ICC

In the modern psychological and pedagogical literature, there is no single approach to defining the essence of the investigated phenomenon – Information and communication competence. At the same time, the analysis shows that there is a certain relationship between this concept and the related ones, in particular, "computer competence", "computer literacy", "information literacy", "information and computer literacy", "information culture", "computer competence"," information competence", etc.

Neither, there is a single approach among researchers regarding the use of the term "information and communication competence" and the essential meaning of its content, the definition of the structure, and most importantly, ways and criteria to measure its formation and so on.

ICC is mainly considered as:

1) an ability;
2) a system of knowledge and abilities, but more often as skills;
3) an integrative, integral, dynamic quality of the personality.

A closer analysis showed that when researchers interpret the future teacher's ICC as an ability, they mean:

- teacher's proven ability to confidently use ICT in practice, as well as to apply innovative methods and creative approaches in teaching professional disciplines (Полюхович 2014);
- ability to autonomously and responsibly apply the acquired theoretical and factual knowledge, skills and abilities in the field of ICT to solve socially significant tasks, including professional ones (Сороко 2012);
- ability and readiness of dynamic combinations of knowledge, skills and, abilities to perform pedagogical activities with the help of ICT, upskilling training, self-study of informatics and ICT (Петренко 2013);
– ability of the person to use ICT means for satisfying own personal needs, effective realizing professional activity and supporting scientific researches based on formed knowledge, abilities, skills, and attitudes (Топольник 2019);
– mobile ability to effectively use information processes for professional activities, which involves a certain level of ICT proficiency (Закомірний 2019).

When it comes to ICC as a system of knowledge, skills, and abilities, according to researchers it is:

– a system of knowledge, skills, personal qualities of the teacher, the formation and development of which will allow him/her to solve typical professional tasks, settle the problems that arise in real situations of pedagogical activity. In addition, it provides the ability to professional growth in the field of ICT (Кривонос 2014);
– a system of knowledge and methods of processing various educational information, skills of operating modern information technologies, experience and positive motivation in their application in the learning process (Семчук 2017);
– a perfect ability to navigate in the flow of information and master it accordingly, the personality's ability of dynamic development and self-improvement (Осадча 2010);
– an ability to solve relevant tasks using information and communication technologies (Федорук 2015).

As an integral quality of personality, ICC is interpreted as:

– dynamic combination of knowledge, skills, abilities, values, experience and other personal qualities acquired in the process of educational training in a higher education institution, which allows autonomous and responsible use of ICT in practice to solve professional tasks (Шроль 2017);
– an integral quality of personality, which determines his/her ability to navigate in a dynamic information space, to search, evaluate, store and perform various types of information activities, to develop communicative qualities of speech and communication and to use ICT (Семчук 2017);
– integrative, the dynamic characteristic of future professionals, presenting their motivation and ability to navigate in the information space, receive and systemize information (Тимофєєва 2017).

– dynamic characteristics a person to navigate in space, receive information, operate on it, have the appropriate level of knowledge, skills, and abilities regarding ICT (Федорук 2015).

It should be emphasized that Ukrainian researchers consider ICC not separately but as a structural component of professional competency; an element of another quality, competence, or a part of professional training (Table 1). As it can be seen from Table 1, most often researchers consider it as a component of professional competence.

Table 1. Information and communication competence as part of another quality of a professional

ICC as a structural component of:	Осадча 2010	Рафальська 2010	Осадчий 2013	Гаврілова 2015	Куцак 2015	Крижановський 2017
Professional competence	+			+	+	+
Computer competence		+				
Professional training			+			

For instance, there is an opinion that the professional competence of future teachers should be considered as a set of key competencies, among which communicative, information, and communication are extremely important (Крижановський 2017; Федорук 2015). Another identical point of view (Куцак 2015), according to which ICC as a component of key competencies is a structural part of the professional competence of teachers and it reflects the teacher's culture. I. Zakomirnyi also considers ICC as a separate but mandatory component of a teacher's professional competence, due to the introduction of ICT in all spheres of human activity (Закомірний 2019). However, there is a slightly different approach, when the ICC is considered as a criterion for the effectiveness of the information technology support system for future teachers in a pedagogical university (Осадчий 2013).

Both the formation and development of ICC are directly related to information and communication technologies and involve the use of modern ICT, including computer mathematics systems, to solve problems; the selection of modern ICT tools; the application of the gained experience of using ICT means (Рафальська 2010).

The most generalized approach shows that researchers understand the formation of the future teacher's ICC as a purposeful process of quality training of students to use ICT in professional activities based on a set of approaches. In our opinion, the most significant is that the formation of ICC is a continuous process that has its origins at school when studying the discipline "Computer Science", at the university during ICT training and when studying other disciplines, during pedagogical practice according to educational and professional programs at the level of "Bachelor", then "Master"

which never stops. On the contrary, it develops and improves during further mastering of pedagogical skills of teachers through their training and self-education (Шроль 2017).

3. Research Methodology

3.1 Object and Subject of the Research

The purpose of the research is to identify the level of ICC formation of future teachers, students who are studying at pedagogical universities of Ukraine. To achieve it, we have selected and analyzed the dissertations, in which the content, forms, methods, technologies, as well as pedagogical conditions that directly influenced the formation of ICC of future teachers of different specialties, were presented. The selected dissertations have passed the procedure of public defense, and their performers received the degree of candidate or doctor of pedagogical sciences. In addition, the research process allowed us to find out the most effective means of formating the investigated quality, as well as the tools by which it was measured. The purpose of the study was specified by the category of participants – students of pedagogical universities due to specific conditions that can be used in the educational process and by the final result – competencies necessary for the teaching profession, where knowledge is combined with skills (with emphasis on pedagogical conditions).

The object of the research became the dissertations devoted to the problem of forming future teachers' ICC which were chosen by defining keywords and the date of the dissertation defense. The subject of the research was a set of approaches to the process of ICC formation and development of students of pedagogical faculties.

3.2 Research Methods

In the process of studying, processing, and preparing the materials of the publication we relied on general scientific principles, forms, approaches to reflecting the reality, namely empirical methods of pedagogical research such as the method of studying primary sources, rating method, classification, method of generalization of independent characteristics, particularly generalization, comparison, comprehension of the information received through other methods about organizational bases of formation and development of ICC of future teachers at pedagogical universities of Ukraine. We also used methods of analysis and synthesis, theoretical methods related to the study of dissertation research, documents, the method of induction and deduction, the method of abstraction, and concretization.

3.3 Test Procedure

To select the objects of the research – the dissertations on the formation of information and communication competence of future teachers, we used the electronic database of the State Scientific and Technical Library of Ukraine and searched its

electronic catalogs on the website (https://cutt.ly/qE3LVq9). The choice is explained by the fact that following the procedure for registration of documents related to dissertation defense that are approved by the Ministry of Education and Science of Ukraine, the defended dissertation must be registered in УкрІНТЕІ (Ukrainian Institute of Scientific and Technical Expertise and Information) within 10 days after its defense and e-versions of the abstract and dissertation must be posted on the website of State Scientific and Technical Library of Ukraine within a month.

3.4 Research Technique

A systematic analysis of dissertations was carried out, which involved designing a certain algorithm and selecting criteria according to which the analysis and generalization of the research results were conducted. The search was performed according to the following algorithm: the required search area was selected (keywords, year of defense) by which the full-text search was performed; the method of ranking the found documents was applied; the search results were sorted in descending order of priority of primary sources. Within the period from 2010 to 2020, a total of more than 60 dissertations were defended in Ukraine, in which the problems of forming information competence of future specialists were studied. Of these, 29 dissertations were devoted to the formation of competencies of future teachers, which in their content and essence are close to the information and communication competencies. In particular, 11 dissertations are devoted to information competence (2 doctoral and 9 candidate papers); 13 dissertations reveal the problems of forming information competence (2 doctoral and 11 candidate papers); 1 doctoral dissertation concerned digital competence; by one defended candidate's dissertation is available on the problems of art and information; information technology; information-technical and information-digital competence. In addition, during the established period, the questions of forming information and communication competence in future specialists of non-pedagogical specialties were actively investigated: 9 dissertations were defended (4 doctoral and 5 candidate papers). All in all, there were 18 defended dissertations on the formation of the ICC of future teachers. Fig. 1 represents the scientific works selected for analysis, the year of their defense, and the distribution by level (candidate / doctoral).

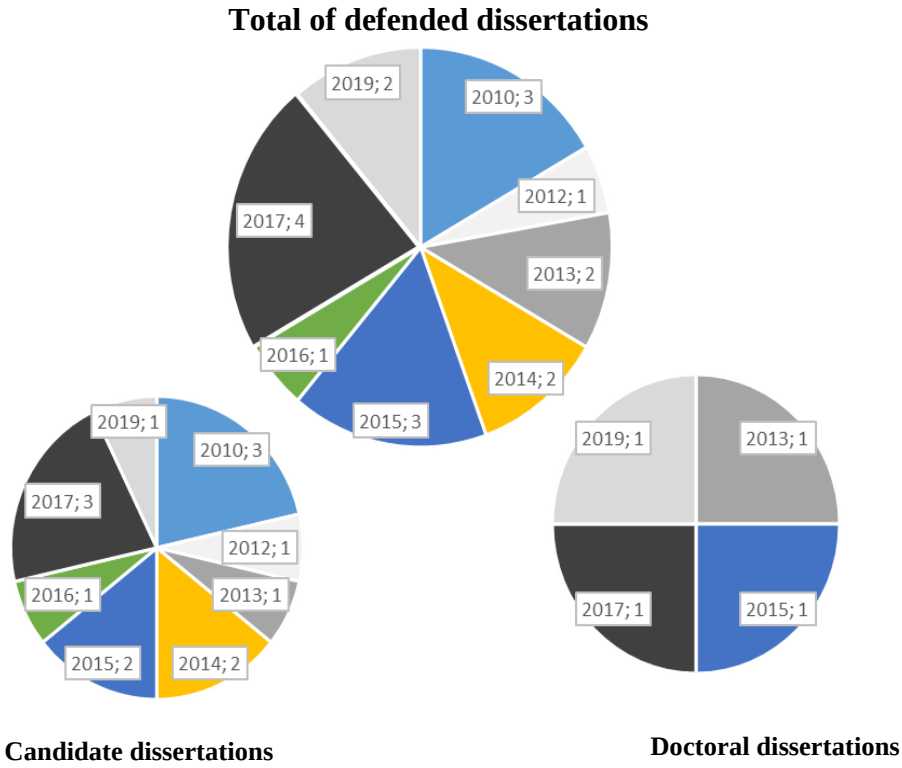

Fig. 1. Total of dissertations on forming ICC of future teachers defended in Ukraine in 2010-2020. (Source own)

The objects of pedagogical influence were teachers of various specialties: masters of education, evening school teachers, computer science teachers, mathematics teachers, music teachers, economics teachers, primary school teachers, natural science and mathematics teachers, technology teachers, philology teachers, preschool education specialists.

3.5 Research Limitations

The limitations of this paper are primarily related to the analysis of the dissertations that have already been defended in specialized academic councils in Ukraine for the past 10 years. Those researches that have been performed, but not yet defended, have not been analyzed. There are limitations related to the orientation of the analyzed works on a) a specific subject area, in particular, ICT learning as it is understood as “a computer-oriented component of pedagogical technology, which reflects a formalized model of a particular component of learning content and its methodology

in the educational process and which is represented in this process by pedagogical software and involves the use of computers, computer-based learning tools, computer communication networks to solve didactic problems or their fragments" (Биков 2008); b) preparation of the future teacher for the implementation of such training. Only experimental dissertations were analyzed, review studies and the researches related to the study of foreign experience in this field were not considered.

For in-depth analysis, 9 types of research have been selected. The general topic of them can be formulated as "the formation or development of information and communication competence of the teacher".

4. Results

The report included an analysis of 18 dissertations (level of candidate and doctor of science in the field of pedagogy), the purpose of which was to substantiate effective approaches to the formation of ICC of future teachers and determine the level of their formation. The analysis of information on dissertation researches defended during the last two decades was conducted in digital form.

The results of the content analysis showed that in the analyzed dissertations the views of researchers on the components/criteria of the ICC of future teachers differ significantly. We found almost 30 different options. Those that occur more than once can be combined into 6 groups. This led to the conclusion that most often the researchers measure the motivational-value, cognitive, activity-oriented, technological, communication, and reflexive components in their dissertations (Table 2).

Table 2. Structural components/criteria of information and communication competence in the analyzed dissertations

Component/ criterion	Availability in ICC structure										
1.1. axiological					+						
1.2. emotional and value	+										
1.3. value-motivational		+		+				+	+		+
1.4. motivational						+				+	
2.1. cognitive		+				+		+	+	+	+
2.2. cognitive-operational				+							
2.3. cognitive-cognitive							+				
3.1. activity-oriented										+	
3.2. activity-reflexive		+									
3.3. activity-technological							+				

3.4. operational and activity-oriented											+
4.1. operational and technological									+		
4.2. technological	+					+					
4.3. technologically effective								+			
5.1. information and communication						+					
5.2. typhloinformation (blind aids)			+								
5.3. communicative						+					
5.4. social and communicative							+				
6.1. personality-reflexive				+				+			
6.2. reflexive						+				+	+

To analyze the content of the selected dissertations, 5 criteria were identified. Their content is presented in Table 3. The most significant for the research are criterion 3 (it reflects the obtained theoretical and practical results) and criterion 5 (the instruments that were used in the process of the pedagogical experiment).

Table 3. The content of the identified criteria

No, and the content of the criterion				
1	2	3	4	5
General characteristics: author, the topic of dissertation research; year and place of the dissertation defense, specialty code	Theoretical framework (subject of research; methodological approaches)	Research results: theoretical and practical significance	Quantitative indicators of the experiment: number of institutions; the duration of the experiment; the number of respondents.	Tools of experimental research: subject of research; basic empirical methods; results of the empirical research; methods of statistical data processing

The results of the analysis according to the identified criteria are presented in Table 4.

Table 4. The results of the dissertation research analysis

No	**Criteria Description**
Сороко 2012	
1	Development of information and communication competence of teachers of philological specialty in the conditions of the computer-oriented environment, 2012, Kyiv,

	13.00.10.
2	There were studied the content, means, and technologies of developing information and communication competence of philological specialty teachers in the conditions of the computer-oriented environment in postgraduate pedagogical education; methodological competence approach was used.
3	The model of development of information and communication competence of philological specialty teachers in the conditions of computer-oriented environment was theoretically substantiated and developed; methodical bases of development of teachers-philologists' ICC were substantiated; the educational and methodical complex of a special course "Fundamentals of information and communication competence of philological specialty teachers " was designed.
4	5 higher education institutions took part in the experiment. The experimental study was conducted during 2010–2012. 483 philology teachers participated in the experimental research.
5	There was diagnosed the formation of philology teachers' ICC by determining the levels of forming cognitive, activity-reflexive, value-motivational, creative, and adaptive components of ICC. The results of the initial and final sections using the methods of statistical processing and comparative analysis confirmed the positive dynamics of philology teachers' ICC. The influence of computer-based environment on the development of philology teachers' ICC had a positive effect in 69% (EG) and 51% (CG). To verify the reliability of the obtained experimental data, the Kolmogorov-Smirnov λ-criterion and the angular transformation ϕ * - Fisher were used.
Кривонос 2014	
1	Formation of information and communication competencies of future computer science teachers in the process of programming learning, 2014, Kyiv, 13.00.02.
2	There were examined the components of the methodical system of forming information and communication competencies of future computer science teachers in the process of programming learning; the methodological activity-oriented and competence approaches were used.
3	There were developed and substantiated the components of the methodical system (content, methods, means, organizational forms) of forming ICC; the model of formation of computer science teacher's ICC was theoretically substantiated; educational and methodological provision for the discipline "Programming" and its educational and methodological support were developed and implemented in the educational process. There were created student's textbooks "The beginnings of Algorithmization and Procedural Programming", "The Use of Information and Communication Technologies in Education", "Fundamentals of Standardization of Information and Communication Competencies in the Education System of Ukraine". The ZDU Project website (http://project.zu.edu.ua) was designed, developed and implemented in the educational process, the use of which helps to increase the level of students' information and communication competencies.
4	3 higher education institutions were involved in the research. The experimental study was conducted during 2008–2012. 214 respondents took part in the experimental study.
5	There were diagnosed the formation of information and communication competencies of future computer science teachers according to 4 components: motivational-value, organizational-semantic, cognitive-operational, personal-reflexive. The following empirical methods were used: survey, self-assessment, expert assessment. The result of the experiment. The most significant changes in the experi-

	mental groups occurred at high (+3.92%), sufficient (+19.61%), and initial (-22.55%) levels of IC competence. In the control groups, there was a slightly positive trend at all levels of IC competence. To verify the reliability of the obtained experimental data, statistical methods by the Kolmogorov-Smirnov λ-test were used.
Федорук 2015	
1	Formation of information and communication competence of future technology teachers in the process of professional training, 2015, Vinnytsia, 13.00.04.
2	There were investigated pedagogical conditions of forming information and communication competence of future technology teachers in the process of learning at higher educational pedagogical institutions; such methodological approaches were used: individual, competence.
3	The pedagogical conditions for forming information and communication competence of future technology teachers were substantiated and determined (formation of the need for ICC through the organization of students' activities in the information and educational environment of the educational institution; providing guidance on the formation of the ICC on the basis of an individual approach and the establishment of subject-subject interaction between teacher and students; organization of autonomous students' work with the use of innovative learning technologies); there were designed the model and a technique of forming information and communication competence of future technology teachers; there were developed methods of forming information and communication competence of future technology teachers; the corresponding methodical recommendations for teachers were worked out; diagnostic techniques were developed and adapted for the use in the process of monitoring the components of information and communication competence of future technology teachers.
4	5 higher educational institutions were involved in the research. The experimental study was conducted during 2010–2014. 426 students of the first-the fifth year of study and 12 university teachers took part.
5	There was diagnosed the formation of ICC future technology teachers by 3 criteria: motivational-value, information-cognitive, technological-effective. Three levels of formation of the studied quality were determined: elementary-reproductive (low), conceptual-productive (medium), methodological-creative (high). The level of ICC formation was determined by using a set of empirical methods: questionnaires, testing, the method of expert assessment. According to the results of the experiment, it was found out that in the experimental group there was recorded a positive trend at all levels of ICC: high - +8.3; average - +11.6; low - -19.9. Students of the control groups showed a slightly positive result. Pearson's agreement criterion $\chi 2$ (Pearson's xi-square) was used to verify the reliability of the obtained experimental data.
Петренко 2016	
1	Delphi system as a means of forming ICT competencies of the future primary school computer science teacher in visual programming learning, 2016, Kyiv, 13.00.10.
2	There was investigated the use of the Delphi system for forming ICT competencies of the future primary school computer science teacher in visual programming learning; methodological competence approach was used.
3	The model of forming ICT-competences of the future primary school computer science teacher through visual programming was substantiated and developed; the main components of the methodology of using the Delphi system as a means of forming ICT competencies of the future teacher were developed; educational and methodological support for forming ICT competencies of future primary school computer

	science teachers in visual programming learning, in particular, the educational and methodological provision for the discipline “Visual Programming” was worked out and related electronic educational resources were recommended.
4	4 higher educational institutions participated in the research. The experimental study was conducted during 2012-2015. The experimental study involved 449 full-time and part-time students in the specialty “Primary School Teacher” (additional specialization “Computer Science”).
5	There was diagnosed the formation of information and communication competence of future primary school computer science teachers by motivational, cognitive, informational, communicative, technological, reflective criteria. Four levels of formation of the studied quality were used: reproductive, basic, advanced, creative. The level of formation of information and communication competence was determined by using a set of empirical methods, namely: pedagogical questionnaires, expert surveys, conversations with students, teachers, lecturers. According to the results of the formative stage of the experiment, it was found out that in the experimental group the number of students with creative (26.83% vs. 10.98% at the beginning of the experiment) and advanced (28.05% vs. 17.07% at the beginning of the experiment) levels of ICC significantly increased. In the control groups, there were also recorded positive results at all levels of ICT competence, but the methods of mathematical statistics proved the insignificance of their changes at different stages of empirical research. Pearson's agreement criterion $\chi 2$ (Pearson’s xi-square) was used to verify the reliability of the obtained experimental data.
Семчук 2017	
1	Theoretical and methodological principles of forming information and communication competence of future preschool education specialists, 2017, Uman, 13.00.04; 13.00.08.
2	There were researched theoretical-methodological principles and pedagogical conditions of forming ICC of future preschool education specialists at higher educational pedagogical institutions; methodological approaches were used: integrative, complex, personality-oriented, reflexive, environmental, system, and activity-oriented.
3	There was developed a structural-procedural model of forming ICC of future preschool education specialists, consisting of a set of interconnected blocks (methodical-target, content-operational, effective) and being implemented in three stages; an experimental method of forming the ICC of future specialists in preschool education was developed and implemented; educational and methodical manual “Computer technologies in work with children” was prepared and published; educational and methodical provision of materials in the disciplines of the pedagogical cycle was offered.
4	The faculties of preschool education of five universities were involved in the research. The experimental study was conducted during 2011–2016. 454 students and 126 university teachers took part in the experimental research.
5	There was diagnosed the formation of future preschool education specialists’ ICC by criteria: cognitive-cognitive, social-communicative, gnostic-developmental, activity-technological. Four levels of formation of the studied quality were used: low, satisfactory, sufficient, high. The level of ICC formation was determined by using a set of empirical methods. The formative stage of the pedagogical experiment showed an increase in the levels of ICC forming among the students of the experimental group. 29.4% of students reached a high level of ICC formation (at the beginning of the experiment it was

	7.5%); sufficient - 26.0% (at the beginning of the experiment was 9.9%); satisfactory - 19.7% (at the beginning of the experiment 17.2%); low - 24.9% (65.4% at the beginning of the experiment) in. There were also changes in the control group, but not significant. The student's t-test was used to verify the reliability of the obtained experimental data.
Тимофєєва 2017	
1	Formation of information and communication competence of future educators of preschool educational institutions, 2017, Kyiv, 13.00.08.
2	The subject of the research was pedagogical conditions, content, forms, and methods of forming information and communication competence of future educators of preschool educational institutions in the process of their professional training; The following methodological approaches were used: activity-oriented, competence, personality-oriented.
3	The method of forming information and communication competence (ICC) of future educators of preschool educational institutions was developed, which included: educational and methodical provision, control, and measuring materials for students of pedagogical specialties.
4	Three universities were involved in the research process. The experimental study was conducted during 2011–2017. 275 respondents took part in the experimental study: 136 students of the experimental group and 139 students of the control group.
5	The formation of future educators' ICC was diagnosed. The level of ICC formation was determined by using a set of empirical methods, namely: questionnaires, surveys, testing. As a result of the formative stage of the pedagogical experiment, it was found out that in the experimental groups the number of students with creative (up to 16.2%) and productive (up to 64.8%) levels of ICC increased significantly, the number of students with reproductive level - 19%. There were also changes in the control group, but not significant. Pearson's agreement criterion $\chi 2$ (Pearson's xi-square) was used to verify the reliability of the obtained experimental data.
Шроль 2017	
1	Formation of ICT competence of future mathematics teachers, 2017, Kyiv, 13.00.04.
2	There was investigated the formation of ICT competence of future mathematics teachers; methodological approaches were used: activity-oriented, competence, synergetic, systemic, student-centered.
3	The model of formation of ICT competence of future mathematics teachers was designed; there was developed a method of forming ICT competence, based on the use of mobile, computer, cloud-oriented technologies in the training of future mathematics teachers to solve professional problems with the ability to create their electronic educational resources; there was introduced educational and methodical provision for the disciplines "Fundamentals of Multimedia", "Packages of mathematical programs" (educational and working programs, educational and methodical manual "Packages of Mathematical Programs in the Training of Future Mathematics Teachers", methodical recommendations "Formation of ICT Competence of Future Mathematics Teachers", "Fundamentals of Multimedia"), methodological and technological support in the form of electronic training courses.
4	4 universities were involved in the research. The experimental study was conducted during 2013–2017.

	378 students took part in the experimental study.
5	The formation of the ICC was measured by such criteria: value-motivational, cognitive, operational-technological, personal-reflexive. The level of formation of information and communication competence was determined by using a set of questionnaires, psychological and pedagogical methods. During the pedagogical experiment, the positive dynamics of the general indicator of ICT competence was revealed: the growth of high level among the students of the experimental group took place by 17.1%, CG - by 4.1%; sufficient level increased in the experimental group by 19.0% and in the control group by 6.7%. Pearson's agreement criterion $\chi 2$ (Pearson's xi-square) was used to verify the reliability of the obtained experimental data.
Закомірний 2019	
1	Development of information and communication competence of evening school teachers in the conditions of non-formal education, 2019, Kyiv, 13.00.04.
2	The content, forms, and methods of development of ICC of evening school teachers in the conditions of non-formal education were studied; the following methodological approaches were used: andragogical, competence, personal-activity, system.
3	The model of developing ICC of evening school teachers in the conditions of non-formal education was designed; the workshop “Development of information and communication competence of evening school teachers” was held, methodical recommendations were prepared and implemented.
4	Four evening schools became the participants of the research. The experimental study was conducted during 2016–2019. The experimental study involved 290 evening school teachers.
5	There was diagnosed the formation of evening school teachers’ ICC according to the criteria: motivational, cognitive, activity-oriented, reflective. The level of forming ICC was determined by using a set of questionnaires and the method of expert assessment. During the pedagogical experiment the positive dynamics of the general indicator of ICC was revealed: the growth of a high level among teachers of the experimental group - by 17,1%, control group - by 4,1%; the number of teachers at a sufficient level increased in the experimental groups - by 19.0%, in the control group - by 6.7%. Pearson's agreement criterion $\chi 2$ (Pearson's xi-square) was used to verify the reliability of the obtained experimental data.

5. Discussion

In the modern Ukrainian psychological and pedagogical literature, there is no established definition of the term “information and communication competence” and quite often it is identified with several other concepts that are related but not identical (computer competence, information competence, etc.). There are also significant differences in determining the structural components of information and communication competence of future teachers, that is there is no reasonable set of indicators to be measured. This, in turn, results in a problem of generalizing research results, in particular in determining the effectiveness of the proposed models, methods, educational and methodological provision.

In the vast majority of peer-reviewed studies, the main mechanism in achieving this goal was the pedagogical conditions that directly influenced the process of formation of the future teachers' ICC. In general, a large number of them were identified, many of which are poorly substantiated and insignificant. Among those that can effectively influence the formation of the studied quality are: 1) the motivation development (the creation of positive motivation of future primary school computer science teachers to study the course "Visual Programming" (Петренко 2016); the increase of positive motivation and interest of future pre-school teachers to the formation of ICT in studying the discipline "Computer technology in working with children"(Семчук 2017); providing long-term motivation to learning through shifting the educational process to the realities of future professional activity (Шроль 2017); 2) the focus on the students' autonomous work (organization of students' autonomous work by using ICT during extracurricular activities) (Тимофєєва 2017); organization of students' autonomous work by using innovative learning technologies (Федорук 2015); transforming educational work into creative and research nature tasks, activation of students' educational and cognitive activities, the organization of their autonomous work (Шроль 2017); 3) practical orientation of professional training (ensuring the priority of practical activities; creating an information and educational environment aimed at forming the need for ICC through the organization of students' educational activities and pedagogical practice (Тимофєєва 2017); 4) implementation of subject-subject interaction in the educational process (providing guidance for forming the ICC on the basis of an individual approach and establishing subject-subject interaction between teacher and students (Шроль 2017); providing subject-subject interaction between teacher and students-future school teachers in the process of forming the ICC (Тимофєєва 2017); providing guidance for forming the ICC on the basis of an individual approach and the establishment of subject-subject interaction between teacher and students (Федорук 2015).

In all the reviewed researches there was demonstrated the effectiveness of the created mechanisms, which was confirmed by the growth of a high level of ICC formation in the experimental groups. However, most of the measuring instruments which were used do not have a clear definition and have little correlation with the measured components. Typically, they are usually based on general assumptions and do not fully cover all the characteristics of the measured indicators. It is a system error to determine the level of ICC formation as the average arithmetic means of all measured components, as they are all of the different weights, and therefore, in the calculation procedures, it was necessary to take into account the weighting factor of each indicator. Under such conditions, it is difficult to accurately state a certain level of information and communication competence of future teachers in Ukraine.

6. Summary

Ukraine is currently in the process when information technologies are penetrating all spheres of life, thus the need for professionals who can quickly adapt to the ever-growing demands of the information society is increasing. This necessitates the solu-

tion to the problem of modernizing the national educational system and encourages higher education pedagogical institutions to train teachers capable of implementing radical changes in the field of education. This, among other things, requires a high level of ICC formation. In general, the analysis of works showed a great increase in interest in this problem and showed that the pedagogical science of Ukraine had accumulated relevant experience over the past 20 years.

There were investigated various aspects of the problem of forming and developing ICC in the system of future teachers' professional training, the most popular of them were:

1) theory and practice of developing pedagogical software and its implementation in the educational process, principles, and methods of computer-based learning;

2) peculiarities of using ICT in the educational process at a modern school;

3) teachers' professional training in the use of ICT;

4) peculiarities of forming and developing ICC of various specialties teachers.

At the same time, several aspects need further investigation. Powerful processes of informatization of all education levels necessitate the improvement and actualization of future teachers' training, in particular the need to adjust the content of education, to introduce new disciplines, to constantly search for new organizational forms, learning technologies that contribute to forming and developing future teachers' information and communication competence. The future teacher should obtain knowledge of peculiar features of schoolchildren's psychophysiological development, in particular, the perception of the information by a modern student; knowledge of the essence and types of meta-subject ICT skills of students, the stages of their formation; knowledge of ICT tools focused on forming meta-subject ICT skills of students; awareness of innovative educational practices in working with students; knowledge of new educational methods based on the existence of single information and educational environment in the educational institution; knowledge of educational media resources focused on ICT support, etc.

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