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АНАЛІЗ СТАНУ РОЗРОБЛЕНOSTІ ПРОБЛЕМИ ПРОФЕСІЙНОЇ ПІДГОТОВКИ МАЙБУТНІХ УЧИТЕЛІВ МАТЕМАТИКИ ТА ІНФОРМАТИКИ

Анотація. У статті подано аналіз стану розробленості проблеми професійної підготовки майбутніх учителів математики та інформатики на основі аналізу нормативних документів та наявних науково-методичних розвідок. Виявлено низку суперечностей: на концептуальному рівні сучасної освіти (між активним споживанням молоддю інформаційного контенту через зорові канали сприйняття та недостатнім використанням цієї активності в умовах ЗЗСО; між потенційними можливостями ЗВО щодо якісної підготовки вчителів математики та інформатики та недостатньою реалізацією такого потенціалу через помірне оновлення матеріальної бази та відсутність підготовлених до використання віртуальної наочності викладачів); на соціально-педагогічному рівні (між суспільним запитом на висококваліфікованих фахівців, здатних швидко сприймати та представляти різного роду й обсягу інформаційний контент, та відсутністю обґрунтованих освітніх стратегій, які зумовлюють активне впровадження засобів віртуальної наочності в інформатико-математичну підготовку молоді; між соціальним запитом суспільства на візуальні форми подання навчального матеріалу та недооцінкою значення засобів віртуальної наочності у професійній діяльності вчителів); на теоретико-методичному рівні (між необхідністю формування професійної готовності вчителів математики та інформатики використовувати засоби віртуальної наочності та обмеженістю теоретичних уявлень про сутність і структуру моделей формування такої готовності; між розробленістю загальної теорії й методики професійної педагогічної освіти та недостатнім обґрунтуванням теоретико-практичних основ підготовки вчителів математики та інформатики використовувати віртуальну наочність у професійній діяльності).

Ключові слова: майбутній вчитель математики; майбутній вчитель інформатики; проблеми професійної підготовки вчителя; суперечності у професійній підготовці вчителя математики та інформатики.

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ANALYSIS OF THE STATE OF DEVELOPMENT OF THE PROBLEM OF PROFESSIONAL TRAINING FUTURE TEACHERS OF MATHEMATICS AND INFORMATION SCIENCES

Abstract. The article presents an analysis of the state of development of the problem of professional training of future teachers of mathematics and informatics based on the analysis of regulatory documents and available scientific and methodological research. A number of contradictions were revealed: at the conceptual level of modern education (between the active consumption of information content by young people through the visual channels of perception and the insufficient use of this activity in the conditions of vocational education and training; between the potential opportunities of higher education institutions regarding the quality training of teachers of mathematics and computer science and the insufficient realization of such potential due to the moderate renewal of the material base and lack of teachers trained to use virtual visibility); at the socio-pedagogical level (between the social demand for highly qualified specialists who are able to quickly perceive and present various types and volumes of information content, and the lack of well-founded educational strategies that lead to the active introduction of virtual visualization tools in the informatics and mathematics training of young people; between the social demand of society for visual forms of presentation of educational material and underestimation of the value of virtual visual aids in the professional activity of teachers); at the theoretical and methodological level (between the necessity of forming the professional readiness of mathematics and informatics teachers to use virtual visualization tools and the limitations of theoretical ideas about the essence and structure of models for the formation of such readiness; between the development of the general theory and methodology of professional pedagogical education and insufficient justification of the theoretical and practical foundations of teacher training mathematics and informatics to use virtual visualization in professional activities).

Keywords: future teacher of mathematics; future teacher of computer science; problems of professional training of teachers; contradictions in professional training of teachers of mathematics and computer science.

Problem statement. An extremely important factor of success on the way to the development of the modern information society is high-quality professional training. The activity of educational institutions of different levels (higher, professional, vocational) is the training of specialists who are able to ensure the transition from industrial to information technology society not only through innovations in education but also through the requirements that relate to the results of education – this is the quality, universality of training

graduate and his adaptability to the labor market, the personal orientation of the educational process to ensure sustainable human development.

The profession of a teacher is one of the most important for any society. According to the results of a study by UNESCO and the International Labor Organization on the profession of a teacher, it was revealed that this is the world's largest group of specialists. Over the past thirty years, the number of teachers around the world has almost quadrupled. At the beginning of the XXI century, there are about 60 million people in the world. working teachers. Indicators of the statistical yearbook of Ukraine show noticeable fluctuations in the number of teachers with an upward trend [2].

Special attention should be paid to the training of future teachers of mathematics and computer science, since, on the one hand, the study of fundamental disciplines in higher education today takes place with the use of information technologies in teaching, and on the other hand, the training of future teachers of mathematics and computer science takes place in the conditions of implementation of the new paradigm of education "New Ukrainian School" in general secondary education institutions. For future teachers of mathematics and computer science, there is now a situation in which it is necessary to learn how to make qualified decisions on the possibilities of effective and effective application of effective teaching technologies, select and predict the necessary digital technologies for use in professional activities, which often does not correlate with the expectations of society or the needs of consumers of educational services.

Analysis of current research. The normative basis for the training of teachers in higher education institutions of Ukraine are the laws of Ukraine "On Education" (2017), "On Higher Education" (2014), the Strategy for the Development of Higher Education in Ukraine for 2022-2032 (2022), the Concept of Pedagogical Education Development (2018), the Concept of the New Ukrainian School (2016), the Roadmap for the Integration of the Scientific and Innovative System of Ukraine into the European Research Area (2021).

The documents define priority directions for reforming higher education, which include: updating the content of higher education, introducing effective pedagogical technologies; creating a new system of methodological and information support of higher education. According to the National Doctrine of Education Development, the introduction of information and communication technologies in education, which ensure further improvement of the educational process, accessibility, and efficiency of education, and preparation of the younger generation for life in the information society, is added to such priority areas; training of qualified personnel capable of mastering and implementing information technologies.

In the Concept for the implementation of state policy in the field of reforming general secondary education "New Ukrainian School" for the period up to 2029 [10] states that "reforming the pedagogy of general secondary education requires thorough training of teachers according to new teaching methods and technologies, in particular information and communication technologies." The concept focuses on the formation of students' information and digital competence, which "... involves the confidence and at the same time critical use of information and communication technologies for the creation, search, processing, exchange of information at work, in public space and private communication. Future teachers should acquire the ability to solve both standard and non-standard professional tasks, interact in the information and communication educational environment, etc., which in accordance with the sectoral Concept of pedagogical education implies "... mastering pedagogical technologies, including using elements of information and communication and digital technologies..." [16].

Therefore, the problem of high-quality and proactive teacher training is becoming relevant again, which requires analysis and generalization of existing experience and the identification of contradictions that cause the modernization of educational programs for the training of teachers of mathematics and computer science to improve the quality of their professional activities.

The purpose of the article is to highlight the contradictions that exist today in the professional training of teachers of mathematics and computer science.

Materials and methods. We used normative acts, and scientific and pedagogical intelligence of Ukrainian scientists, which are subjected to analysis and generalization in order to clarify trends and requests from Ukrainian society and directions of development of scientific thought in the field of professional training of teachers by scientists, comparison of positions of both sides to identify existing contradictions.

Presentation of the main material. Analysis of regulatory documents showed the focus of education on the competence principles of its development. Now in Ukraine, there is a change in the educational paradigm from "knowledge" to competent. The defining feature of the first paradigm is the focus on the formation of knowledge. Attention is paid more to the development of memory and less to the development of thinking. The criterion for evaluation is the thesis: "The student must know." The defining feature of the competence paradigm is the formation of skills and gaining experience in solving problems in standard and non-standard situations. This trend turned out to be relevant due, among other things, to the psychological characteristics of the younger generation, which often grows in the conditions of "virtual space", and therefore stands out among other generations by active visual perception of the world and more developed short-term memory. Modern adolescents often remember not the content, but their location. In the context of teaching mathematics and computer science, we must say that there is a tendency to reduce the volume of mathematical knowledge (mathematical facts). On the other hand, the peculiarities

of the memory of modern youth are based on visual images. Therefore, the use of specific tools that visualize images becomes relevant for the teacher, and their professional training should ensure the possession of computer tools of such means.

It should be noted that the described problem is partially solved for the training of teachers of mathematics in terms of the formation of their readiness to use the means of computer visualization of mathematical knowledge. O. Semenikhina considered such tools – these include specialized computer environments of mathematical direction (in particular, programs of dynamic mathematics such as GeoGebra), which make it possible to visualize mathematical objects and operate them interactively. [7; 17; 19; 20; 21].

However, her research does not concern the visualization of non-mathematical objects – visualization of ideas, processes, and various data left out of the researcher's attention, but is important in the context of the work of computer science teachers, whose professional tasks include the formation of a modern information picture of the world at the macro and micro levels among young people, which cannot be carried out using only mathematical programs.

Part of the solution to the problem of memorizing significant amounts of knowledge in various subjects is proposed to be solved on the basis of mnemonic techniques and rules. Mnemonics (from the Greek "art of memorization") is a way of memorizing new information by creating associative relationships using special methods and techniques. Its leading principle is the principle of visualization, which today can also be observed using computer visual aids [4; 18; 26; 28].

Important for our study are the conclusions of M. Druslyak [12], that the most pressing issue of today is the preparation of a highly cultural, educated teacher of mathematics and computer science, adapted to the "visual turn" in society, ready to work with students of the new generation, differing mainly in the visual way of perceiving information, that is, a teacher with a high level of visual and information culture.

Another trend, which stands out, is the trend of forming digital competence among teachers. Awareness of the expediency of this approach occurred at the end of the twentieth century when the processes of informatization of society led to changes in priorities in education [3; 5]. Competence in the digital industry is an invariant of national and international programs for the development of modern education. In particular, the authors of the UNESCO project "ICT Competency Standards for Teacher (ICT-CST)" pay special attention to the fact that for a successful life, study, and work in the information society, teachers and students must use ICT, namely [1]: search for data, analyze them, carry out certain operations with them; solve professional problems and make decisions; creatively and effectively use all possible means to increase the productivity of training and professional work. Such competencies serve as the basis on which the professional competencies of the future specialist are formed and his mobility in the labor market and readiness for lifelong learning is ensured. On the other hand, the analysis of educational training programs for teachers indicates a lack of attention to mastering the computer tools of the teacher's work. Analysis of the content of work programs of disciplines (such as "ICT" or "IT in the work of a teacher") demonstrates accents in the direction of mastering the environment of organizing distance learning and a cursory acquaintance with computer tools for visualizing educational material.

Modernization of educational programs for the training of teachers of mathematics and computer science should take into account and ensure the formation of universal competencies (soft skills), the acquisition by teachers of skills and experience in the formation of competencies of such competencies in students. This thesis is based on the theoretical analysis of scientific research, which shows that today the socio-pedagogical conditions of the professional activity of a teacher of mathematics and computer science have changed, so his professional training should be focused on preparing for work in a variety of innovations for teaching a school course in mathematics and computer science, level and profile differentiation in a modern school, the use of modern and innovative educational technologies, etc.

We have identified another relevant trend: the spread of non-formal education and the development of open educational resources on digital educational platforms. Today, in accordance with the recommendations of the National Agency for Quality Assurance in Higher Education, at least 25% of the volume of specialist training (bachelor's degree – 180-240 credits; master's degree – 90-120 credits) should be allocated to selective educational components that can be re-credited by taking courses on digital educational platforms. It should be noted that such courses today are becoming increasingly popular due to their high-quality visual content, and therefore the trend of high-quality visualization of the educational process requires mastering the pedagogical and scientific-pedagogical personnel of the relevant software.

Modern requirements of society for specialists necessitate the strengthening of training in the field of computer graphics, which is currently one of the most powerful computer technologies that are constantly evolving. The use of computer graphics not only allows to increase in the speed of information transfer and increases the level of its understanding, but also contributes to the development of figurative thinking, and the study and further use of computer graphics form the ability not only to quickly perceive visualized objects but also to create high-quality author's materials. Due to the intensive development of visual content, the mastery of computer graphics by teachers in the conditions of non-formal education is becoming increasingly popular [7-8].

It should also be noted the trend of using information technology in the training of specialists. Based on the analysis of the results of scientific research, the main goals of using IT in the professional training of teachers are identified:

1) development of the student's personality, preparing him for a comfortable life in an information (digital) society: the development of various types of thinking and communicative abilities; formation of aesthetic culture due to the visualization of information by means of computer graphics programs, multimedia technologies, etc.; formation of skills to find optimal solutions in unpredictable difficult situations; development of skills to carry out experimental research activities – computer modeling, research of the latest ICT tools, etc.; formation of information culture, ability to process different types of information by means of appropriate software, etc.;

2) implementation of social order in accordance with the needs of the information society and the stage of its informatization: training of specialists in the field of ICT; training of PC hardware and software users, etc.;

3) intensification of all levels of the educational process: improving the efficiency and quality of the educational process through the realization of the entire didactic potential of ICT; ensuring an increase in motivation for learning through computer visualization of information, the ability to manage the activities of students, interactive interaction of subjects of the educational process; expansion and deepening of interdisciplinary connections through the use of modern means of processing textual, graphic, audiovisual information in solving problems from different subject areas, etc.

Nevertheless, often these goals are not achieved, and according to the results of professional training, society does not receive the specialist whom it expects. We have investigated scientific explorations [9; 11; 13-15; 20; 22-25; 27; 29] on the directions of using IT in the training of teachers of mathematics and computer science:

- psychological and pedagogical – neurophysiological foundations of the theory of visual perception (R. Arnheim, P. Halperin, V. Krutetsky), theoretical and practical aspects of visual thinking (L. Zankov, V. Zinchenko, N. Manko, V. Shatalov), theoretical and methodological foundations of cognitive visualization in teaching mathematics (V. Reznik, V. Dalinger, etc.);

- informatics and mathematical – fundamental ideas and assessments of trends and prospects of modern computer science and mathematics education (V. Bykov, L. Rodent, M. Zhaldak, M. Kovtonyuk, N. Morse, M. Pratsiovytyi, Y. Trius, S. Semerikov);

- theoretical and methodical – theory of teacher training in the conditions of informatization of education (Y. Goroshko, S. Rakov, Y. Ramsky, O. Semenikhina, etc.), theoretical foundations of the formation of professional, informational, visual, and information culture of teachers (M. Drushlyak, L. Gavrilova, V. Proshkin), conceptual research in the field of theory and methodology of teaching mathematics (V. Dalinger, G. Mikhlin, S. Semenets, S. Skvortsova, N. Tarasenkova, etc.) and computer science (M. Zhaldak, M. Morse, Y. Ramsky).

Along with significant theoretical and methodological developments in the field of training teachers of mathematics and computer science, including technologies for the formation of professional competencies, their methodological training, and preparation for the use of specialized software, we recorded fragmentation of developments on the use of virtual clarity in the educational process and appropriate teacher training to use it in professional activities.

So, according to the analysis of the practical state of development of the problem of training teachers of mathematics and computer science, comparing the results of scientific and pedagogical research, working out regulatory documents on the organization of the educational process and the existing concepts for the development of the pedagogical industry, we identified a number of contradictions at several levels:

1) at the conceptual level of modern education:

- between the active consumption of information content by young people through visual channels of perception and the insufficient use of this activity in the conditions of schools;

- between the potential of higher education institutions for high-quality training of teachers of mathematics and computer science and the insufficient realization of such potential due to moderate updating of the material base and the lack of teachers prepared for the use of virtual clarity;

2) at the socio-pedagogical level:

- between the public demand for highly qualified specialists who can quickly perceive and present various kinds and volumes of information content, and the lack of substantiated educational strategies that determine the active implementation of virtual clarity tools in computer science and mathematics training of young people;

- between the social demand of society for visual forms of presentation of educational material and the underestimation of the importance of virtual clarity in the professional activities of teachers;

3) at the theoretical and methodological level:

- between the need to form the professional readiness of teachers of mathematics and computer science to use the means of virtual clarity and the limited theoretical ideas about the essence and structure of models for the formation of such readiness;

• between the development of a general theory and methodology of professional pedagogical education and insufficient justification of the theoretical and practical foundations of the training of teachers of mathematics and computer science to use virtual clarity in professional activities.

In connection with the theoretical and practical significance of this problem, the need to resolve these contradictions, and the study of the theoretical and practical foundations of *preparing future teachers of mathematics and computer science for the use of virtual clarity in professional activities* is considered relevant.

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