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# MATHEMATICS TEACHER TRAINING RESULTS THROUGH THE PRISM OF STAKEHOLDERS' OPINIONS

*The article examines stakeholders' opinions on the expected results of mathematics teacher training. The experimental basis of the study was: Sumy State Pedagogical University named after A.S. Makarenko, and Uzhhorod National University. The interview method was used. The stakeholders were: students, future mathematics teachers, professors and trainers involved in teacher training, and working math teachers. The survey revealed that the use of IT in the educational process occurs to a greater extent through video communication and digital remote platforms. There is insufficient professional training in using special tools in the educational space. Therefore, it is time to develop and implement such models of training future teachers, ensuring their readiness to use modern specialized digital technologies and tools.*

***Key words:*** *mathematics teacher, teacher training, stakeholders, digital technologies, use of DT in teacher activities, digital means, visual tools.*

**Problem statement.** The world is evolving along with information and digital technologies. The modern generation of students was born in the digital era and perceived technology not only as a means for communication and dissemination of their content but also as a tool for educational activities. The virtual world is based on visual content and operates with graphical models to present various data, demonstrate processes and use technologies that take it into account. Therefore, visual computer environments are becoming widespread for organizing virtual experiments, programming, simulation, etc. They affect the specifics of the organization of the modern educational space, which uses a variety to accompany new material, and deepen students' knowledge. The need for high-quality mathematical and computer training and the constant development of software and cloud services based on optical communication channels actualize the problem of appropriate proactive training of mathematics and computer science teachers capable of virtualizing the educational space and introducing modern digital technologies into professional activities.

**Analysis of current research.** Awareness of this at the state level is supported by relevant regulations and state programs, including Laws of

Ukraine "On Education" (2017), "On Higher Education" (2014), Strategy for the Development of Higher Education in Ukraine for 2022-2032 (2022), Concept of Development of Pedagogical Education (2018), Concept of the New Ukrainian School (2016), Concept of implementation of state policy in the field of reforming general secondary education "New Ukrainian School" for the period up to 2029, Roadmap for the integration of Ukraine's research and innovation system into the European Research Area (2021), Strategic Program of European Cooperation in Education and Training "Education and Training 2020" and others.

The analysis of the results of scientific research on solving modern problems of teacher training in general and teachers of mathematics and computer science, in particular, has shown several studies that cover: issues of teacher training of subjects; topics of modern professional methodological and subject training of teachers; aspects of the formation of various kinds of teacher competencies – subject, methodological, professional; development of a specific type of teacher's culture (visual-informational, information-digital, etc.); formation of teacher's readiness to particular actions (readiness for career guidance, to use IT in professional activities, willingness to work in specialized classes; use of IT in the process of teacher training, including social networks and services; consideration psychological characteristics of the younger generation in the context of specific subjects and education in general. The generalization of scientific developments on the problems of visualization of educational content showed that scientists investigated the psychological and neurophysiological aspects of visual perception of various objects (Arnkheym, 1974), methodological aspects of visual thinking and its development (Symonenko, 2005); theoretical foundations of cognitive visualization of educational material (Semenikhina & Yurchenko, 2016).

Generalization of results of scientific research on the use of software for the visual accompaniment of the educational process (Shamonia et al., 2019; Semenikhina O. et al., 2020a; Semenikhina O. et al., 2020b; Drushlyak et al., 2021a; Drushlyak et al., 2021b; Drushlyak et al., 2021c; Semenikhina et al., 2021; Yurchenko et al., 2021; Semenog et al., 2019) and others made it possible to isolate the scientific results of IT usage in the educational process. Thus, scientists have developed the concept of creating and using computer-oriented systems for teaching mathematics (Tryus, 2005), substantiated the theoretical and methodological foundations of practical and technical training of future computer science teachers in conditions of mixed learning (Tkachuk, 2019), and the system of training future teachers of mathematics

on the use of computer visualization of mathematical knowledge (Semenikhina, 2016), etc. These results have been obtained over the past ten years. This is a significant period given the active development of technology: new software and cloud services have appeared, often used by teachers. Therefore, the problem of young people's high-quality mathematical and IT training and the problem of advanced training of mathematics teachers are actualized. Dynamic results of teacher training are the subject of research not only at the normative level at the level of educational institutions. Such results are interesting to a broader group of stakeholders (students, teachers, teachers).

**The article's goal** is to generalize stakeholders' opinion on the expected results of mathematics teacher training.

**Materials and methods.** The experimental basis of the study was: Sumy State Pedagogical University, named after A.S. Makarenko and Uzhhorod National University. The interview method was used to study stakeholders' opinions on the expected results of training future mathematics teachers. The stakeholders were: students, future mathematics teachers; professors, trainers involved in teacher training; Math teachers.

The survey was conducted as part of research on teachers' use of virtual tools and implementing STEM technologies in the educational process. To find out the actual state of professional training of future teachers of mathematics and computer science, we conducted a survey involving 168 students of the specialty "Secondary Education. Mathematics", "Secondary education. Informatics", and 32 professors, trainers, as well as 54 teachers of mathematics and computer science from Sumy and Uzhgorod, who have work experience of not fewer than three years. The vast majority of respondents are undergraduate students who have no teaching experience.

**Presentation of the primary material.** Below we present the results of the survey.

Question 1, "Is it important for a teacher to be ready to use visual aids in professional activities?" was answered in the affirmative by 93% of respondents.

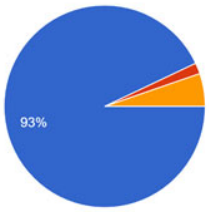


**Figure 1. Distribution of Respondents' answers to Question 1**

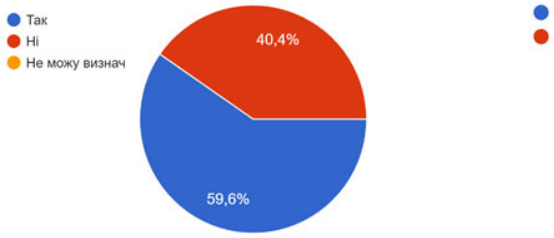


**Figure 2. Distribution of Respondents' answers to Question 2**

To question 2, "Do you use virtual visual aids in your university?" only about half of the participants answered in the affirmative (fig. 2), indicating such digital tools for supporting the educational process as collaboration systems, digital whiteboards, presentation tools, publication platforms, electronic didactic materials, etc.).

Also, most respondents indicated that presentations are the leading means of visualizing educational content used by students and teachers. Respondents also indicated that such presentations are equally used in studying all disciplines: psychological, pedagogical, mathematical, informatic, and methodological direction.

It turned out to be interesting that the vast majority of respondents are familiar with digital technologies in the field of visualization of educational material in mathematics (almost 80%), but mostly superficially (indicated by about 50% of respondents) (Fig. 3).

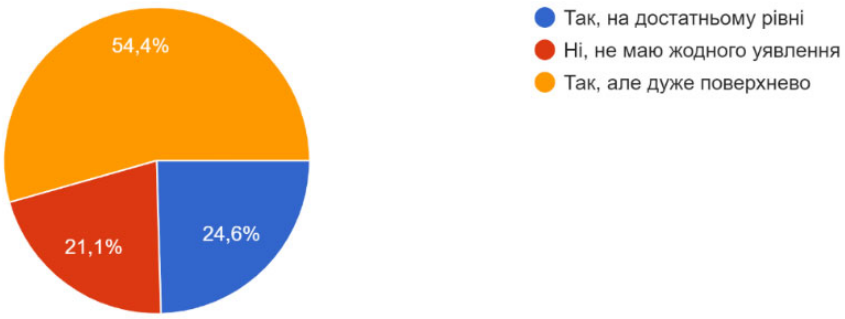


**Figure 3.** Distribution of Respondents' answers to Question 4

The respondents also assess their level of knowledge about modern approaches to the visualization of knowledge and available tools for visualizing educational material in mathematics as average (indicate 71%) (Fig. 4).

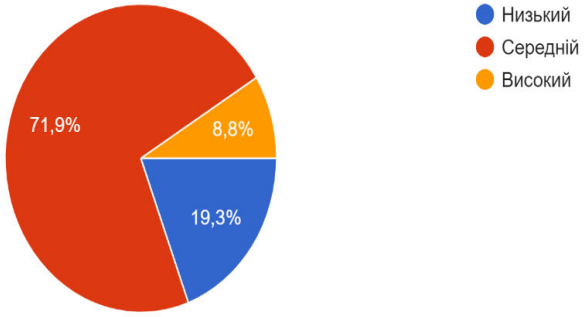


**Figure 4.** Distribution of Respondents' answers to Question 5

The respondents determine the level of their methodological skills in using digital means in professional activities as an average (Fig. 5).

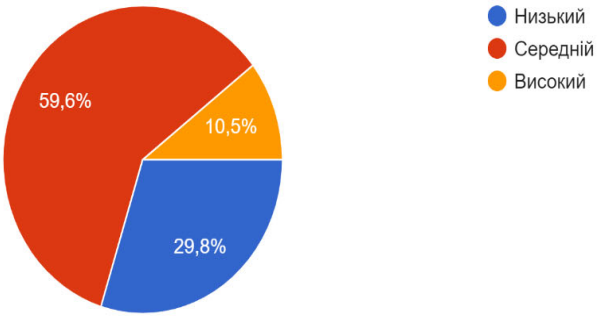


**Figure 5.** Distribution of Respondents' answers to Question 6

We believe this can be explained by the lack of experience in using virtual visualization tools for teaching mathematics since almost half of the respondents (47%) state this (fig. 6).

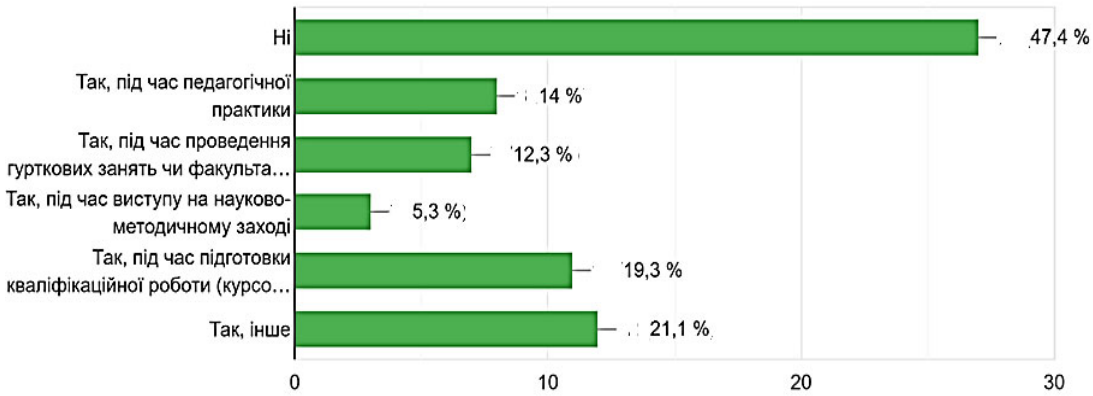


**Figure 6.** Distribution of Respondents' answers to question 7

It is optimistic that the majority of respondents (54%) attended teachers' lessons that used digital means in the vast majority of presentations (indicated by 45% of respondents) (Fig. 7). Still, the number of those who did not have such an opportunity is also high - 36% (Fig. 8).

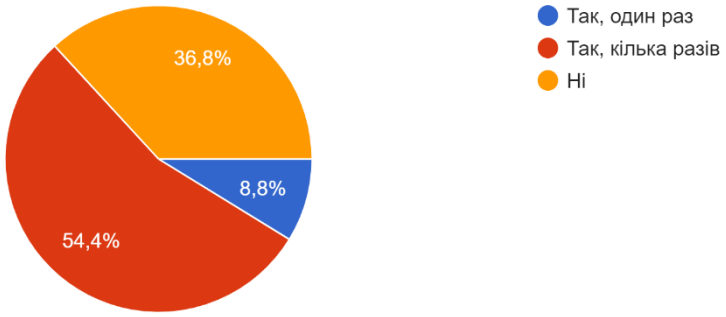


**Figure 7.** Distribution of Respondents' answers to Question 8

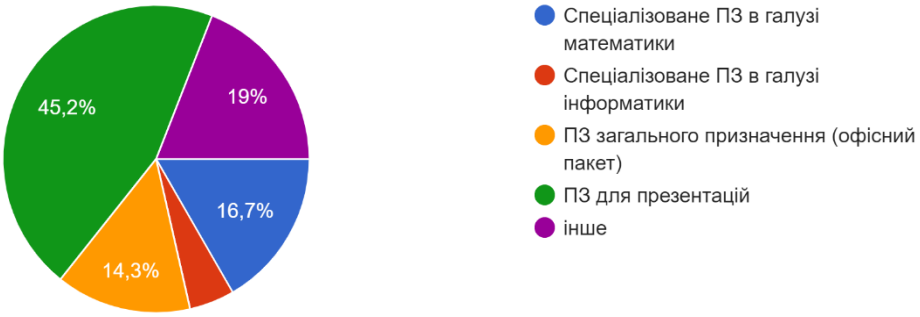


**Figure 8.** Distribution of Respondents' answers to Question 9

82% of respondents have never participated in activities to master specialized digital tools (82% of respondents, fig. 9). Among those who had such an opportunity, a minimal number of respondents noted web quests (8%), mastering courses on open educational platforms (17%), and webinars (17%). Unfortunately, the respondents do not indicate special courses, training, or events devoted to mastering the means of visualizing educational material (fig. 10).

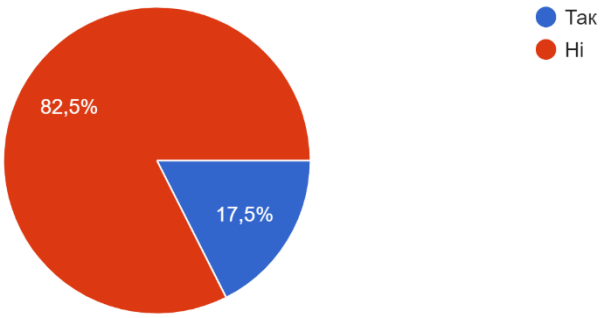


**Figure 9.** Distribution of Respondents' answers to Question 10


**Figure 10.** Distribution of Respondents' answers to Question 11

A respectful majority of respondents want to take part in training on mastering such tools (fig. 11). Restrictions on participation may be: potential opportunities for use in future professional activities (54% of respondents), free training (50% of respondents), time (45% of respondents), etc. (fig. 12).

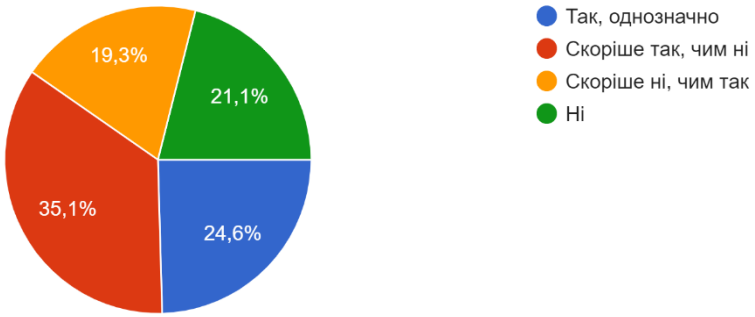


**Figure 11.** Distribution of Respondents' answers to Question 12

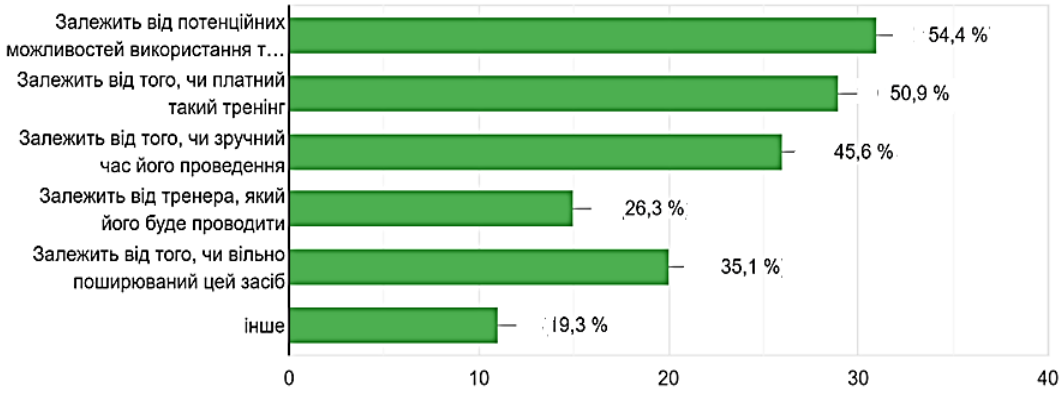


**Figure 12.** Distribution of Respondents' answers to Question 13

To question 14, "What level of motivation do you have to use digital means in your professional activities," the majority of respondents rated it as average and high (fig. 13).

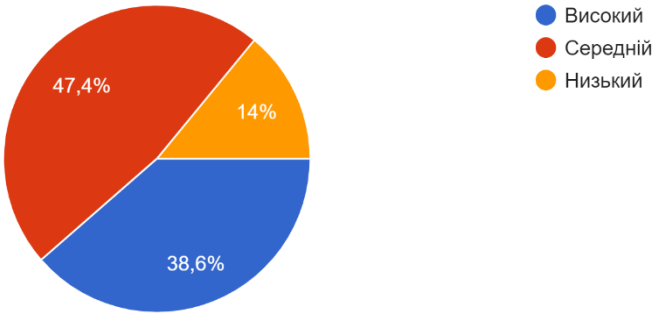


**Figure 13.** Distribution of Respondents' answers to Question 14

Interestingly, the vast majority of respondents believe that their universities should provide unique training for future teachers to use specialized digital means in future professional activities (fig. 14); however, they indicate the disciplines of pedagogical and methodological direction as the most appropriate.

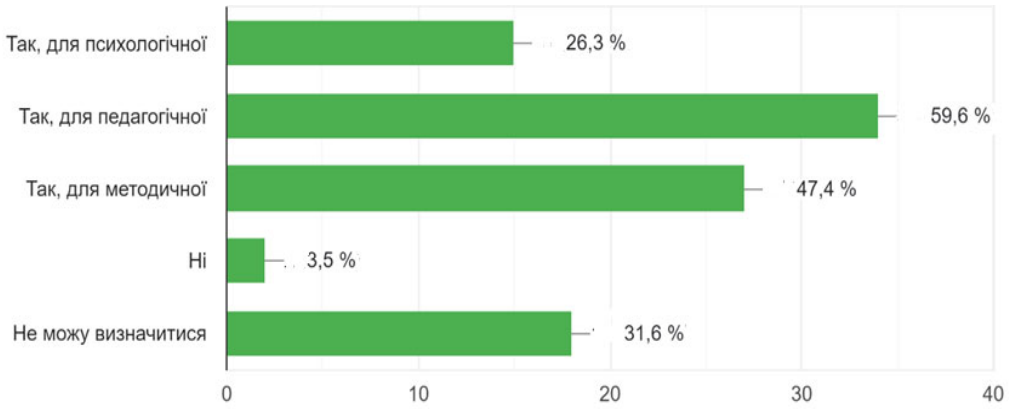


**Figure 14.** Distribution of Respondents' answers to Question 15

A positive fact is that 61% of respondents consider it reasonable to expand the list of elective subjects (question 16) and add special courses on mastering various digital means of supporting teachers' professional activities (Fig. 15).

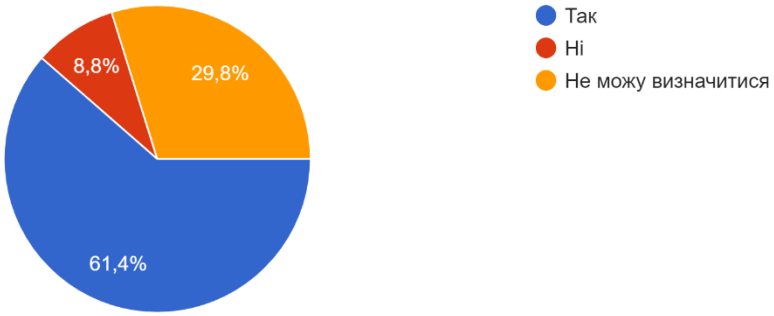


**Figure 15.** Distribution of Respondents' answers to Questions 16

The analysis of the survey results conducted among teachers (teachers of Sumy and Zakarpattia regions) revealed that all of them use visibility in the form of presentations and demonstration materials in their practical activities and consider it necessary to use digital means today. More than two-thirds of respondents believe this process is effective and are ready to implement it. But at the same time, despite the availability of various electronic materials and digital solutions for school, teachers take most of the electronic content from the Internet and do not develop it on their own. This situation does not always satisfy them. Teachers are not satisfied with the content of the content, the concentration of educational material in it, etc. Even though most of the surveyed teachers improved their skills in implementing IT in practice, they feel the need to develop their skills in using virtual tools in the educational process.

**Conclusions.** Therefore, there is reason to assert that the attitude of stakeholders to the introduction of specialized digital technologies and means, which, among other things, support visualization, is generally

favorable. But teachers lack awareness about the choice of digital means, the dominance of their tools, and effective use in professional Activity.

The survey revealed that the use of IT in the educational process occurs to a greater extent through video communication and digital remote platforms. There remains the problem of high-quality visualization of educational material in the virtual educational space: the school uses presentations and textual educational content, and only half of the respondents noted that teachers themselves develop/create models of knowledge, do not use specialized software for dynamic visualization of connections between concepts, models, and phenomena, do not systematize material using computer tools, do not use visualization tools in computer testing, do not use educational Internet resources for organizing digital visual space. Among the reasons, there was a lack of time to prepare such materials and insufficient professional training in using tools in the virtual educational area.

Therefore, it is time to develop and implement such models of training future teachers, ensuring their readiness to use modern specialized digital technologies and tools.

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# ЦИФРОВА КОМПЕТЕНТНІСТЬ МАЙБУТНЬОГО ПЕДАГОГА ЯК НЕОБХІДНА СКЛАДОВА ЗАБЕЗПЕЧЕННЯ ЯКОСТІ ПРОФЕСІЙНОЇ МАЙСТЕРНОСТІ

*У статті обґрунтовано необхідність формування цифрової компетентності майбутнього педагога та розглянуто шляхи її удосконалення для забезпечення якості актуальної педагогічної освіти. Зазначено, що сучасний*