

## FORMATION METHODOLOGICAL COMPONENT OF PROFESSIONAL COMPETENCE OF STUDENTS SPECIALTY “SECONDARY EDUCATION” (MATHEMATICS AND PHYSICS) BY DIGITAL TOOLS

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### Summary

The article considers the formation of professional competence of students majoring in secondary education (mathematics and physics). Attention is paid to the methodological component of professional competence and the expediency of its formation by pedagogical and methodological orientation of the courses taught for future teachers is substantiated. The method of formation of methodical competence with the use of modern digital teaching aids in the pedagogical process is described. It is proved that integrated use of digital tools in the pedagogical process pursues two goals, motivation and strengthening of cognitive processes of students involved in the learning process, their active participation, awareness of the learning process, building their own trajectory and the second goal, which is important for students majoring in secondary education (physics and mathematics) – the formation of ideas about the organization of the modern educational process. The classification of digital teaching aids into visualization tools, memory tools, comprehension tools, communication tools, and assessment tools is carried out, their didactic value in the pedagogical process is described. Digital tools for the formation of methodological competence were selected on the basis of analysis of their impact on cognitive processes involved in all stages of the learning process. The integral process of using digital applications in the pedagogical process at all stages of the learning process is designed to ensure the formation of methodological competence of future teachers by their own example of the organisation of educational process.

**Keywords:** methodical competence, digital applications, design of pedagogical process, future teachers of physics and mathematics, specialty secondary education.

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### 1. Introduction

We live in a time of rapid scientific and technological progress and an avalanche of information that affects all areas of our lives and education. Approaches to teaching and education are changing, others today are learning outcomes, and our children are children of the digital age, for whom gadgets are a habit and a necessity. Ensuring a quality and modern educational

process in physics and mathematics at the level of modern requirements depends primarily on the degree of universal training of teachers, an important component of which is professional competence. The formation of higher education students' ability to solve specialized problems in the organization of the educational process in physics and mathematics, due to the laws and features of modern theory and methods of teaching physics and mathematics should occur not only through the study of fundamental and professional disciplines, but also using the example of a teacher on the organization of the pedagogical process.

In accordance with the general developmental function of the teacher's task is not only to transfer to the student a modern scientific and theoretical way of thinking, but also to teach how to transfer and form such a way of thinking in students (*Zabolotnyi, 2013*).

The purpose of the article is to design the process of formation the the methodological component of professional competence of future teachers of mathematics and physics using of digital technologies.

## 2. Methodical component of professional competence of a teacher

Analysis of psychological and pedagogical literature on the formation of professional competence of future teachers of physics and mathematicians engaged in a number of scientists who interpreted professional competence as a complex property of the individual to perform their professional duties: "practical and psychological personality traits based on knowledge, skills, abilities, individual qualities, values, internal motivation, effectively and efficiently perform certain professional activities" (*Zabolotnyi, 2009*); "A set of pedagogical abilities and capabilities, the presence of a motivated focus on the educational process, the system of necessary knowledge, skills, abilities and experience" (*Rakov, 2005*); "The ability to productively solve educational problems that arise during the training of a qualified specialist, the formation of the personality of another person" (*Zeer, 2003*).

Analyzing the interpretation and the structure of the concept, we conclude that in most researchers the professional competence of future teachers is considered as a set of subject and pedagogical components and in the structure of professional competence of the teacher must be present (A. Markova, A. Khutorsky, A. Novikov) subject-methodological component, which is manifested through (A. Iron) experience in the implementation of well-known traditional and creative methods of activity; experience of educational and cognitive activity, fixed in the form of its results – knowledge of teaching methods; experience of emotional and value relations, which is formed during pedagogical practice. We are impressed by the opinion and approach to the formation of methodological competence V. Zabolotnyi, who defines "methodological competence – as knowledge in the field of didactics, methods of teaching the discipline, the ability to logically construct the learning process for a specific didactic situation taking into account psychological mechanisms", and notes (*Zabolotnyi, 2013*) that for teachers of higher education there is a task of formation of methodical competence by own example of the organization of pedagogical process, or as N. Kuzmyna notes "means of creation of special pedagogical orientation" of courses which contribute to formation of professional competence as a whole (*Kuzmyna, 1990*).

Thus, an important component of the professional competence of the future teacher is the methodological component, which is formed both by means of «pedagogical» courses of educational and professional program, and the way of monitoring the activities of the teacher in the classroom.

### 3. Digital tools as a learning tool

In the age of the digital age, which has changed communication, cooperation, training, understanding of professional and methodological competence is somewhat expanded, as it involves knowledge of the didactic potential of digital tools and experience in the use of digital tools in the pedagogical process.

Research on the use of modern information and communication technologies in teaching physics and mathematics has recently focused on the use of digital tools for laboratory work, research (O. Pinchuk), as a means of formative assessment (N. Mozre), as a means of illustrating educational material (Yu. Melnyk, V. Sipi, etc.). Yu. Myroshnichenko proved the pedagogical expediency of introducing information and communication technologies in the learning process, taking into account the psychological and pedagogical provisions of educational activities. He notes that the introduction of modern digital technologies increases the motivation of educational activities, forms a stable cognitive interest in the subject, provides individualization of the learning process, which contributes to better and more conscious assimilation of educational material, gives educational and cognitive activities research, creative character. education of interest in science, the development of cognitive independence and improving the quality of knowledge on the subject (*Myroshnichenko, 2011*).

Today, according to statistics, 4 billion people on the planet use a mobile phone, the future requires citizenship, which is fluent in science, technology, engineering and mathematics (*O'Donnell, 2019*). We have the opportunity to use a variety of digital applications for learning. According to the results of surveys on the use of modern mobile devices in the pedagogical process, it is indicative that: more than 70% of parents consider the effective use of technology vital for the future of their child; students argue that online learning helps better in systematic learning and control; educators note that the use of digital devices increases students' curiosity, motivation and confidence (*Morse, 2018*). Among the advantages of using digital tools in the educational process, which are most heard in the works of researchers are: accessibility (applications are easily installed on students' mobile devices); effectiveness (quick feedback in assessment, simultaneous coverage of all students in the survey, visually rich learning environment); multitasking (ability to change activities using digital tools); individualization of learning rates, etc. (*Miroshnichenko, 2011*).

### 4. Design of digital methodological competence

According to the results of our research of educational programs and observations of the bulk process, the skill of using digital tools in the educational process of secondary education (mathematics and physics) takes place only in separate (computer) courses of the educational program. problem solving, construction of three-dimensional geometric figures, etc.), while for a teacher of physics and mathematics is important not only the use of digital tools to form components of subject competence of the student, but also to form the competence of learning, for pedagogical support students' mastery of educational material, self-organization, self-control, assessment process and gaining experience working with them in the study of the discipline.

That is, for a modern teacher of physics and mathematics "digital component", or information technology (*Zabolotnyi, 2009*) in his methodological competence is a necessity. For its formation it is important for the teacher to introduce digital tools at different stages of the

pedagogical process. Today, the traditional set of tools (pen, pencil, paper, compass, notebook, laboratory supplies, models, etc.) to support educational activities in physics and mathematics is supplemented by modern tools: text and graphic editors, messaging systems, virtual laboratories, digital meters, digital applications, etc. (*STEAM Education, 2018*). There are also many digital applications that help to better master the educational material, ie to conduct educational activities in the pedagogical process.

To be effective in the pedagogical process, the use of digital tools must be planned. We selected applications based on the establishment of their ability to influence cognitive processes (*perception, attention, thinking, imagination, memory*), which are involved in each of the stages of the internal process of learning: *perception – understanding and understanding – generalization – consolidation – application to practice* and based on the characteristics of modern children: *communication, fragmentary thinking, understanding the language of visual objects, a willingness to cooperate, the desire for quick results, connoisseurs of technology, connoisseurs of honesty and open in social networks*. The process of designing the use of digital tools also contributes to the formation of methodological competence of the future teacher.

For an effective pedagogical design process, the use of digital tools should include:

1. Professional understanding of the development of the pedagogical plan, modeling the distribution and inclusion of resources (identification of tools appropriate to the stages of learning, gaining experience with them, overcoming and avoiding difficulties that arise in the process of their use);
2. Registration of the productive program of activity (vision of the teacher of all educational process, the organization and realization);
3. Adjustment of the methodological system based on the results of critical reflection.

Among all digital tools (*O'Donell, 2019*) we will allocate:

- **visualization tools** – for creative and effective separation of the main from the whole context, for better memorization and understanding of abstract images;
- **memorization tools** – for training memory, perception of new information;
- **tools of understanding** – for establishment of logical communications;
- **communication tools** – for the organization of group work, self-study, group projects;
- **assessment tools** – to establish the level of progress in the study of educational material, identify gaps and eliminate them.

Among the **visualization applications** we will highlight Word Clouds, with which you can present a lot of information on a small part of the workspace, highlight key points, the basis of the thesis, the basic concepts of the topic, highlighting the key points of any discussion with the help of tags.

**Memorization tools** include memory training tools and knowledge maps, which also help to translate information from short-term memory to long-term memory, establishing logical connections between the particles of the topic, the material being studied. Creating mind maps helps you capture, record, remember, combine, and display information visually. Timeline is a tool with which, using various multimedia and timing, you can illustrate the plan and history of the studied issue with all the moments or remember the topic.

**The tools of understanding** are best suited to mind maps, which Tony Buzan considers “a multifaceted training device that develops every mental muscle of the mind” (*Buzan, 2018*).

Among the **assessment tools** we will highlight those (Plickers, Poll Everywhere, eKahoot), which give quick feedback and help to find gaps in learning, to correct them.

Table 1 provides a brief design of the use of digital tools in the pedagogical process of training future teachers.

Table 1

### Designing the use of digital tools in the learning process

Stage of the learning process	Cognitive processes	Tools	Examples of digital applications	Purpose of use
Perception	Attention Perception	Visualization tools	<u>TAGUL</u> <u>TAGXEDO</u> <u>WORDLE</u> <u>GOOGLE CHARTS</u>	Select the main,
Comprehension and understanding	Memory Thinking	Memorization tools Comprehension tools	<u>QUIZLET</u> <u>MINDMEISTER</u> <u>COGGLE</u> <u>WISEMAPPING</u> <u>MIND42</u> <u>FREEMIND</u> <u>SPIDERSCRIBE</u> <u>MINDMEISER</u>	Translating perceived information from short-term and long-term memory, establishing logical connections, creating short visual summaries from a large amount of material.
Generalizations	Memory Thinking	Memorization tools Comprehension tools	<u>TIMELINE JS</u> <u>TIKI-TOKI</u> <u>MIND42</u> <u>FREEMIND</u>	Creating reference notes, summarizing the topic, recording the basic formulas of the topic.
Consolidation	Memory Thinking	Assessment tools	<u>KAHOOT</u> <u>TIMELINE JS</u> <u>PLICKERS</u> <u>MIND42</u>	Recalling basic concepts, identifying gaps, consolidation of acquired knowledge.
Application in practice	Memory Thinking Imagination	Tools communication	<u>BLOGS</u> <u>SOCIAL NETWORKS</u> <u>TIMELINE JS</u>	Development of joint projects, practical application

## 5. Conclusions and suggestions

An important characteristic of the future teacher in addition to subject professional knowledge is his methodological competence, which today is somewhat modernized through the active entry of digital resources into all parts of the educational process. The process of formation of the methodical component of professional competence can take place both on special courses, and also on an example of conducting pedagogical process by the teacher. We considered the design of the formation of methodological competence of the teacher by means of planned and conscious use of digital resources in the process of teaching and learning. Integrated use of digital tools in the pedagogical process pursues two goals, motivation and strengthening of cognitive processes of students involved in the learning process, their active participation, awareness of the learning process, building their own trajectory and the second goal, which is important for students majoring in secondary education (physics and mathematics) – the formation of ideas about the organization of the modern educational process. Among the digital resources, we have chosen those that have an impact on the cognitive processes involved in the stages of the internal process of learning.

The prospect of further research is to create a methodological description of the use of digital tools at different stages of the learning process.

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