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On the Professional Competence of a Mathematics Teacher

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Abstract

This article aims to show the science competencies of future mathematics teachers and the factors that shape them, as well as the effects of the use of their abilities by a teacher with science competencies in the classroom. In particular, the use of mathematical models in solving problems in algebra and its importance.

Keywords: *Competence; Ability; Communicative Ability; Synergetic System; Mathematical Modeling; Professional Component; Individual Skills and Competencies*

Introduction

In a changing world, the current education system must be able to shape such qualities as competence, initiative, and flexibility, interest in innovation, resourcefulness, enthusiasm and systematization in a graduate of a higher education institution. It is also important that the future teacher strives to work on himself throughout his life, to be able to make independent decisions, to adapt to the social and professional environment, to solve problems, to be ready for hard work, stress and to get out of these situations quickly. A mathematics teacher must fully meet all the qualification requirements of the teacher professional standard.

At the same time, the logical thinking of each teacher depends on his knowledge, and in order to teach this subject, the competence required to perform specific learning tasks is required.

The Main Findings and Results

The concept of “competence” often has different definitions that are quite different from each other. L.V. Budyak describes competence as follows: “Competence is a specific stage of completed education, a quality that requires a person to successfully perform their duties”. Most scholars, in defining the concept of competence, believe that there should be a synergetic system of interrelated knowledge, personal skills and qualifications, personal qualities that allow performing professional activities at a highly qualified level.

Competence can be viewed as a complex of competencies. The competencies that make up the complex are the competencies that underlie professional activity. Indeed, if a person has competence in a certain direction, that person is manifested in the process of education and upbringing, as well as in the system of independent learning and specific competencies.

N.F. Sergienko calls the special competencies of a mathematics teacher, which provide information (new knowledge), producer (new knowledge), professional ability, social activity, psychological state, level of mathematical knowledge, communication, moral and personal characteristics of the teacher, as the main competencies that make up a teacher's professional competence.

Professional science competence is the ability to have sufficient knowledge in one's subject and to move in that direction. This means that the formation of science competence is a process that is inextricably linked with general professional activity. The competence of each subject is formed in the learning process of the future mathematics teacher (student) in a well-organized way.

Learning-cognitive activity is a specific system of sequential actions that moves the learning material in a specific direction, including the content of the learning material and the methods of using the learning material.

Prospective mathematics teachers will need to formulate the following in order to increase their math mastery:

• Ability to think logically and communicatively, to use this ability effectively and to show its importance;

• Ability to construct mathematical models of a real object, process, model real objects and processes, anticipate and describe their properties.

A.N. Tikhonov considers mathematical modeling: “Mathematical modeling is the third way of perception”. Mathematical modeling is the process of translating the content of a given problem into mathematical language and using a mathematical method (formula) to solve the problem.

Let us consider the solution of a problem brought up in the Algebra course to the topic of “System of Equations” using the steps of mathematical modeling.

For example: In the center of the district there are “Yoshlik” and “Dustlik” cinemas, one for 400 seats and the other for 600 seats. The audience hall of “Dustlik” cinema is 4 rows longer than the auditorium of “Yoshlik” cinema. In addition, there are more than 5 seats in each row of the “Dustlik” cinema than in each row of the “Yoshlik” cinema. If the number of seats in each row of the cinema "Friendship" is more than 25, how many rows of seats in the auditorium of the cinema "Youth"?

Solve.

1. Preliminary Considerations about the Object

Students try to determine what information (what is given) is given in the context of the problem. What is the number of rows in the second cinema if the number of rows in the first cinema is more than 25? How do we determine the number of seats in each row? What method do we use to solve a system of equations? Do the answers obtained fit the context of the issue? Students solve the problem by looking for answers to questions such as.

2. Creating a Mathematical Model (Selection)

Let's say that with x we denote the number of seats in the "Yoshlik" cinema, and with y the number of seats in each row.

In this case, the number of rows in the cinema "Dustlik" is determined by $+4$, and the number of seats in each row of the cinema "Dustlik" is determined by $y+5$.

Knowing the number of rows and the number of seats in each row, you can find the total number of seats in each cinema: $x \cdot y$ - number of seats in the cinema "Yoshlik", $(x+4)(y+5)$ – number the number of seats in the cinema "Dustlik". According to the terms of the issue, the number of seats in the cinema "Yoshlik" is 400, i.e.,$x \cdot y = 400$, and the number of seats in the cinema "Dustlik" is 600, $(x+4)(y+5) = 600$.

It can be seen that in order to find a solution to the problem, we construct a system of two unknown equations:

$$\begin{cases} xy = 400 \\ (x+4)(y+5) = 600 \end{cases} \quad (1)$$

We have created a mathematical model of the problem. In order to find the answer to the problem, it can be said that in "mathematical language" it is necessary to solve two systems of two unknown equations.

3. Solve and Study a Mathematical Problem

Before we determine which method to use to solve a system of equations to solve a structured mathematical model, we simplify it, that is, a system of equations $\begin{cases} xy = 400 \\ xy + 4y + 5x + 20 = 600 \end{cases}$ and $\begin{cases} xy = 400 \\ xy + 4y + 5x = 580 \end{cases}$ is appropriate.

In solving a system of simplified equations, we continue to work on the example using the "Addition method" of the system of equations:

$$(xy + 4y + 5x) - xy = 580 - 400;$$
$$4y + 5x = 180;$$

Replacing this equation (1) with the second equation in the system of equations:

$\begin{cases} xy = 400 \\ 5x + 4y = 180 \end{cases}$ systems are formed.

(2) It can be seen that the system (1) is a much simpler system than the system.

(2) We determine that the system must be solved using the "Substitute" method of solving the system of equations. (2) In the second equation of the system, we denote *y* by *x*:

$$4y = 180 - 5x; \rightarrow y = \frac{180 - 5x}{4}$$

we come to equality. We put this expression (2) in the first equation in the system and simplify it:

$$x \cdot \frac{180 - 5x}{4} = 400$$
$$x(180 - 5x) = 1600$$

$$5x^2 - 180x + 1600 = 0$$

$$x^2 - 36x + 320 = 0 \quad (3)$$

When it comes to expression (3), the student's knowledge of solving the quadratic equation helps, and the student finds the roots of the quadratic equation: the roots of the quadratic equation$x_1 = 20, x_2 = 16$. Here, the student now considers the $y = \frac{180-5x}{4}$ equations identified in the steps of solving the example:

a) if $x = 20$, then $y = 20$;

b) if $= 16$, then $y = 25$.

From this, it was found that (1) the system has two solutions: (20; 20) and (16; 25). We divide these solutions into cases that correspond to the conditions of the case:

1-stage. There are 20 seats in each row in the "Yoshlik" cinema;

2- stage. There are 16 rows in the "Yoshlik" cinema, with 25 seats in each row.

Now we need to analyze the circumstances identified by the condition of the problem: In the first case, the cinema "Dustlik" will have 24 rows and 25 seats in each row, depending on the conditions of the problem. However, this does not mean that the number of seats in each row of the "Dustlik" cinema is more than 25. Therefore, if we choose the second case, that is, if the cinema "Yoshlik" has 16 rows and

25 seats in each row, then the cinema “Dustlik” will have 20 rows and 30 seats in each row. This will be a solution that satisfies the condition of the issue.

So, the answer to the question: there are 16 lines in the auditorium of the “Yoshlik” cinema.

4. Interpretation of Mathematical Result

In the process following the mathematical modeling of the problem, the student solves the mathematical problem directly. However, this may not be sufficient to give a complete answer to a given given problem, which may not allow the solution to be considered complete. To do this, it is necessary to analyze the mathematical solution found in terms of a practical problem and show the required answer. That is, it is necessary to determine which answer gives the result of the calculation in accordance with the conditions of the vital (practical) problem.

Addressing such issues is multifaceted. First, students master a scheme for solving practical problems. Second, it helps to develop a culture of mathematical application, to form the most necessary skills to apply mathematical knowledge and methods in solving problems of practical content. Third, students become acquainted with the connection between practical activity and mathematics (in a broader sense - the role of theory in practice).

Mathematical modeling was used to solve the problem in the above professional context. In modeling (mathematical modeling only), the following processes can be seen: taking into account important factors in an event or situation and omitting unimportant ones; to establish a system of correlation of the received factors; draw the necessary conclusions from the obtained scheme.

To know the main factors, connections and objects in the scope of activities applied to implement the main content of the modeling process, to distinguish only the main ones, without paying attention to the factors that are not important in the situation under consideration, to create a situation diagram and, finally, to have the skills and knowledge to solve the problem in this "language".

The following skills are formed and used in the activities of a mathematics teacher:

- Specific knowledge, skills and competencies in the field of mathematics, for example:
- Internal formation of mathematical conditions (spatial imagination, spatial image);
- Verification of mathematical proofs using counter examples;
- To divide the general task into parts, to give possible options from objects and actions;
- Use of a given mathematical model, in particular, formula, geometric configuration, algorithm, modeling result (for example, calculation);
- Use ICT tools where they are effective in solving the problem;

The ability to overcome intellectual difficulties, to solve new problems radically, to respect intellectual labor and its results is formed and applied in professional activity, which contributes to the effectiveness of the professional activity of a mathematics teacher.

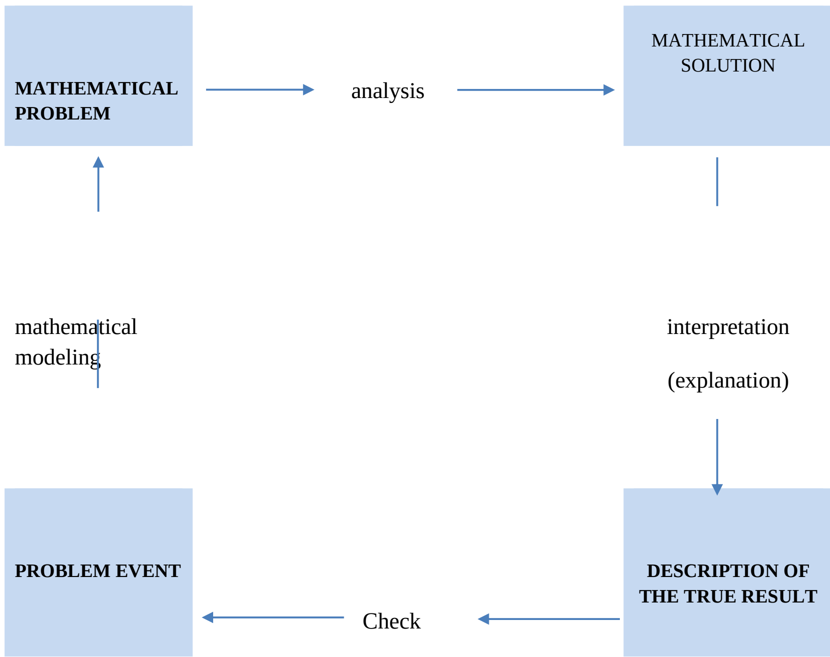

Figure 1

A teacher with science competence can enrich the theoretical part of the science along with the possibilities of its practical part and convey it to the students in practice. This teacher gives real-life examples that shape students ’spatial imagination in mastering the theoretical knowledge they have acquired in science.

Teacher knowledge is a prerequisite for the teaching process and not a prerequisite for a good teaching process. The real problem is that even if a teacher has a good knowledge of his or her subject, he or she may not have the ability to effectively organize the teaching process. Science competence implies not only the ability to independently manage knowledge, but also knowledge of basic scientific concepts, principles, unsolved problems, and research methods.

A good teacher knows what questions students are interested in, tries to get students to fully understand the topic, and informs students about the "black holes" in this area.

Students consider a teacher with such qualities to be a rich source of information on the subject.

Also, the teacher sometimes "hides" information in order to increase students' independent research and interest in science. When students enter a “scientific debate,” the teacher demonstrates the importance of accepting the subject along with its internal structure and connections in mastering the subject in order to guide them in the right way to solve the problem.

The following levels can be used to determine a teacher's level of science competence:

The first level is professional-methodical literacy, literacy, readiness to solve professional-methodical activity in standard and standard situations by performing standard situations and standard methodical tasks, which includes the teacher's methodological ability and professional potential, natural and acquired qualities of the person during professional training.

The second level - this professional-methodological competence - carries out professional and methodological activities, forms in practice and acts adequately, independently and responsibly by solving any methodological problems in accordance with the standards and norms adopted in the changing situation in the process of professional activity.

The third level - professional and methodological culture, “skill” (methodological creativity) - performs professional and methodological activities in non-standard situations and using pedagogical innovations, creative perception of the situation.

Conclusion

Shortcomings in the training of future mathematics teachers include the formal (stereotyped) acquisition of mathematical knowledge and theory, the lack of focus on the pedagogical process, and poor preparation for independent professional activities.

Many future mathematics teachers have a low level of science competence, limited by the “knowledge-skills-education” paradigm and do not always meet the requirements of this educational paradigm, but modern life and constantly evolving science conditions have a higher level of science competence than the teacher requires to be.

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