



The methodology for developing professional competencies of bachelors in the program «Pedagogical Education»

La metodología para el desarrollo de competencias profesionales de los licenciados en el Programa «Educación Pedagógica»

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ABSTRACT:

The goal of this research is to identify the didactic conditions to form professional competencies and to create a methodology aimed at developing them in the Bachelor's of Pedagogical Education program when studying an algebra

RESUMEN:

El objetivo de esta investigación es identificar las condiciones didácticas para formar competencias profesionales y crear una metodología destinada a desarrollarlas en el programa de Bachillerato en Educación Pedagógica al

course. The systems, activity based, competency-based and learner-centered approaches were used as the methodological guidelines when devising the methodology for the development of professional competencies. The authors defined the concept "the development of professional competencies" and identified three groups of professional competencies.

Keywords: method, professional competencies, learning event, lesson components

estudiar un curso de álgebra. Los enfoques de sistemas, basados en actividades, basados en competencias y centrados en el alumno se utilizaron como pautas metodológicas al diseñar la metodología para el desarrollo de competencias profesionales. Los autores definieron el concepto "el desarrollo de competencias profesionales" e identificaron tres grupos de competencias profesionales.

Palabras clave: método, competencias profesionales, evento de aprendizaje, componentes de la lección.

1. Introduction

The relevance of the study is connected with solving one of the most significant tasks facing professional education nowadays—training highly qualified bachelors of education who are ready for innovation, meeting the updated requirements for teachers and the changing digital environment.

Having analyzed the system of bachelor-level training of teachers ("Pedagogical Education," teachers of mathematics) and having studied scientific publications and educational practices, the authors found contradictions in the training of a would-be math teacher. The authors identified the following problems that have not yet been solved: insufficient use of modern forms, methods, and techniques in a lesson; a lack of a holistic system for developing professional competencies; and insufficient skills for solving mathematical problems with IT (Information Technology) tools.

These problems determine the relevance of the study and were used to formulate the research goal: to identify the didactic conditions for the development of professional competencies and to create the methodology aimed at forming these competencies by bachelors of education while studying algebra.

The consistent involvement of each student in active learning and thinking is the starting point for developing his or her deep cognitive interest and motivation to learn. It is important to highlight the specifics of mathematics and its role in the intellectual development of a person from students' first days at university, when they are still identifying their preferences for a particular math subject. It is also crucial for a bachelor's in education program to determine the competencies that will be required for their future work. For this purpose, it is necessary to devise an appropriate methodology for the development of professional competencies when teaching a subject to a student.

In this study, the methodology of developing professional competencies when learning a subject is defined as a way of organizing educational activities with a focus on students' involvement in acquiring the components of these professional competencies while studying a subject

(for instance, algebra) in the digital educational environment of the university.

Research on the structure of learning activities name three components: motivation- oriented, content-related, and reflexive-evaluative. Thus, it can be assumed that the structure of a lesson should also include these key activity components (Ivanova et al., 2009).

The motivation-oriented stage implies actualization of the necessary knowledge, consideration of previous knowledge and experiences, motivation for obtaining new knowledge to overcome the contradiction between "knowledge and ignorance", and setting goals and learning objectives to determine the focus of the knowledge that will be accumulated later. The content-related stage implies transforming the conditions of the learning task, creating its model, and solving certain practical problems. The reflexive-evaluative stage includes the stages of control and self-control, reflection and evaluation. It should be noted that at each of the considered stages the student should be not only obtaining subject knowledge but also mastering the components of professional competencies.

Within the systems approach, the principle of integrity allows one to consider the methodology for developing professional competencies as a system whose components are represented by objectives, content, procedures and results. In other words, they represent the objectives of learning the subject and the development of professional competencies, the content of the subject, the values and attitudes related to the acquired scientific knowledge and professional competencies, and the process of developing subject skills and professional competencies on the basis of deliberately selected forms, techniques, teaching and test methods, and educational results.

The objectives of students' learning are determined by the competency model of the bachelor presented in the Federal State Educational Standard of Higher Education for program 44.03.05, "Pedagogical education with two training specialties" (Ministry of Education and Science of the Russian Federation, 2016), and a professional model presented in the Professional Standard of the Teacher (Ministry of Labor and Social Protection of the Russian Federation, 2013). The focus is on the development of professionally and personally significant qualities of the future teacher.

2. Methodology

The study is based on the systems, activity-based, competency-based, and learner-centered approaches. These approaches were used to devise the methodology for developing professional competencies for bachelors of education. Within the systems approach (Blauberg & Yudin, 1973; Postman, 1979), the methodology for developing professional competencies is considered as an integral system with such components as objectives, contents, procedures, and results. The application of the

activity-based approach (Novikov, 2005) enabled the authors to find adequate ways of managing students' work through their involvement in active learning and research: In an algebra course, students solved various practice-oriented, contextual, and educational research problems. The competency-based approach (Efremova, 2012; Khutorskoy, 2003), which forms the basis of modern higher education standards, made it possible to determine the goals and educational results of students and avoid contradictions present in regulatory documents (Ministry of Education and Science of the Russian Federation, 2016; Ministry of Labor and Social Protection of the Russian Federation, 2013). The learner-centered approach (Yakimanskaya, 2011) is the basis for building the educational process with a focus on active student's participation in the development of professional competencies when mastering the algebra course.

3. Results

To test the effectiveness of the created methodology for developing professional competencies when teaching algebra to first-year students at a pedagogical university, the authors applied the parameters assessing cognitive, value, and activity-related characteristics proposed by researchers (Zenawi et al., 2012; Jonane, 2015) as the components of a student's personal culture.

To measure the cognitive component of the mathematical culture of first-year students during the experiment, the authors assessed their grades (according to the results of the winter and summer exams), students' current results (by rating), the results of midterm assessment for each section of the algebra course (computer testing, educational and research work of students, independent work, self-analysis, etc.).

To measure the value component of the mathematical culture of first-year students, the authors assessed students' attitude to the obtained knowledge and skills as a value necessary for future work. For this purpose, the authors applied such methods as conversation, survey, questioning, and self-analysis.

The activity component was established by the learner's inclination to apply the knowledge and skills gained while studying algebra and the skills that make up professional competencies. The evaluation of this parameter was carried through a conversation, a survey, or self-analysis.

Having assessed the cognitive, value and activity components, the authors classified the results according to high, medium and low levels (Table 1). The final stage of the experiment was conducted in the academic year of 2017-2018. The participants were the students studying "Mathematics and Computer Science" (the experimental group) and the students of "Mathematics and Physics" (the control group). While teaching students of the experimental group, the authors applied the proposed methodology for developing professional competencies in the algebra course, whereas in the control group the training was conducted

using traditional methods, without using this methodology.

Table 1
Results of the First-Year Students' Mathematical
Culture Components Assessment

Components	Experimental Group			Control Group		
	Levels (%)			Levels (in %)		
	High	Mid	Low	High	Mid	Low
Cognitive component	31.8	68.2	-	25.7	62.1	12.2
Value component	30.8	70.2	-	20.8	66.8	12.4
Activity component	26.5	72.4	1.1	19.4	69.8	10.8

Source: Compiled by the authors

The data presented in Table 1 show that in the experimental group 31.8% of students had a high level and 68.92% – the middle level of cognitive component development, compared to 25.7% and 62.1%, respectively, in the control group. The results for the value and activity components in the experimental group are also significantly higher than in the control group. The experimental data demonstrate that the methodology proposed for developing professional competencies influences educational results.

4. Discussion

When developing bachelors' professional competencies, one should consider the training content from two perspectives: the subject of algebra and the constituent professional competencies.

Having analyzed the characteristics of professional competencies of the Federal State Educational Standard of Higher Education for the program "Pedagogical Education", the authors could single out three groups of professional competencies: *learning, personal, and social competencies*. The type of activity and the planned educational results were chosen as the basis for identifying the above groups of professional competencies (Kasparzhak & Kalashnikov, 2014).

Let us briefly describe each group of these competences and highlight the key concepts and the recommended sequence of activities in each of them, taking into account the specifics of studying algebra by first-year students of education. Also, let us consider some methods and techniques for their formation.

To develop the components of *learning competencies*, it seems the most

appropriate and effective to apply the following methods and techniques: a case-study method, techniques for solving contextual and practice-oriented tasks; methods of problem-based learning; games and contests; demonstration of an object in dynamics, a technique for adding emotions to lessons, etc. (Gruzdeva & Smirnova, 2017; Panova, 2016; Perevoshchikova, 2016). As it was shown above, a three-stage structure of a lesson is an important organizational and didactic condition and the method of organizing the educational process aimed at developing the constituent professional competencies of each group.

As an example, let us consider *the method of demonstrating an object in dynamics*. This technique is used at the motivation stage and implies demonstration a model of a real object (a mathematical object, a mathematical situation) on the screen and options for its transformation. The purpose of this demonstration is, on the one hand, to create conditions that help learners identify the contradiction between the theory studied and the lack of necessary practical skills for its application, and on the other hand, to develop the skills required for setting a problem or a learning task.

Let us consider the specifics of using this technique on the example of the topic "Matrices. Elementary transformations of matrices", studied by first-year students of the program 44.03.05 "Pedagogical Education", specialty "Mathematics and Informatics".

Using MathCad program, the teacher demonstrates how to put the matrix to a row echelon form:

$$\text{rref} \begin{pmatrix} 2 & 6 & -9 & 5 \\ 1 & -1 & 2 & 4 \\ 0 & 3 & 2 & 1 \\ -7 & 6 & 3 & 2 \end{pmatrix} \rightarrow \begin{pmatrix} 1 & -1 & 2 & 4 \\ 0 & 5 & 6 & 3 \\ 0 & 0 & -5 & 1 \\ 0 & 0 & 0 & -1 \end{pmatrix}$$

The teacher asks students to identify how many and what transformations were performed to put the matrix to a row echelon form.

The visual representation of the matrix transformation on the screen plays an important motivational role, because the student sees the result, while the method of obtaining it is not evident. Determining the performed transformations, students face a discrepancy between the theoretical knowledge they have about elementary transformations of matrices and the lack of practical skills to apply this knowledge.

Regarding the formation of professional competencies, this technique allows the teacher to involve students in formulating the learning tasks: to establish what operations on the rows and columns of the matrix have been performed in MathCad program to put the matrix to a row echelon form. Thus, students need to comprehend the theoretical facts and focus on the application of individual operations of the developed subject skill of "putting the matrix to a row echelon form", as well as the experience

gained when setting the learning task.

Teaching methods and techniques that involve using software tools for transforming an object and obtaining a quick calculations result when solving educational research problems, as well as the possibility to create their "own" programs for converting an object using modern programming languages meet the considered didactic conditions as they develop all groups of competencies.

The described method of *demonstrating an object in dynamics* should be used when forming competencies not only of the first, but also of the second group. Let us determine the methods that are effective for developing *personal competencies*. These include: the method of drawing up an individual plan for educational and research activities, the project method when support is provided to students in a card containing a list of skills to be formed and the results of the project tasks for the subject.

Social competencies are developed with educational and methodological materials that ensure students' active participation in learning events. Such training activities are aimed at developing skills for predicting and planning actions that are relevant for their future job, communicating in society and a working group, interacting with various representatives of the socio-cultural and professional community, giving self-presentation in the market of educational services, analyzing and interpreting the results of one's activities in the course of algebra.

Such educational events include, for example: a symposium on the evolution of algebra, a business game "I am an algebra teacher", a presentation of creative mathematical ideas, a management game "Assess the teacher's work", a creative workshop "Algebraists".

Conducting such activities when teaching algebra to first-year students, the teacher ensures the integration of subject knowledge with professionally significant competences.

5. Conclusion

In the study the authors described such components as objectives, contents, procedures and results that underlie the methodology for developing competencies when teaching bachelors of "Pedagogical Education". The authors identified the following organizational and didactic conditions for forming their professional competencies:

- 1) the lessons structure should include the motivation-oriented, content-related, and reflexive-evaluative parts relevant to the components of students learning activity;
- 2) information technologies should be used to create a case that allows comparing different points of view, different methods of proof, posing a problem at the motivational stage; to help students solve the case at the content stage; to identify the level of development and understanding of the learning activities, to find errors and give a summary at the reflexive-evaluative stage;

3) the teacher should create conditions for students' active involvement in the educational process while developing their subject knowledge and skills, as well as the components of professional competencies;

4) it is necessary to involve students in creating educational, social, and cultural projects in the digital educational environment as this promotes students' intellectual development and increases their knowledge of IT.

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