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# The modernization project of the mathematics teaching process providing the formation of a personal sense of knowledge for students of non-core areas

## El proyecto de modernización del proceso de enseñanza de las matemáticas proporciona formación de un sentido de conocimiento personal para estudiantes de áreas secundarias

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**ABSTRACT:**

A method for improving the mathematics teaching process is offered with the aim of sense-making activation in class. The topicality of the project is justified by modern requirements of the competence approach to vocational education. The author of the article empirically established difficulties in teaching mathematics at non-core faculties, the reason of which is the students' lack of understanding of the role and place of acquired knowledge, skills and competencies in the process of their own professional development. The article deals with the essential characteristics of the personal meaning of mathematics study in students, reveals pedagogical conditions for the formation of the personal sense of knowledge. A mathematics teaching process model has been developed that provides the development of the sense of mastering a given area of culture; the criteria for the formation and methods of diagnosing levels of the formation of significance of studying mathematics in students of non-core areas are

**RESUMEN:**

Se ofrece un método para mejorar el proceso de enseñanza de las matemáticas con el objetivo de activar los sentidos en clase. La actualidad del proyecto está justificada por los requisitos modernos del enfoque de competencia para la educación vocacional. El autor del artículo estableció dificultades empíricamente en la enseñanza de las matemáticas en las facultades no centrales, debido a la falta de comprensión por parte de los estudiantes del papel y el lugar de los conocimientos, habilidades y competencias adquiridos en el proceso de su propio desarrollo profesional. El artículo trata de las características esenciales del significado personal del estudio de las matemáticas en los estudiantes, revela las condiciones pedagógicas para la formación del sentido personal del conocimiento. Se ha desarrollado un modelo de proceso de enseñanza de las matemáticas que proporciona el desarrollo del sentido de dominar un área determinada de la cultura; Se eligen los criterios para la formación y los métodos de

chosen. The presented project of modernization of the mathematics teaching process that provides the formation of the personal sense of knowledge among students of non-core areas is aimed at actualizing the potential possibilities of the subject "Mathematics" with the goal of forming the professional competence of future specialists and integrating this subject into the integral process of personality development.
**Keywords:** Educational process, educational model, mathematics, personal sense, professional activity.

diagnóstico de los niveles de formación del significado del estudio de las matemáticas en estudiantes de áreas no centrales. El proyecto presentado de modernización del proceso de enseñanza de las matemáticas que proporciona la formación del sentido personal del conocimiento entre los estudiantes de áreas no centrales tiene como objetivo actualizar las posibilidades potenciales de la asignatura "Matemáticas" con el objetivo de formar la competencia profesional del futuro especialistas e integrando este tema en el proceso integral del desarrollo de la personalidad.
**Palabras clave**: Proceso educativo, modelo educativo, matemática, sentido personal, actividad profesional.

# 1. Introduction

The relevance of the study is conditioned upon the contradictions in the theory and practice of teaching mathematics to students of non-major areas. Such are the contradictions between:

- the need for a meaningful attitude of students of non-major areas to the study of mathematics and the inadequacy of the notion of the essence and the criteria for the formation of the purpose of studying mathematics;

– the need to identify and implement the logic of the formation of the purpose of studying mathematics and the lack of a model of the learning process for mathematics that ensures the development of the meaning of this field of culture;

- the need to actualize the psychological mechanisms of the formation of the purpose of studying mathematics and the lack of knowledge about the pedagogical conditions of actualization of meaning formation among students of non-major areas of bachelor's program.

The revealed contradictions allowed formulating the problem of the formation of the meaning of the study of mathematics in students of non-major areas, which formed the basis of this study.

# 2. Materials and methods

The solution to this problem is possible with the introduction of a project to modernize the process of teaching mathematics, which provides the formation of a personal sense of knowledge for students of non-major areas.

The aim of the project is to create the pedagogical conditions necessary for the development of the personal sense of knowledge among students of non-major areas in the process of teaching mathematics.

## Tasks of the project:

1) determine the essential characteristics of the purpose of studying mathematics in students of non-major areas;

2) to develop the criteria for the formation of the personal meaning of studying mathematics;

3) to reveal pedagogical conditions of formation of personal meaning of studying of mathematics at students of non-major areas;

4) to develop a model of the mathematics studying process that provides the formation of the sense of mastering a given area of culture;

5) to select a methodology for diagnosing the personal meaning of studying mathematics in students of non-major areas.

Target group: students of non-major (non-mathematical) areas of bachelor's program.

Main stages of the project and their content:

## I. Preparatory stage:

- studying of philosophical, psychological and pedagogical literature on the research problem; definition of methodological characteristics of the study; generalization of pedagogical experience in teaching student's mathematics.

## II. Substantive stage:

- revealing the pedagogical conditions for the development of the personal sense of studying mathematics in students of non-major areas.

- simulation of the mathematics teaching process, providing the formation of personal sense of knowledge in the field of mathematics.

## III. Final stage:

- development of criteria for the formation of the personal sense of knowledge in future specialists;

- selection of methods for diagnosing levels of the formation of the personal meaning of studying mathematics in students of non-major areas.

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# 3. Results and discussion

Indicative parameters of the project.

- The personal meaning of studying mathematics in students of non-major areas is understood as a subjective reflection in the minds of students of the objective significance of this sphere of education for their professional and personal formation and development realized in an active creative position aimed at acquiring personal and professional experience, solving cognitive-practical problems on the basis of mastering the methods of algebra, geometry and mathematical analysis (Biryukova, 2016, p. 120-122).

- The main characteristics of the personal meaning of knowledge are: the contextuality - the object of reflection is defined through the correlation to the broader integral context of its existence. Intentionality is sensual comprehension of the influence of the process and result of one's activity on other people; subjectivity - the ability to interpret one's being in a general cultural environment; awareness - a meaning is determined through the manifestation of a personal position in the justification of the choice (Biryukova, 2017, p. 115-117).

- The pedagogical conditions for the development of the personal meaning of the study of mathematics in students of non-major areas are:

- the implementation of pedagogical support - as an organization of interaction between participants in the educational process and mutual inclusion in the communication environment, in which dialogue is possible on the meaning and role of mathematics for the graduate of the university (Yakobyuk, 2014, p. 64-65.);
- the activation of reflexive processes, as a result of which meanings are included in the self-regulation of the activity and behavior of the individual (Zeer, 2006, p. 3-9);
- stimulation of subjectivity of the student as a systemic quality of the personality, promoting the realization of self-induced and self-organized activity in the study of mathematics (Yakobyuk, 2014, p. 64-65);
- saturation of the content of the subject "mathematics" with relevant and significant issues of being in the context of the future profession.

- Pedagogical support for the development of the personal sense of study of mathematics in students of non-major areas is achieved by creating such situations that contribute to the formation of meaning in the process of teaching the subject. Such are the situations of a personality-developing character:

- the situation of reconstruction of existing meanings;
- the situation of actualization of the personal meaning of studying mathematics;
- the situation of realizing the personal meaning of studying mathematics;
- the situation of the accumulation of experience of reflection.

- The development of the meaning of studying mathematics is supported by the technology of modeling the relevant situations, which are presented in the technology block of the model, the reflection of which can be seen in Table 1.

- The model of the process of teaching mathematics, which provides the formation of personal sense of knowledge from this field of culture, describes the psychological mechanisms of semantic formation (which will act as reflexive-evaluation experiences) and the stages based on these mechanisms of the formation of the meaning of the study of mathematics (Belyakova, 2008, p. 187-189).

- Psychological mechanisms of semantic formation are the following step-by-step processes of sense formation: 1) the emergence of meaning, 2) own life of meaning in the individual consciousness of the student, 3) exteriorization of the meaning of knowledge in practical activities (Belyakova, 2017, p. 8-12).

- In accordance with the described stages of the formation of meaning and the considered personal-developing situations, the stages of the organization of the process of teaching mathematics, aimed at making sense of studying mathematics in students of non-major areas are distinguished:

1) A stage of activation of reflection, a critical attitude to the existing meanings of studying mathematics. As the goal of the first stage, the formation of a semantic position toward the process of studying mathematics is considered, as a result of the reflection of its educational activity and the reconstruction of motives and meanings. To achieve the stated goal, the following tasks need to be solved: to expand the students' idea of intersubject communications (Vinogradova, 2017, p. 17-25), to activate cognitive interest in the study of mathematics by realizing the significance of the subject material in practical activity; to create a favorable climate for assessing the subjective position of each student. To solve the described problems, the following tools can be used: - filling abstract mathematical concepts with concrete content; solving problems with practical content; creation of the first of the four situations identified above - the situation of reconstructing the existing meanings, which sets a pattern of professional and personal success in studying mathematics. The main psychological mechanism in this type of situation was the identification process. Students identify themselves with successful representatives of the future profession, there is a meaningful adoption of norms and values, among which is knowledge in mathematics (Rubtsov et al., 2014, p. 74; Rogach et al., 2017). The function of the teacher at this stage is to help students in the analysis of existing and necessary knowledge in mathematics to ensure their general cultural and professional competence; analysis and interpretation of their personal experience, disclosure of the purpose and specifics of the study of mathematics; ensuring the emotional attractiveness of the educational material.

2) Pedagogical support of the actualization of the personal meaning of studying mathematics. At the second stage, the primary actualization of meaning in the individual consciousness of students is carried out; accumulation of experience of self-report, reflection of one's activity (Bratus, 1999, p. 18). From the above-mentioned types of situations, the second stage uses the situation of actualization of the personal meaning of studying mathematics, in which, thanks to the psychological process of internalization, students actively engage in a dialogue about the role of mathematics for self-realization and self-assertion in the personal and professional sphere. The teacher involves students in the discussion of value-semantic questions of the importance of mathematics; actualizes ways of applying knowledge of mathematics in solving practical tasks.

3) The stage of stimulating self-realization in the process of teaching mathematics. The goal of the third stage is the realization of meaning as a regulator of activity, as the driving force for determining the student's individual path of studying mathematics, in the context of professional and personal formation. During this stage, it is supposed to solve such problems as the formation of students' readiness to apply knowledge in mathematics in the future

activity, the accumulation of experience of self-report, the reflection of one's activities. To implement the goal of the third stage, methods are used to develop the experience of creative activity - methods activating creative thinking that help develop the ability to solve new problems and promote productive mental activity, a deliberate, conscious search for a solution to the problem, as well as the situation of realizing the personal meaning of studying mathematics.

- The criteria for the formation of the personal meaning of the study of mathematics reflect:

- subjective understanding of the importance of studying mathematics;
- emotionally positive experience of the situation of studying mathematics;
- demonstration of strong-willed effort and satisfaction from overcoming difficulties in this field;
- the formation of an individual approach to the study of mathematics;
- the stability of the semantic position, the degree of "getting" the meaning (Novakova, 2011, p. 34).

- For each criterion, a certain level of formation of the personal meaning of studying mathematics is distinguished. The first level is a low level of the formation of the personal sense of knowledge - a formal relation to mathematics. The second level - an average level of the formation of the personal sense of knowledge - a positive amorphous attitude to mathematics. The third level - a high level of the formation of the personal sense of knowledge - an actively cognitive attitude to mathematics. The fourth level of the formation of the personal sense of knowledge - the highest level - the value-semantic relation to mathematics (the characteristics of the levels of the formation of the personal meaning of studying mathematics in students of non-major areas according to a given criterion value are given in Table 2).

- Diagnosis of the formation of the meaning of studying mathematics will be carried out on the basis of comparison and analysis of the results of different types of methodologies (direct and indirect) by the following criteria:

- the nature of the activities of students in the process of performing practical tasks in mathematics (creative, active, situational-active, passive)
- the desire to perform optional, additional tasks (always, sometimes, never)
- the preferable selectivity of the individual stages of the lesson (the formulation of theoretical positions, the solution of problems on the model, the solution of problems of increased complexity)
- enthusiasm, emotional lift in the process of studying mathematics (positive emotions, passivity, negative emotions)
- quality of knowledge (excellent, good, satisfactory, unsatisfactory)
- the principle of determining the significance of the process of studying mathematics (egocentric, group-centric, prosocial)
- the experience in reflection of learning activities in mathematics (yes, no).

**Table 1**

Process of formation of personal sense of studying mathematics in students of non-major areas

| Stages | Pedagogical conditions |
|---|---|
| **Stage 1:** stage of activation of reflection and critical attitude to the existing meanings of studying mathematics<br>**Purpose:** a critical analysis of the existing meanings<br>**Pedagogical support:** modeling the situation of reconstruction of existing meanings<br>**Technologies:** contextual training, reflection | - saturation of the content of the subject with the contexts of professional and socially significant activities;<br>- activation of reflexive processes |
| **Stage 2:** stage of pedagogical support of actualization of the personal meaning of studying mathematics<br>**Purpose**: actualization of personal meaning | - Inclusion in the dialogue about the meaning and role of mathematics in the professional and personal sphere;<br>- activation of reflexive processes |

| | |
|---|---|
| **Pedagogical support**: modeling the situations of actualization of personal meaning<br>**Technologies**: interactive training, reflection | |
| **Stage 3:** the stage of stimulating self-realization in the process of studying mathematics.<br>**Purpose**: realization of personal meaning<br>**Pedagogical support**: modeling the situation of students' self-realization in the creative process of studying mathematics<br>**Technologies**: project training, reflection | - stimulation of students' subjectivity;<br>- activation of reflexive processes |

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**Table 2**

Levels of formation of the personal meaning of studying mathematics among students of non-major areas

| Criterion | 1st level | 2nd level | 3rd level | 4th level |
|---|---|---|---|---|
| Subjective understanding of the importance of studying mathematics | Does not want to study mathematics (I do not want, I have to) | Tries to study mathematics (I do not mind) | Consciously studies mathematics (It is necessary, I try) | Consciously desires to study mathematics<br>(I want, I can) |
| Emotional attitude to the process of studying mathematics | Negative feelings predominate or indifferent | positive feelings are observed rarely, often without emotion, calm | Positive feelings predominate, althoug it is subjected to mood changes,<br>dynamic | Positive feelings prevail, the mood is upbeat, active |
| Demonstration of a strong-willed effort and satisfaction from overcoming difficulties | Low level of activity,<br>bad attendance | There is no strong-willed effort to overcome difficulties, "cliched" way of solving tasks | activity in the performance of familiar tasks, a sense of satisfaction | Creative approach to the performance of tasks, a sense of satisfaction |
| Formation of an individual approach to the study of mathematics | no individual approach to the study of mathematics | search for an individual approach to the study of mathematics | Individual, but not systematic approach to the study of mathematics | individual system of work on the study of mathematics |
| The stability of the semantic position, the degree of "getting" the meaning | There is no sense in studying mathematics | Situational attribution of meaning | Personal attribution of meaning | Personally significant attribution of meaning |

# 4. Conclusions

Actualization of the potential possibilities of the subject "Mathematics" is caused by the need to form the professional competence of future specialists. This requirement will be facilitated

by a critical analysis of the available motives and incentives for studying mathematics and the formation of a personal-creative sense of studying mathematics in students of non-major areas.

The implementation of the proposed project to modernize the process of teaching mathematics, aimed at improving the quality of teaching the subject, in teaching and educational activities, creates the conditions for the integration of this subject into a holistic process of personal development.

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