ПЕДАГОГІЧНА АКАДЕМІЯ:
НАУКОВІ ЗАПИСКИ

ТЕОРІЯ І МЕТОДИКА ПРОФЕСІЙНОЇ ОСВІТИ

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Culture of a mathematics teacher: structure and derivative formations

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Abstract. *The* ***purpose*** *of the article is to reveal the essence and structure of the concept of "a mathematics teache's culture" based on the analysis of the psychological and pedagogical literature on the research problem. The main* ***research methods*** *are analysis of scientific sources, systematization of data, generalization of pedagogical experience on the investigated problem; observation, comparison, analysis of the obtained results. In* ***the results*** *of the study, various approaches to defining the concepts of "culture" and "personal culture" were analyzed. An analysis of scientific sources was carried out in order to reveal the essence of the mathematics teacher's culture, its structure and derivative formations. It is suggested that the culture of a mathematics teacher should be understood as the level of personality development of a teacher serving – a subject of social activity, which is focused on the education of students and the teaching of subjects in the field of mathematical education. The main components of the phenomenon of the culture of a mathematics teacher are defined, including professional, pedagogical, psychological, intellectual, mathematical,*

informational and general culture of a specialist. Attention was drawn to the main purpose of general culture: to unite all types of a mathematics teacher's culture into a single formation. It is noted that each of the listed characteristics of a specialist's personality has a general and a special part. An example of the successful practice of implementing a culturological approach in the organization of teacher training is given – the use in the educational process of the author's course "Professional culture of a mathematics teacher", the purpose of which is to increase the level of professional and general culture of mathematics teachers, and develop their professional and cultural competences.

***The conclusions** indicate that an integral approach to defining the culture of a mathematics teacher is the most favorable for establishing relationships and interdependencies between its structural components, as well as further scientific research regarding the spread of a culturological approach in matters of improving the qualifications of mathematics teachers is considered relevant today.*

***Keywords**: culture of a personality; mathematics teachers; culturological approach; postgraduate pedagogical education; professional development of teachers.*

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Культура вчителя математики: структура та похідні утворення

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Анотація. Мета *статті полягає у розкритті сутності та структури поняття «культура вчителя математики» на основі аналізу психолого-педагогічної літератури з проблеми дослідження. Основні* ***методи*** *дослідження – аналіз наукових джерел, систематизація даних, узагальнення педагогічного досвіду на досліджувану проблему; спостереження, порівняння, аналіз отриманих результатів. У* ***результатах*** *дослідження проаналізовано різні підходи до визначення понять «культура» і «культура особистості». Проведено аналіз наукових джерел щодо розкриття сутності культури вчителя математики, її структури та похідних утворень. Запропоновано під культурою вчителя математики розуміти рівень розвитку особистості вчителя – суб'єкта соціальної діяльності, що орієнтована на виховання учнів та навчання предметів математичної освітньої галузі. Визначено основні складові феномену культури вчителя математики, серед яких професійна, педагогічна, психологічна, інтелектуальна, математична, інформаційна та загальна культура фахівця. Звернено увагу на головне призначення загальної культури – об'єднати між собою всі види культури вчителя математики в єдине утворення. Зазначено, що кожна із перерахованих характеристик особистості фахівця має загальну і спеціальну частини. Наведено приклад успішної практики впровадження культорогічного підходу в організацію підвищення кваліфікації вчителів – використання в освітньому процесі авторського курсу «Професійна культура вчителя математики», метою якого є підвищення рівня професійної та загальної культури вчителів математики, розвиток їхньої професійної й культурної компетентностей.*

У ***висновках*** *зазначено, що інтегральний підхід до визначення культури вчителя математики є найбільш сприятливим для встановлення взаємозв'язків і взаємозалежностей між її структурними компонентами, а також нині актуальними вбачаються подальші наукові пошуки щодо поширення*

культорологічного підходу в питаннях підвищення кваліфікації вчителів математики.

Ключові слова: *культура особистості; вчителі математики; культорологічний підхід; післядипломна педагогічна освіта; підвищення кваліфікації вчителів.*

A general statement of the problem and its connection with important scientific or practical tasks (Introduction). A modern mathematics teacher acts as a carrier of the cultural and spiritual content of education, and not just a teacher of a certain educational subject. He must freely and quickly integrate into the global socio-cultural space and adapt to the changes that constantly accompany pedagogical activity. All these qualities are to some extent formed in future specialists during the acquisition of basic pedagogical education in institutions of higher education. At the same time, post-graduate pedagogical education is equally important for the development and formation of the teacher's culture, where progressive harmonious development of the personality continues.

A detailed study will include the definition of the concept of "the culture of a mathematics teacher" from the standpoint of an integrated approach, consideration of individual types of culture in its structure, as well as the presentation of the course "Professional culture of a mathematics teacher" for improving the qualifications of mathematics teachers in general secondary education institutions, which helps to understand the possibilities of implementing a culturological approach in the educational process of institutions of postgraduate pedagogical education.

Analysis of recent research and publications. The works of many modern scientists are devoted to the study and analysis of various types of a teacher's culture, in particular, the following issues were considered: the development of the pedagogical culture of future specialists on the basis of the acmeological approach in institutions of

higher education (A. V. Kelemen [7]), the development of the psychological culture of a future teacher (N. V. Chepeleva [19]), training of future mathematics teachers for the development of the intellectual culture of secondary school students (A. Ya. Klimishyna [8]), the formation of the basics of the professional culture of a mathematics teacher in the process of teaching mathematical analysis (G. O. Mykhalin [12]), the development of pedagogical culture of future mathematics teachers in the context of the implementation of the competence approach (Y. R. Sadikova, O. V. Razumova, R. R. Nasibullov [22]), the development of the information culture as a component of the competitiveness of a modern mathematics teacher (O. S. Povidaichyk, M. M. Povidaichyk, M. I. Glebena [13]), professional and psychological culture as an integrative property of a social worker (V. M. Husak [3]).

Highlighting previously unresolved parts of the overall problem. During the review of modern scientific works it was discovered that the question of the development of the professional culture of a mathematics teacher in the post-graduate period and the peculiarities of the introduction of a culturological approach to the educational process of postgraduate pedagogical education institutions in Ukraine remains insufficiently researched.

Furthermore, for scientific research, a number of objective contradictions remain unresolved between the objective need of the country to update the content, forms and methods of professional improvement of mathematics teachers in the postgraduate period and the imperfection of modernization of this area in the system of postgraduate pedagogical education, as well as the need to take into account the constructive ideas of the European experience on the subject under study and the lack of methodological recommendations regarding the implementation of the best practices in the organization of professional development of Ukrainian specialists.

Taking into account the social importance of school mathematics education and the need to improve the qualifications of Ukrainian mathematics teachers in accordance

with the requirements of the European educational space, the solution of these issues is critically important, which will also contribute to the successful reform of the general secondary education of the country along with the implementation of the ideas of the New Ukrainian School.

Formulation of the article goals (setting the task). The purpose of the article is to reveal the essence and structure of the concept of “a mathematics teacher’s culture” based on the analysis of scientific sources from philosophy, sociology, psychology, and pedagogy.

In accordance with the purpose of the article, the following tasks are formulated:

– to analyze scientific sources on the research problem;

– to find out the structural components of the culture of a mathematics teacher;

– to propose constructive ideas regarding the implementation of the culturological approach in the educational process of postgraduate pedagogical education institutions of Ukraine.

Presentation of the main material of the study with a full justification of the obtained scientific results (Results of the study). A culturological approach in postgraduate pedagogical education plays an important role in the gradual development of the personality of a teacher, who, according to their calling, should strive to carry out training and upbringing of the student youth in the context of social culture and solve the tasks of transferring their achievements from generation to generation. The cultural knowledge and skills of the teacher contribute to the solution of many didactic tasks, the implementation of social (spiritual and cultural) adaptation of students, which is aimed at their active acceptance and assimilation of the values and norms of the school team and promotes their better self-realization.

The cultural wealth acquired by a teacher is embodied in the culture of pedagogical activity (the level of performance of one’s professional duties), in one’s behavior and attitude to the world and oneself. Practice shows that teachers who have

a high level of culture achieve significant results in teaching and educating students and, on the contrary, negative phenomena that, unfortunately, still exit in pedagogical practice, testify to the absence or inadequate level of a teacher's culture. According to V. V. Yagupov, culture "must be the foundation of the teacher's activity and ensure both the improvement of the educational process and the self-improvement of every teacher" [20, p. 148]. Therefore, in accordance with the set goal of our research, there is a need to review different approaches to the interpretation of such concepts as "culture" and "culture of a mathematics teacher".

In the process of studying scientific research sources, it was established that culture is a complex, multifaceted and polyhedral phenomenon. Culture (lat. cultura - upbringing, education, development) is "a set of material and spiritual assets, a combination of characteristic intellectual and emotional features of society, which includes not only various arts, but also the way of life and basic rules of human existence; the system of values, traditions and beliefs. In the narrower sense, it is the sphere of spiritual life, which includes language, upbringing, education, science, literature, and various types of arts; the system of religious beliefs, and political, legal, everyday culture, as well as institutions and organizations that ensure their functioning. At the same time, the concept of "culture" is used to define the level of education, upbringing of a person, the degree of mastery of a certain branch of knowledge or activity (language culture, personal behavior culture, everyday life culture, etc.)" [9, p. 171].

Thus, in numerous interpretations, the phenomenon of "culture" appears as a historically determined level of social development, the individual's creative powers and abilities, expressed in the types of organization of people's lives and activities. From the point of view of philosophy, the function and purpose of the term "culture" is that it serves as a means by which the idea of culture is revealed as the sphere of development of "humanity" and "human nature", "human existence" and "human

beginning in man" – it "contrasts the world of man with the world of nature as exclusively the natural world" [14].

Considering the focus of our research, it is relevant to compare the content of the definition of "culture" and the concepts of "personality", "social", and "society". It is appropriate to distinguish the concept of "culture" according to the criterion of the subject of culture – the culture of personality – and the use of a psychological approach, in addition to the above-mentioned approaches, that indicates the connection of culture with the psychology of people and singles out in it socially determined features of the human psyche: the totality of a person's adaptations to the conditions of one's life [23, p. 46-47], the set of behavior and the way of thinking [24, p. 351], socially standardized behavior, thinking, and feelings of a certain group [25, p. 17]. Psychological definitions of culture, which focus on the learning process, contribute to the teacher's solution of certain problems related to culture at the psychological level.

It should be noted that each of the presented approaches and interpretations do not contradict each other and has its own methodological value depending on the tasks that the researcher sets for himself. From this it follows that whatever approach is used, the definition of culture will be incomplete, as it usually tends to reflect only a certain aspect of culture, and therefore, when establishing its content from the standpoint of one approach, the possibility of using others should not be rejected. Thus, the interpretation of culture as a manifestation of human life, which is expressed in behavior patterns, means and products of activity, in particular ideas, ideals, norms and values [14] leads to an understanding of the specialist's culture through the level of his mastery of a certain field of knowledge and the corresponding type of activity. This makes it possible to determine the culture of a mathematics teacher in direct connection with pedagogical activities aimed at educating a student who is capable of reproducing the socio-cultural experience accumulated by him, and creating new models of cultural activity in the future.

A great responsibility of a teacher to society for education and upbringing of the younger generation is determined by the peculiarities of pedagogical activity, thanks to which the connection of generations is not interrupted. It is difficult to imagine the development of society or an individual without it. In the process of interaction between a teacher and a student, new ideas are born, spiritual and material values are formed, and the creative potential of an individual is realized. The content of pedagogical activity is training and upbringing, education and development of the student youth. Pedagogical activity is "a special type of social activity, which is aimed at transferring the culture and experience accumulated by mankind from the older generations to younger ones, creating conditions for their personal development and preparation for fulfilling certain social roles in society" [4, p. 191].

A teacher's culture can be defined as a substance that does not exist outside of a person; it is a source of human activity, which serves as a measure of the spiritual, moral, professional development of a specialist – a gradual, complex and not always linear progression from a beginner teacher to a true master, serving as a subject of professional activity. In particular, by the culture of a mathematics teacher, we will understand the level of personality development of a teacher as a subject of social activity, which is focused on the education of the student and the teaching of subjects in the field of mathematical education. Let's consider the main components of the phenomenon of "the culture of a mathematics teacher", which include professional, pedagogical, psychological, intellectual, mathematical and general personality culture.

Professional culture is the complex of knowledge, abilities and skills, the mastery of which makes a specialist of each specific type of work a master of his field, who carries out his activities at the level of world standards. Thus, according to M. A. Mykhaskova [11], "the professional culture of a teacher is a set of intellectual, spiritual, creative abilities, qualities and properties of a person and a style of activity, which involves an established way of life and a general culture created on the basis of

general and specific professional knowledge, along with positive experiences that allow individuals to solve professional tasks effectively and qualitatively" [11, p. 30].

G. O. Mykhalin [12] defines mathematical, methodical, pedagogical, psychological, informational, linguistic and moral culture as the main types of professional culture of a mathematics teacher. The research emphasizes that each of them, with the exception of moral culture, consists of a general and a special part, and their content significantly depends on the specifics of the specialist's activity. The scientist reveals the professional culture of a mathematics teacher as a set of his practical, material and spiritual assets that determine the quality of his professional activity.

Professional culture is completely determined by the level of education and upbringing of a person and the level of mastery of the field of activity of a mathematics teacher. An indicator of the professional culture of a mathematics teacher is the level of professional competence development of a specialist, which is "manifested in the ability to perform pedagogical activities at the level of modern requirements, the unity of the theoretical and practical readiness of a teacher to carry out professional activities, the ability to effectively act and efficiently solve standard and problematic situations, which arise in the process of teaching mathematics students" [17].

Pedagogical culture of a person in a general sense characterizes the activity of any person, for example, a manager, parents, etc., related to the education and training of another person. However, as noted by the researcher A. V. Kelemen [7], "from a psychological and pedagogical point of view, in the structure of general culture, it is the pedagogical culture of an individual that is a separate direction and acts as an important component of the professional culture of a specialist" [7, p. 35]. Most scientists, defining the concept of "pedagogical culture of a teacher", mean professional and pedagogical culture, since we are talking about those who are engaged in pedagogical activities at a professional level.

Professional and pedagogical culture includes pedagogical mastery, pedagogical knowledge and skills, desire and need for self-improvement, pedagogical creativity, pedagogical experience, etc. V. O. Sukhomlynskyi, reflecting on the teacher's pedagogical culture, repeatedly emphasized: "This is, first of all, a teacher's deep knowledge of his subject. We believe it is very important for a teacher to navigate the most complex issues of science, the basics of which he teaches at school, in the issues that represent the cutting edge of scientific thought. Pedagogical culture begins with this and is built on it" [18, p. 450].

Modern researchers consider pedagogical culture as an integral quality of the teacher's personality, which projects his general culture into the sphere of the profession, as a synthesis of high professionalism and internal qualities of the teacher. The teacher's pedagogical culture is characterized by both a high level of subject teaching methods and the presence of cultural abilities. Under these conditions, the building blocks of the teacher's pedagogical culture are the following components: high general culture, intellectual culture, language culture, communication culture, appearance culture, etc. [6].

Psychological culture of a teacher begins with the acquisition of psychological literacy (psychological knowledge, skills, abilities) and the formation of psychological competence (on condition of one's practical implementation of these psychological knowledge, skills and abilities) until it becomes a mechanism of personal self-regulation as the main factor in personality development. Psychological culture consists of theoretical and practical ("psychological activity") components; its main aspects are general (necessary for any person) and professional-psychological, which is specific in a certain field of personal activity. From this position, it makes sense to talk about the professional-psychological component of the psychological culture of a specialist teacher who teaches subjects in the field of mathematical education. In particular, "one of the elements is a system of psychological and pedagogical

knowledge. In the general structure of the psychological knowledge of a mathematics teacher, a special role is played by specific psychological knowledge about the peculiarities of the formation of mathematical ideas and concepts, particularly geometric spatial representations or extremely formalized algebraic concepts; knowledge of psychological features of specific mathematical skills acquisition, for example, methods of working on the study of the number system and solving the arithmetic problems “on processes” [22].

The reflective component of a teacher’s psychological culture is of great importance for the successful implementation of professional activity, namely the ability to analyze one’s behavior as well as identify the results of one’s own professional activity and the presence of the necessary professionally important qualities [19, p. 5]. Furthermore, as the researcher V. M. Husak [2] notes, in most scientific studies, psychological culture is mainly reduced to psychological competence, which “presupposes the ability to determine and take into account the age and other individual characteristics of students in the educational process, along with the ability to use strategies for working with students that contribute to the development of their positive self-esteem, self-identity, as well as the ability to form the motivation of students, organize their cognitive activities and the ability to form a community of students in which everyone feels part of it” [15].

Intellectual culture is a characteristic of a person’s activity in the field of thinking during interaction with the surrounding world and other people, which results in the creation of something new on an objective or subjective level. A feature of the intellectual culture of a practicing teacher is “the creation of one’s own creative products – pedagogical innovations” [11]. From this position, it becomes clear the need to base intellectual culture on “knowledge of the laws of logic, the ability to use it in learning reality, along with the ability to make logically based decisions and provide their irrefutable argumentation” [1, p. 25]. The disclosure of the tasks of intellectual

culture is carried out through the development of intellectual abilities, creative professional thinking, erudition, the culture of intellectual feelings, high personal moral qualities and the ability to self-critically evaluate the results of one's own activities.

The components of this phenomenon are the depth, awareness, breadth of cognitive interests and the presence of a personal meaning of cognitive activity; the development of intellectual feelings (love of truth, joy of discovery, etc.), skills and methods of organizing mental activity, peculiarities of the flow of intellectual activity and individual properties of intellectual thinking development, along with the use of creativity in professional activity, respect for intellectual property, as well as practical experience in working with information for the achievement of educational and cognitive, pedagogical and research tasks (real and potential behavior in the information field), in addition the value of information security [3, p. 70].

It is valuable to understand the term "intellectual culture of the future teacher of mathematics" as an integral property of the personality, which is based on the value orientations of society. It is characterized by the speed of information transformation, a combination of general and professional competences, high-level thinking skills (analysis, synthesis, evaluation), intellectual and communicative abilities, on the basis of which it is formed the ability to flexibly respond, adapt to environmental conditions and create new products of pedagogical creativity. A derivative of this concept is "the readiness of a future teacher for the development of the intellectual culture of students" – a complex personality trait, which includes the creation of one's own intellectual culture, the presence of stable motivation for the development of the specified culture in students, the mastery of theoretical knowledge, methods and technologies for the effective implementation of the educational process [8, p. 3].

Mathematical culture is an integral component of the professional culture of a mathematics teacher, the core of his professional activity, which includes knowledge of basic facts from professional mathematical disciplines, general methods of solving

mathematical problems, including methods of proving statements, as well as the essence of mathematical modeling and methods of building mathematical models, along with the examples of important applications of mathematics in various fields of science, technology and life, and the most striking facts from the history of mathematics; apart from knowledge of school mathematics course, its features in different types of secondary educational institutions, logical gaps in the school mathematics course, the reasons for their occurrence and possible means of their elimination, in addition basic mathematical publications (textbooks, manuals, monographs, magazines, etc.) related to the professional activity of a mathematics teacher [12].

A reflection of the level of a teacher's mathematical culture is the acquired corresponding level of a specialist's mathematical competence. Mathematical competence, as M. Niss [21] writes, is the ability to understand, judge, perform and use mathematical activities in mathematical and non-mathematical contexts. Niss lists eight components of mathematical competence. These are: 1) mathematical thinking, 2) placement and solving of mathematical problems, 3) mathematical modeling, 4)mathematical reasoning, 5) presentation of mathematical entities, 6) use of mathematical symbols and formalisms, 7) communication on the subject, about mathematics and with the use of mathematics, 8) the use of aids and tools [21, p. 218]. A condition for effective teaching of mathematics, especially the correct construction of mathematical concepts in the mind of a student, is the integration of educational mathematical (geometric, algebraic, algorithmic, logical) competences of specialists.

A person's *information culture* is understood as a set of qualities that reflect one's knowledge and understanding of information processes in the surrounding world, possession of information means, mastering of systems of moral, ethnic and legal norms, values, attitudes related to information and communication technologies, as well as possession computer literacy. The most important components of a teacher's

information culture, according to M. I. Zhaldak [5], are the following: the ability to define and formulate goals, set tasks, build information models of processes and phenomena being studied, as well as analyze information models using automated information systems and interpret the results obtained; predict the possible consequences of one's decisions, use modern information and communication technologies. At the same time, the ability to organize, systematize, structure data and knowledge, as well as understand the essence of information modeling, methods of presenting data and knowledge is important.

Scientists have identified such components of the information culture of a mathematics teacher as: general education (knowledge and skills of effective use of information; knowledge of the possibilities of computer information technologies; knowledge and understanding of the main areas of application of information technologies in modern society and their development prospects; possession of practical IT application skills); worldview (understanding of the essence of information and information processes, its role in the process of learning about the surrounding reality; a person’s ability to predict the consequences of one’s own actions and subordinate one’s interests to those norms of behavior that must be followed in the interests of the information society); professional (understanding of the goals and directions of application of information technologies in the process of pedagogical activity; skills and abilities to work with IT, as well as with software for special (pedagogical) purposes (standard ICT: the Internet, office applications, electronic educational materials, computer testing systems; computer mathematics systems: Maple, Mathematica, MatLab, Sage; Dynamic mathematics programs: Gran, DG, GeoGebra, etc.) [13]. It should be noted that the information culture of a mathematics teacher, its formation at a high level, is an important condition for the competitiveness of a modern specialist.

Thus, we support the opinion of many scientists that general culture is the core component, due to which all structural components of a mathematics teacher's culture, complementing each other, unite into a coherent hierarchical system and reflect the essence of the concept of "teacher culture" as a set of changing values, orientations, customs, social relations, ideology which are formed and developed throughout the entire professional activity. The significant variety of culture types is explained precisely by the fact that each of them focuses on one specific aspect of the teacher's activity.

Summarizing, we note that it is the complex approach that allows us to define the culture of a mathematics teacher as a complex, integrated, dynamic personality formation, in which qualitative changes occur under the influence of various factors and under certain conditions throughout life and professional activity. Targeted training and continuous development of the teacher as a specialist in the field of mathematics play a leading role in the creation of the culture of the mathematics teacher. The defining characteristics of this pedagogical phenomenon are personal culture and personal self-determination, the culture of life activity and the culture of social existence, along with the culture of intellectual and subject activity.

The introduction of a cultural approach to postgraduate pedagogical education contributes to overcoming the attitude of specialists towards their own culture and its development as a secondary personal characteristic of a modern teacher, and towards culture in general as a subject supplement in teaching mathematics. Among the constructive ideas for solving this issue in practice, we include the implementation of specially developed advanced training courses for mathematics teachers in general secondary education institutions. For example, organized training of specialists takes place on the basis of the Chernihiv Regional Institute of Postgraduate Pedagogical Education named after K. D. Ushynskyi according to the program of the author's courses "Professional culture of a mathematics teacher" (mixed/distance form of

teaching, course volume is 30 hours, 1 ECTAS credit) [16]. The purpose of training is to increase the level of professional and general culture of mathematics teachers, to develop the professional and cultural competence of specialists. The proposed course consists of educational modules for independent study, face-to-face/online communication with teachers for joint work. The combination of individual and group forms of training, the constant feedback supported by the organizers and direct communication between the participants of the educational process provides an opportunity for specialists to develop their own learning trajectory, learn the educational material at a time convenient for everyone, as well as create effective models of one's own professional development.

Conclusions. The analysis of approaches to the definition of the concept of "culture" and its numerous interpretations contributed to revealing the essence of the culture of a mathematics teacher. A comprehensive approach to defining the culture of a mathematics teacher is recognized as the most favorable for establishing relationships and interdependencies between its components. It was established that the general culture of a teacher is directly related to his professional, pedagogical, psychological, intellectual, mathematical, and informational culture.

The leading ideas and principles of the culturological approach implemented in the system of postgraduate pedagogical education of Ukraine are designed to create the necessary basis for the development of the culture of mathematics teachers. In addition, in the conditions of new challenges facing the Ukrainian education system, further scientific research regarding the spread of the culturological approach in the matters of improving the qualifications of mathematics teachers is considered relevant.

The leading ideas and principles of the culturological approach implemented in the system of postgraduate pedagogical education of Ukraine are designed to create the necessary basis for the development of the culture of mathematics teachers. In addition, in the conditions of new challenges facing the Ukrainian education system, further

scientific research regarding the spread of the culturological approach in the matters of improving the qualifications of mathematics teachers is considered relevant.

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