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THE CONTENT OF THE RESEARCH COMPETENCE OF THE FUTURE TEACHER OF MATHEMATICS

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Abstract. The article deals with the preparation of a mathematics teacher for the students research activities. Questioning of students, polls of employers indicate a low level of formation of the research competencies among students and graduates of pedagogical specialties. The relevance of the problem of the research competencies formation in future teachers is obvious.

The analysis of psychological, pedagogical and methodological literature showed that the researchers studying the issues of the competence-based approach in education have different points of view on determining the content of these concepts.

The article presents various interpretations of the concepts of “competence”, “pedagogical competence”, “research competence”, “research competence”.

The study and generalization of work experience shows that the research competencies are acquired by students in the study of most academic disciplines, however, it is the content of mathematics education which a future mathematics teacher receives at a university that is a system-forming factor in the formation of the research competence.

Formation of research competencies of future teacher students is connected, first of all, with the organization of research activities. The category "research activity" is the basis of the concept "research competence". Research competence of a mathematics teacher is defined by us as an important professional quality as an integral part of pedagogical competence, a comprehensive characteristic of the teacher's personality, expressed in a conscious desire for research, cognitive, methodological and analytical activities.

The aim of the article is to determine the content of the teacher's research competence. The components of the research competence of a mathematics teacher are: a set of axiological, methodological, analytical, logical, mathematical, process and communicative competencies.

The article provides the examples of the use of tasks during studying at a university which will help the students to develop some research competencies.

Key words: research competence, competence, research competences, axiological, analytical methodological, mathematical and logical competence, competence approach.

Main provisions

The ideas of competence-based approach in education become a priority in the conditions of modernization of the educational system. One of the main qualities of higher education graduates is competence. The competence approach is reflected in the Law of RK on Education, in the professional standard "Teacher". [1]. These normative documents emphasize the training of competitive staff with professional knowledge, skills, and competencies.

In today's socio-economic realities, there are increasing requirements for professional training of mathematics teachers in the field of research activities, which is an important and significant factor in the formation of research competence.

The genesis of the competence approach in education shows the complexity, ambiguity and multidimensionality of the interpretation of the term "competence" and "competence". There are a huge number of definitions in the literature, revealing the content of different types of competences and competencies.

Research competence of a mathematics teacher is considered as an indicator of professionalism, a condition for development and self-development, the quality of the teacher's personality who has research competences.

Introduction

The peculiarity of the current stage of developing the higher education system in Kazakhstan is characterized by modernization and the search for innovative ways of professional training of pre-service teachers.

The relevance of the problem in forming research competence among future teachers in the university training relates to the requirements of society for a teacher. Nowadays society needs a teacher capable of rethinking his own experience, with high intellectual potential and research interest in innovations, who are willing to form students' research competencies.

However, practice shows that alumni of pedagogical specialties are not ready to conduct independent research. In order to determine students' cognitive motives and students' awareness of research activities, we conducted a survey among 2nd and 3rd-year bachelor students of the northern region studying at the educational program "Mathematics". 246 students took part in the survey. The results of the survey indicate that every third student does not know how the role of research skills is expressed in tailoring professional qualities. More than half of the respondents (63%) pointed to certain aspects of research activities in developing general and subject-specific competencies such as developing, motivational, and professional.

Students define the specifics of research activity as the pursuit of knowledge, in cooperation with a teacher in problem-solving, self-education, and self-realization. 15% of respondents indicated the answer "solving creative, research problems with an unknown solution in advance". Students find that working with scientific literature and self-education are the most important ways of forming research competencies. Only 35 out of 246 North region students being interviewed are currently working on a research project. 80% of students responded that they were not taught to do research work and that they challenge in carrying out research activities.

Surveys and questionnaires of employers, school principals in Kokshetau city and the Akmola region indicate that graduates of the universities have an insufficient level of research skills, and research competence. Thus, today's modern society faces contradictions between the modern school requirements and needs for the teacher possessing research competence and the need to improve teacher training in this direction. This task requires the purposeful developing research competence of

students during their studies at the university and determining the entire spectrum of research competencies of a mathematics teacher.

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Methods and materials

The history of forming the competence approach in education shows the complexity, ambiguity, and multidimensional interpretation of the term "competence" and "competency". The concept of "competence" is closely interrelated and interdependent with the term "competency". It is believed that the American psychologist Robert White was the first to introduce the term "competence" into the scientific literature. In 1959, in his article "Motivation reconsidered: the concept of competence", R. White, explaining the meaning of this term, focuses on the social aspect.

Linguist Noam Chomsky used the concept of "competence" to the theory of language. According to N. Chomsky, competence is the ability to perform language activities in the mother tongue.

The study and analysis of the literature developing the American approach to the formation of competencies indicate that it aims at identifying behavioral characteristics of the individual. If the American school focuses more on people who perform various types of activities, then the English school of competencies is aimed at studying the characteristics of the activity.

The terms "competence" and "competency" were introduced into pedagogical science in the 80-90 years of the twentieth century. The analysis of psychological, pedagogical, and methodological literature has shown that researchers studying the competence approach in education have different points of view on defining these concepts.

Competence as a didactic concept is presented in the concept of Russian scientists A.V. Khutorsky, L. N. Khutorskaya. They distinguish competencies in the following hierarchy:

- key (basic) competencies that relate to the meta-subject content of education;
- general subject competencies that relate to a specific cycle of academic subjects and educational areas;
- subject competencies that can be formed when studying specific academic subjects.

According to A.B. Khutorskoy the key competencies include: value-awareness, general cultural, educational and cognitive, informational, communicative, social and labor, as well as the competence of personal self-improvement [2].

A number of authors view competencies as universal skills, developed as a result of implementing the competence approach (A.N.Tubelskaya, and as the ability to mobilize knowledge, skills and experience in a specific socio-professional situation (E.F.Zeer).

It In order to determine the content of the research competence of pre-service mathematics teachers it is reasonable to consider the works in which the term “competence” is investigated.

The problem of the forming teacher's research competence is explored and reflected in the works of Kazakhstani authors Khan N.N. Sarsenbayeva D.K. Syzdykbaeva A.D., Akzholova A.A., Levchenko T. A., Ageeva L. E., Ushakova N. M. and Alimova Sh. Zh.

Various aspects of the content of the teacher's research competence are considered in the works of Russian authors L.S.Abdulova, E.V.Berezhnova, O.V.Berseneva, L.A.Golub, A.A.Gubaidullina, O.V.zDanovich, E.M.Ibragimova, I.E.Idiatov, E. V. Nabieva, E.L.Makarova, T. Y. Lomakina, Yu.V. Ryndina, V.G.Sotnik.

The authors E.M.Ibragimova, I.E.Idiyatov present research competence as the readiness and ability of an individual to carry out research activities based on the integrative application of value attitudes, personally meaningful knowledge in a particular field, and research skills (the ability to navigate in new situations, set goals and plan activities, put forward and justify hypotheses, choose the most optimal methods for proving a hypothesis, exercise self-control and self-assessment, to present the results of the research) to solve problems of a theoretical and practical nature [3, p.26].

Thus, E.V.Brezhnova claims that the essence of research competence is characterized by implementing educational and research activities by a teacher. Research competence can be formed and developed through active participation in projects and research activities. E.V. Brezhnova perceives research competence as a special functional system of the psyche and an integral set of human qualities associated with it, providing him/her with the opportunity to be an effective subject of this activity [4, p.327].

The author Berseneva O.V. developed a structural model of forming research competencies of pre-service mathematics teachers, determined the levels, identified and described the criteria and their indicators. Research competencies are viewed as an integrative and dynamic quality, which should be considered in two aspects:

- student's willingness to independently master and obtain systematic mathematical knowledge and skills to solve research problems from the school mathematics course (RC-1);
- readiness to organize and implement the research work of students in teaching mathematics (RC-2) [5].

Kazakh scientists N.M.Ushakova, Sh.Zh.Alimova distinguishes an activity component in the content of research competence. They determined the main properties of research competence in professional activity, presented the components and criteria for measuring the research competence of students studying pedagogical specialties. In the article "Structural components of the research

competence of students studying pedagogical specialties", the authors note that "teacher's research competence is a complex object consisting of several interrelated components: value-semantic, motivational, cognitive, activity and reflexive [6].

Syzdykbaeva A.D. notes that research competence is an integral quality of the personality of a future primary school teacher enabling to holistically implement a system of motivational and value attitude to design and organize learning process in primary school as an object of its professional activity by methods of scientific cognition [7].

The analysis of literary sources shows that research competencies are considered in the following contexts:

- As a result of research activities (I.V.Shubina, V.V.Poznyakov, T.A.Levchenko, V.S.Elagina, etc.).

Author T.A.Levchenko considers: "In forming research competence, much attention is paid on activating students' cognitive activity, forming critical thinking, research skills, and abilities, independently analyze and find the right scientifically grounded solution in pedagogical situations arising during the theoretical learning process and pedagogical practice" [8].

V.S. Elagina notes that "research competence is defined as acquiring methodological knowledge and skills, techniques of research activity and manifesting readiness for their use in professional activity [9, p.119].

- It is also viewed as an independent component of education, as a scientific concept has content, structure and properties (A.D.Syzdykbaeva, V.I.Zagvyazinsky, I.A.zImnaya, Yu.V.Ryndina, O.V.Zdanovich, Skorzhnova A.Yu., etc.).

According to O.V.Zdanovich research competence is defined as an integral part of research competency. O. V. Zdanovich identifies cognitive, axiological, and praxiological components in the structure of research competence [10].

Designing the author's model of the process of forming research competencies O.V. Berseneva determined the target, theoretical and methodological, content-based, technological, performance-evaluation components [11].

Skorzhnova A.Yu. in her dissertation work perceives research competencies as integrative qualities of a person, expressed in a conscious willingness and ability to independently do research and show creativity in the professional subject area, aimed at obtaining an adequate result based on the actualizing personal characteristics and experience [12].

Results and discussion

The study and generalization of work experience show that research competencies are acquired by students when studying most academic disciplines, especially the content of mathematical education that a pre-service mathematics teacher receives at a university serves as a system-forming factor in forming research competence.

The specificity of research competence is determined by the peculiarities of the tasks that a mathematics teacher solves in his professional activity. The teacher –researcher should possess a certain level of methodological culture, be able to identify the main features of the object under study, possess the technology of

research activity. The various aspects of research competence discussed above are relevant to all pedagogical specialties. However, we are interested in the components of the research competence of mathematics teachers.

The content of the research competencies of a mathematics teacher was presented in the work of the Russian author Makarova E. L. Research competence is considered as a set of simpler for diagnosis and explicit (expressed, explicit) formation of competencies: analytical, process, heuristic, methodological, communicative, socio-cultural, strategic.

We agree with the point of view of Makarova E. L. however, we believe that the listed competencies do not fully reflect the content of research activities in mathematics lessons. The analysis of psychological and pedagogical literature on the competence approach in training bachelors-pre-service mathematics teachers, the study of methodological literature, regulatory documents regulating the activities of teachers, observation, questioning, enabled to distinguish research competencies, qualities and requirements necessary for developing and forming the content of research competence.

Thus, the components of the research competence of a future math teacher include:

-Axiological competence is the ability to realize the relevance and significance of research activities, showing interest and willingness to be engaged in research, the ability to apply methods for developing students' research competencies.

-Methodological competence includes knowledge of the scientific apparatus, methodology, and methods of research, understanding of the logic of scientific research,

-Analytical competence is based on the competencies mastered by the student to distinguish the main and secondary, essential and non-essential, general and singular, to compare, analyze, synthesize, generalize and draw conclusions.

-Logical competence determines the success of a person's logical actions and gives him the opportunity to "think correctly".

-Mathematical competence is the ability to apply mathematical apparatus to solve professional problems, a systemic attribute of the personality, characterizing his deep knowledge in the subject area, personal experience aimed at prospects in work which is open to dynamic enrichment, able to achieve significant results and quality in mathematics.

-Process competence is the ability to follow the determined research algorithm and to control intermediate results

-Communicative competence enables to competently formulate and effectively solve various communicative tasks, to communicate with other subjects effectively, includes the discussion skills on research topics.

All the above-listed competencies are acquired while studying academic disciplines, however mathematical disciplines act as system-forming subjects.

Let us consider several examples of the formation of individual research competencies in the process of solving mathematical problems. For example, process competence enables to control of intermediate research results, while the

basis of this competence is formed due to elementary mathematical tasks that require solving math tasks according to specific familiar algorithms and formulas.

Thus, when studying the discipline "Mathematical Analysis", students were offered tasks in which they made mistakes due to the algorithmic approach to calculating the integral. After analyzing the results, students were offered more specific tasks:

Task 2. Find the error in calculating the integral

$$\int_{-1}^{2} \frac{dx}{(3x+1)^2} = -\frac{1}{3(3x+1)}\Big|_{-1}^{2} = -\frac{3}{14}$$

(As a result of calculating the integral of a positive function, a negative number was obtained, which indicates an error).

Task 4. Calculate:

а) $\int_{-4}^{2} \frac{dx}{\sqrt{x+5}}$; б) $\int_{-3}^{-2} \left(\sqrt{x+1}\right)^2 dx$.

The proposed integrals cannot be calculated due to the fact that there is no integrand function at each point of the integration limits.

It should be noted that, based on the geometric meaning of the integral, sometimes it is possible to determine a simpler way to calculate integrals.

The use of such mathematical tasks in studying the discipline "Mathematical Analysis" contributes to the formation of process competence, which is an integral part of research competence.

One of the significant ways of forming logical competencies is the search for patterns in solving tasks.

Each complex task is a kind of research in which require finding any patterns. When studying the discipline "Methodology of scientific and pedagogical research", students were offered to solve mathematical tasks which pushed them to search for patterns. The following task can be considered:

Problem 3. There are 16 positive numbers written on the board, not exceeding 1000. At each step, the following operation is allowed: erase any two numbers a and b and write numbers instead of them

$\sqrt{\frac{3a^2+4b^2}{5}}$ и $\sqrt{\frac{\left|4a^2-3b^2\right|}{5}}$. Prove that using only these operations it is impossible to get a number greater than 2015 on the board.

Solution. The search for a pattern in this problem leads to the search for an invariant of this problem:

$$\left(\sqrt{\frac{3a^2+4b^2}{5}}\right)^4 + \left(\sqrt{\frac{\left|4a^2-4b^2\right|}{5}}\right)^4 = \left(\frac{3a^2+4b^2}{5}\right)^2 + \left(\frac{4a^2-3b^2}{5}\right)^2 = a^4+b^4.$$

Thus, the sum a^4+b^4 is an invariant of the problem. Since all numbers do not exceed 1000, then

$a^4+b^4 \le 2\cdot(10^3)^4 = 2\cdot 10^{12}$,

т.е.

$a^4+b^4 \le 2\cdot 10^{12}$.

If any number a after the conversion turned out to be greater than 2015 (i.e.), $a \geq 2016$), then we would get the inequality

$2 \cdot 10^{12} \prec (2{,}016 \cdot 10^3)^4 + b^4$,

which contradicts inequality (1). Therefore, it is impossible to get a number greater than 2015.

Solving such tasks plays a crucial role in forming logical competence of pre-service mathematics teachers, in addition, such tasks trains pre-service mathematics teachers to fulfill the requirement providing with proper argumentation.

What are the steps of solving such mathematical tasks?

To do this, it is necessary to: a clear theory-based representation, usage of simple and clear scientific constructions, and visual clarity of concepts ensure effective scientific teaching.

Searching for relationships between formulas and properties indicates a desire to explore.

Conclusion

Summarizing various points of view, we came to the conclusion that research competencies are a set of professional and personal qualities necessary for the implementing research activities. The formation of research competencies of pre-service teachers is mainly connected with the process of organizing research activities. The category "research activity" bases on the concept "research competence". We define the research competence of a mathematics teacher as a professionally significant quality, as an integral part of pedagogical competence, as an integral characteristic of a teacher's personality, expressed in a conscious readiness for research, cognitive, methodological and analytical activities.

This study considers research competence as a result of research activity, as a focus on solving research problems, as the ability to put into practice axiological, analytical, methodological, logical, process, communicative competencies, as technological skills, the ability to use mathematical apparatus to solve research problems.

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МАТЕМАТИКА МҰҒАЛІМІНІҢ ЗЕРТТЕУ ҚҰЗІРЕТТІЛІГІНІҢ МАЗМҰНЫ

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Аңдатпа. Мақалада математика мұғалімінің оқушыларды зерттеу қызметіне дайындаудың мәселелері қарастырылады. Студенттердің сауалнамасы, жұмыс берушілердің сауалы педагогикалық мамандықтардың білім алушылары мен түлектерінің зерттеу құзыреттіліктерінің қалыптасуының төмен деңгейін көрсетеді. Ол болашақ мұғалімдердің зерттеу құзіреттілігін қалыптастыру мәселесінің өзектілігін айқындайды.

Психологиялық-педагогикалық және әдістемелік әдебиеттерді талдау барысы білім берудегі құзыреттілік мәселелерін зерттейтін зерттеушілердің осы ұғымдардың мазмұнын анықтауда түрлі көзқараста екендігін көрсетті.

Мақалада "құзыреттілік", "педагогикалық құзыреттілік", "зерттеу құзыреттілігі" ұғымдарының әртүрлі түсіндірмелері берілген.

Жұмыс тәжірибесін зерттеу және жалпылау студенттердің зерттеу құзіреттіліктерін көптеген оқу пәндерін оқу кезінде алатындығын көрсетеді, алайда болашақ математика мұғалімінің университетте алған математикалық білім мазмұны зерттеу құзіреттілігін қалыптастырудың жүйелік факторы болып табылады.

Болашақ мұғалім болатын студенттің зерттеушілік құзіреттілігін қалыптастыру, ең алдымен, ғылыми-зерттеу қызметін ұйымдастырумен байланысты. «Ғылыми-зерттеу қызметі» категориясы «зерттеу құзыреттілігі» ұғымының негізінде жатыр. Математика мұғалімінің зерттеу құзіреттілігін біз маңызды кәсіби сапа ретінде, педагогикалық құзіреттіліктің ажырамас бөлігі ретінде, зерттеу, танымдық, әдістемелік және аналитикалық

қызметке саналы түрде ұмтылыста көрінетін мұғалімнің жеке басының жан-жақты сипаттамасы ретінде анықтаймыз.

Мақаланың мақсаты-мұғалімнің зерттеу құзіреттілігінің мазмұнын анықтау. Математика мұғалімінің зерттеу құзіреттілігінің құрамдас бөліктері: аксиологиялық, әдіснамалық, аналитикалық, логикалық математикалық үдеріс және қатысымдық құзіреттіліктер жиынтығы.

Мақалада университеттегі оқу кезінде студенттердің зерттеу құзыреттілігін қалыптастырудың кейбір түрлерін дамытуға арналған тапсырмаларды қолдану мысалдары келтірілген.

Тірек сөздер: зерттеу құзыреттілігі, құзыреттілік, зерттеу құзыреттер, аксиологиялық, аналитикалық, әдіснамалық, математикалық және логикалық құзыреттер., құзыреттілік тәсіл.

СОДЕРЖАНИЕ ИССЛЕДОВАТЕЛЬСКОЙ КОМПЕТЕНТНОСТИ УЧИТЕЛЯ МАТЕМАТИКИ

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Аннотация. В статье рассматривается вопросы подготовки учителя математики к исследовательской деятельности учащихся. Анкетирование студентов, опросы работодателей свидетельствуют о низком уровне сформированности исследовательских компетенций у обучающихся и выпускников педагогических специальностей. Актуальность проблемы формирования исследовательских компетенций у будущих учителей очевидна.

Анализ психолого-педагогической и методической литературы показал, что исследователи, изучающие вопросы компетентностного подхода в образовании имеют различные точки зрения на определение содержания этих понятий.

В статье представлены различные трактовки понятия «компетентность», «педагогическая компетентность», «исследовательская компетентность», исследовательская компетенция».

Изучение и обобщение опыта работы показывает, что исследовательские компетенции приобретаются студентами при изучении большинства учебных дисциплин, однако, именно содержание математического образования, которое будущий учитель математики получает в вузе, является системообразующим фактором формирования исследовательской компетентности.

Формирование исследовательских компетенций студентов-будущих учителей связано, в первую очередь, с организацией исследовательской деятельности. Категория «исследовательская деятельность» лежит в основе понятия «исследовательская компетентность». Исследовательская компетентность учителя математики определяется нами как важное профессиональное качество, как неотъемлемая часть педагогической компетентности, комплексная характеристика личности учителя, выражающаяся в сознательном стремлении к исследовательской, познавательной, методической и аналитической деятельности.

Целью статьи является определение содержания исследовательской компетентности учителя. Составляющими исследовательской компетентности учителя математики

являются: совокупность аксиологической, методологической, аналитической, логической математической процессной и коммуникативной компетенций.

В статье приведены примеры использования задач во время обучения в вузе, для развития у студентов некоторых компетенций исследовательской компетентности.

Ключевые слова: исследовательская компетентность, компетенция, исследовательские компетенции, аксиологические, аналитические, методологические, математические и логические компетенции, компетентностный подход.

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