

ANNOTATION

to dissertation work of Gavrilova Yekaterina Nikolayevna on «Systematic and methodological support of innovative orientation in the process of teaching mathematical disciplines at universities», presented for the degree of Doctor of Philosophy (PhD) in specialty 6D010900-Mathematics.

Relevance of the research. One of the main tasks of forming an effective society today is modernization of the education system. The article “Looking into the future: Modernization of public consciousness” by Yelbassy Nazarbayev N.A. states that “Every citizen of Kazakhstan must understand that education is the most fundamental factor for success in the future... In the system of youth priorities, education should come first. If education becomes the main value in the system of values, then the nation will be successful”.

The Republic of Kazakhstan is on the path of modern education development, where modernization of public consciousness takes a leading position. Modern society requires new socio-psychological standards of behavior for citizens of Kazakhstan with preservation and high importance of national identity, cultural context, model of self-development, self-education and a successful creative personality based on the highest professionalism, competence, education, and increasing role of family potential.

Thus, fundamentally new approaches have become the main modernization of education in Kazakhstan, the main of which is renewal of secondary education content. Qualitatively new requirements are imposed on teachers’ professional competence in the context of renewal of secondary education content. A teacher becomes the main figure in implementation of changes.

One of the objectives of the updated content of rising generation education, under the “Ruhani zhangyru” program of public consciousness modernization, is forming of information literacy and motivational space that guarantees development of talent, leadership skills and intellectual capabilities of each person. Within this context, the mechanism for implementing this direction is inclusion of scientific innovations, digital technologies, new techniques, mathematical modeling in education programs.

Due to introduction of the updated secondary education content in Kazakhstani schools, the issue of improving methodological training of future mathematics teachers at universities becomes topical. Thus, teaching mathematical disciplines in a pedagogical university faces a number of difficulties, which will be discussed in this dissertation research.

The effectiveness of Kazakhstani school renewal depends on the level of understanding the main ideas of innovative processes by teachers and on readiness to implement these changes. In these conditions, the degree of responsibility at training future teachers, and in particular teachers of mathematical disciplines, is increasing. The role of universities is to promptly respond to renewal of the secondary education content. The problem of training of future mathematics teachers

at universities is solved by development of educational programs focused on training of new format teachers.

Teaching and training of future mathematics teachers is extremely important at the moment. The widespread getting of digital educational technologies and scientific methods into all areas of our human life and into all specialties required a general increase of school teaching level, and, in particular, improvement the training of future mathematics teachers. This has led to the fact that universities of almost all profiles make especially serious demands on mathematical training of prospective students, i.e. upon admission to university the applicant takes the Unified National Testing (UNT), which necessarily includes the subject “Mathematical Literacy”. Only highly qualified teachers can guarantee teaching mathematics at secondary school at a high level. Hence, successful methodological preparation of future mathematics teachers and teaching of mathematical disciplines in accordance with modern requirements at a pedagogical university is the guarantee of a high level of mathematics training for secondary school students, and therefore university students, and as a result, future builders, architects, engineers, metallurgists, etc.

As the analysis of the literature on the research problem has shown, systematic and methodological support of future mathematics teachers training in the context of innovative orientation is an integrative characteristic that includes certain components. The main component of the activity of a mathematical disciplines teacher is his/her methodological preparation, especially characteristics of his/her work with mathematical content (Moro M.I., Kolyagin Yu.M., Abylkassymova A., Nugussova A., Seitova S.M., etc.).

The modern stage of Kazakhstani education modernization demands higher standards for teachers professional training, for mastering the latest teaching methods and technologies. This requires, on the one hand, new and more effective ways of organizing educational process in universities, in particular, modernization of the structure and the content of methodological training for students. On the other hand, the very concept of “professional pedagogical activity of a teacher” is currently undergoing certain changes.

According to some scientists, presence of systematic and methodological support in teaching mathematical disciplines is an important pedagogical condition for effectiveness of the learning process, which sets creative environment for personality development of future mathematics teachers and their professional formation (Lyzhin A.I., Khutorskoy A.V., Kaskatayeva B.R., Kadirbayeva R.I.).

Currently, there is a large number of studies devoted to the problem of methodological training of future mathematics teachers in a pedagogical university. For instance, the monograph by Stefanova N.L. and Podkhodova N.S. present the theoretical aspects of modern methodological system of mathematical education development. Pyskalo A.M. introduces in his research the concept of “methodical system of teaching mathematics”, including such components as goals, content, methods, forms and means. Snegurova V.I. developed in her dissertation research the criteria for methodological system effectiveness.

Abylkassymova A.Ye. states in her research that “Modern conditions set new challenges for school education, in particular for mathematics education, which

should provide every student with an opportunity to achieve the required level of mathematical knowledge. In this regard, the content of mathematics education in pedagogical universities should be aimed at implementing the principle of continuity of studying the course of mathematics, in other words, represented by related sections of mathematics, including integration with methodological disciplines, which will significantly improve the quality of professional training of future mathematics teachers”.

Problems of training of future teachers and the content of mathematical disciplines are reflected in many national and international researches, for instance, in the work of Tatto M.T., Rodriguez M.C., Reckase M., Sarantseva G.I., Fridman L., Pototskiy M.V., Kastayeva B.R., Abylkassymova A.Ye., Kagazbayeva A.K., Satybaldiyeva O.S., etc.

In the tutorial “Didactic foundations of teaching in higher education institution” Abylkassymova A.Ye. notes that the key figure in mathematical education of students is a modern teacher who has sufficient basic and applied knowledge, who uses modern innovative technologies in his/her work and, above all, who loves mathematics and is able to solve mathematical problems and interested in success of his/her students.

In the context of modernization of the educational process, the implementation of the funding concept (from German word "Fundierung" - justification, foundation) and visual modeling in professional training of future mathematics teachers and their formation as teachers introduces significant imperatives in the content of mathematical education in the context of innovative activities.

Therefore, mathematical education at a pedagogical university should educate future teachers with necessary mathematical apparatus used in various fields, equip them with a system of mathematical methods for perception of the world around us and provide understanding the scientific foundations of the school mathematics course.

The geometry course is of a particular importance, according to Professor Tomsy G.V., who for many years (1992-2005) was a specialist (of the highest category P-5) of the UNESCO Education Sector, in the following terms:

“The process of modern scientific knowledge is formed through construction of models, and real theoretical knowledge is based on an axiomatic approach. Therefore, mathematical education should give a concept of the axiomatic method of making scientific theories and put it down to the mathematical modeling method.

In this respect, the Euclidean geometry is of special interest. The study of axiomatic construction of at least the school plane course (plane geometry) serves as the basis for understanding the logic of making any developed scientific theory. At the same time, elementary geometry is an example of the mathematical model of spatial properties and relationships of the world around us.

Indeed, surrounding real objects give us an idea of geometric lines and shapes, but unlike them, geometric lines and shapes are ideal."

Kagazbayeva A.K. described in her dissertation research the contradictions between the need to develop the system for training specialists-teachers of a new type and the insufficient development of didactic problems of training future mathematics

teachers, between the objective needs and competitive teachers of general education schools, including new types of schools, and the level of readiness of mathematics teachers for perfect methodological creativity and research in the field of mathematics. In her work, she developed the concept of methodological training of a mathematics teacher at a university as an integral system, proposed the methodology for effective management of professional and methodological training of a mathematics teacher, aimed at developing methodological culture of students, and prepared the system of educational and methodological tasks in the theory and methodology of teaching mathematics, aimed at forming students' creative independence, taking into account their individual capabilities and abilities.

Despite the huge number of scientific research works of methodological scientists, the issue of improving teaching mathematical disciplines in the universities of the Republic of Kazakhstan considering the updated content of education remains open.

In the course of the analysis of different literary sources on the problems of systematic and methodological support of teaching mathematical disciplines in the context of innovative orientation and the effectiveness of methodological training of mathematics teachers at a pedagogical university, the following **contradictions were** revealed:

- between the social order of the society, formulated in the requirements of the modernization concept of Kazakhstani education and the **need to** improve the level of professional training of a mathematics teacher at a university;

- between the **objective** results of pedagogical research of innovative processes in teaching mathematical disciplines and the existing system of methodological training of a mathematics teacher, in most cases, through traditional teaching approaches;

- the process of modernization of the content of higher pedagogical education is **slowed**, there is a tendency to keep traditional approaches to selecting the content of academic disciplines, as well as an obvious shortage of methodological ideas which can assess adequately the challenges of nowadays.

The stated contradictions became the reason for choosing the research theme, which consists in theoretical substantiation of existing skills and the results of scientific research in the field of pedagogy, psychology and methodology of teaching mathematics and their optimization, as well as revealing the required conditions to improve methodological training of future mathematics teachers in the conditions of innovative orientation. Insufficient research of the problem of the methodology for making systematic and methodological support in the process of teaching mathematical disciplines, adaptation of unified training of future mathematics teachers to professional activities and establishment of suitable solutions have determined the choice of the problem of the dissertation "**Systematic and methodological support of innovative orientation in the process of teaching mathematical disciplines at a university.**"

The purpose of the research is scientific substantiation of the methodology for making systematic and methodological support when teaching mathematical disciplines at a university based on funding innovative concept.

The object of the research is the process of teaching mathematical disciplines in the system of higher pedagogical education in the conditions of innovative orientation.

The subject of the research is system of methodological support at teaching mathematical disciplines.

The hypothesis of the dissertation research: if you teach students according to the developed scientifically-based methodology, taking into account the model of systemic and methodological support of the educational process, considering the funding innovative concept, **it is possible** to ensure a sufficient level of professional and methodological training of a future mathematics teacher, which will contribute to fundamentalization of methodological and mathematical training, improving the quality of professional training of future mathematics teachers at a pedagogical university.

Based on the purpose and hypothesis of the research, the following **research objectives** were set:

1. To reveal psychological and pedagogical features of training future mathematics teachers based on modern requirements;
2. To define the problems of modernization of mathematics education, the mechanisms of their solution in accordance with the funding concept;
3. To develop a model of systematic and methodological support at teaching mathematical disciplines in the conditions of innovative orientation;
4. To check experimentally the ways of implementing the systemic and methodological support of innovative orientation in teaching mathematical disciplines at a university.

The leading idea of the research is an in-depth study of the theoretical foundations of the research of innovative orientation in teaching mathematical disciplines, as well as the development of a model of system and methodological support and its implementation in the educational process for effective training and professional development of future teachers of mathematics.

To achieve the goal and solve the set tasks, the following **research methods** were used, consisting in their interrelated and interacting implementation principles:

- scientific methods of theoretical research: collecting and analysis of theoretical material on the problem of providing innovative orientation in the process of teaching mathematics at a university, as well as study of mathematical, psychological, pedagogical and methodological literature on the basis of educational standards, curricula, textbooks, teaching aids and teaching - methodological complexes, studying the experience of teachers of mathematical disciplines, the method of classification and generalization of the results attained;
- methods of social research: attending classes of teachers of mathematical disciplines, oral and written surveys of teachers, students, undergraduates, doctoral students and school teachers, questionnaires, testing;
- methods of empirical research: making pedagogical experiments to confirm the hypothesis of the research, analysis and processing of experimental activity using the statistical research methods.

The theoretical and methodological basis of the research was formed by the following approaches:

- *the problems of formation and development of innovative activity of teachers* - V.A. Slastenin, N.R. Yusufbekova, V.D. Shadrikov, E.G. Leontyeva, E.I. Smirnov, O.P. Podosinnikova, E.M. Rogers, E. Brausuik, A. Bill, E. Bolen.

- *the fundamental works of teachers, psychologists, mathematicians - methodologists on the methodology, theory and practice of training and innovative activities of future teachers* - K.D. Ushinskiy, Ya.A. Komenskiy, J. Bruner, B. Bloom, L.S. Vygotskiy, S.L. Rubinstein, G.V. Tomskiy, V.D. Shadrikov, D. Rakhymbek, A.E. Abylkassymova, B. Baimukhanov, S.E. Shakilikova, S.S. Maussymbayeva, E.U. Medeuov, I.S. Sabyrova, A.A. Moldazhanova, G.R. Alimbekova and others;

- *research on didactic and methodical preparation of future teachers of mathematics are reflected in the works of* A.E. Abylkassymova, L.M. Fridman, V.M. Monakhov, Z.I. Yansufin, A. Nugussova, B.R. Kaskatayeva, A.K. Kagazbayeva, S.M. Seitova, O.S. Satybaldiyev, Kh. Azimehsadat, I. A. Mendes.

- *the issues of using innovative technologies in teaching mathematical disciplines* are reflected in the scientific works of G.I. Sarantsev, M.V. Pototskiy, G.M. Berkimbayeva, K.K. Kabdykairova, A.R. Kabulova, G.A. Karayeva, G.O. Kozhasheva, R.Ch. Bekturganova, S.M. Kenesbayeva, S.M. Taulanov, M.S. Malibekova.

The research sources: study the Law and the Republic of Kazakhstan "On Education", the State obligatory standard of higher education, professional standard "Teacher", the President's Messages to the People of Kazakhstan, Conceptual bases of education within the frameworks the program "Ruhani zhangyru", study the documents relating to education, scientific works of domestic and foreign scientists concerning the issues in the field of pedagogy, psychology and mathematics, official materials of the Ministry of Education of the Republic of Kazakhstan, regulatory documents of the Republic of Kazakhstan.

The scientific novelty of the research lies in the following:

1. Theoretical substantiation of the problems of modernization of mathematical education and mechanisms for their solution has been done;
2. Psychological and pedagogical features of training future mathematics teachers have been investigated on the basis of funding innovative concept.
3. The model of systemic and methodological support in teaching mathematical disciplines has been developed, which helps to improve preparedness of future teachers for activities in the context of the updated content of education.

The theoretical significance of the research results lies in the fact that: the combination of the funding innovative concept to improve professional training of a future mathematics teacher and teaching of mathematical disciplines meets the basic requirements of higher pedagogical education.

The practical significance of the research lies in the fact that the dissertation research includes material that can be used by undergraduates and doctoral students of the specialty "6B015 - Training of natural science teachers" under the "Mathematics" educational program. The dissertation research considers the problems, main trends and characteristic features of training future teachers of

mathematical disciplines in the light of modern requirements. The presented model of teaching mathematical disciplines in the conditions of innovative orientation can provide methodological assistance to undergraduates, doctoral students and young teachers of mathematical disciplines.

The reliability of the research results attained is ensured by: analysis of scientific and educational-methodical literature on the problem under study, which are logically adequate to the set goals and objectives of the research; using a complex of scientific research methods, rational combination of theoretical and experimental types of the research; using statistical methods and mathematical processing of experimental data, confirming success of the experimental study.

The following provisions are defended in the dissertation:

1. The revealed problems of modernization of mathematics education and the mechanisms for their solution are the theoretical basis for their solution;
2. Psychological and pedagogical features of training future mathematics teachers on the basis of innovative funding concept are the methodological basis of the research.
3. The model combining innovative funding concept to improve the training of a future mathematics teacher with teaching mathematical disciplines and meeting the essential requirements of the higher pedagogical education has been made;
4. The results attained during implementation and testing the experimental model of systematic and methodological support for teaching mathematical disciplines at a university.

The basis of the research: experimental research was conducted on the basis of Zhetysu University named after I. Zhansugurov and the Kazakh National Women's Pedagogical University, Advanced Training Center at the Zhetysu University named after I. Zhansugurov.

The main stages of the research: In accordance with the purpose and the objectives of the research, the experimental work was done in the period from 2018 to 2021 in the usual conditions of the educational process and consisted of three stages.

At the *first* stage (2018-2020), the analysis of educational and methodological literature devoted to different aspects of the problem set was done. The features of implementation of innovative orientation in teaching mathematical disciplines at a university were analyzed. The theoretical analysis of the literature and the data attained in the course of the ascertaining experiment served as the basis for formulating the goal and objectives of the research, and advancing the working hypothesis (ascertaining experiment).

At the *second* stage (2018–2019), the model of methodological support of innovative orientation in training of future mathematics teachers was formed and specific recommendations for its use (search experiment) were formulated.

At the *third* stage (2019–2021), diagnostic studies of the methodological training of future mathematics teachers were done, the model of methodological support of innovative orientation in teaching mathematical disciplines was tested and the effectiveness of its use was checked, the theoretical and experimental results attained were processed and generalized, corrections were made to the

methodological system of training future mathematics teachers, the conclusions were formulated and doctoral dissertation (formative experiment) was drawn up.

Approbation of practical research results:

- the main provisions and results of the research were reviewed and discussed at scientific and methodological seminars of the Department of Mathematics and Informatics of the ZhU named after I. Zhansugurov, and also were reflected in the tutorial "Systematic and methodological foundations of teaching mathematical disciplines in the conditions of innovative orientation." In addition, the results of the research were reported during the scientific training at the Department of Mathematics of the Faculty of Physics, Mathematics and Digital Technologies of the Kazakh National Women's Pedagogical University (Kazakhstan, Almaty);
- the attained research results were reported at scientific and practical conferences: the 13th Annual International Technology, Education and Development Conference (Valencia, Spain 2019), International Scientific and Practical Conference "Achievements and Prospects of Modern Science" (Nur-Sultan, 2021), International Scientific and Practical Conference "Modern science: problems, ideas and trends" (Prague, Czech Republic 2021);
- the results of the research were presented at the scientific seminar in the online mode of the International Academy of CONCORD (Paris, France);
- in the period from January 27th to February 29th, 2020, together with the Center for Advanced Studies and Additional Education at ZhSU named after I. Zhansugurov, advanced training courses were organized on the topic: "Development of professional competence of a mathematics teacher in the context of updating the content of education" for mathematics teachers of secondary schools in Taldykorgan city and the Almaty region. The intensity of the courses was 72 academic hours.
- the main results and provisions of the dissertation research were published in different scientific journals and collections (16 works totally, 4 of them are articles in journals included in the list of peer-reviewed scientific publications, determined by the Committee for Quality Assurance in Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan, 2 articles in the peer-reviewed international journal included in the SCOPUS database, 4 articles in scientific journals and 3 articles in materials of international scientific and practical conferences, 2 tutorials with certificate of authorship and 1 monograph in English language).

The structure of the dissertation. The logic of the research and presentation of its results determined the structure of the dissertation, consisting of normative references, designations and abbreviations, the introduction, two chapters, the conclusion, a list of references and appendices.

The introduction formulates the relevance, scientific apparatus of the research problem: goal, object, subject, scientific hypothesis of the research, tasks, theoretical and methodological foundations, stages and methods of research, research base, scientific novelty, theoretical significance, practical significance and provisions submitted for defense.

The first chapter considers the psychological and pedagogical foundations of training future mathematics teachers. The problems of modernization of mathematics

education and the ways of their solution are described. The theoretical foundations of the system-methodological support of the process of teaching mathematical disciplines in a pedagogical university are presented on the basis of funding innovative concept.

In the second chapter the model of methodological support of innovative orientation in the training of mathematics teachers has been developed. Based on the research, elective courses have been developed, which serve as means of improving methodological training of future mathematics teachers. The methodology for organizing the research has been described and the results of the experimental research have been presented.

In the conclusion, the main results of the dissertation research have been formulated, as well as conclusions and recommendations for their further use in the research in the field of pedagogy and methods of teaching mathematics, as well as the prospect of further research.

The list of cited references: in the process of doing the dissertation research, sources consisting of 130 titles have been used.

The appendix contains the material developed during the research. The acts of implementation of the research results into educational process of the ZhU named after I. Zhansugurov, Kazakh National Women's Pedagogical University and the Advanced Training Center at the ZhU named after I. Zhansugurov have been presented.