

ANNOTATION
on the dissertation for scientific degree of Doctor of Philosophy (PhD.) in the
specialty 6D010900 - “Mathematics”

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“Methods of using WEB technologies in developing intellectual abilities of
future Mathematics teachers”

Urgency of the research. Modern society needs educated, entrepreneurial and resourceful professionals that are able to make independent decisions in difficult situations and willing to improve their professional competencies and mobility. In the context of integration of social and educational processes and information access, highly competitive world-class specialists are needed.

The President K.K. Tokayev in his Message to the Nation of Kazakhstan dated September 1, 2021, mentioning the development of science, noted that “it needs a fresh perspective, new approaches, and reliance on international best practice”. Significant socio-economic and political changes in the Republic of Kazakhstan in recent decades have made it necessary to reconsider the goals and objectives of training of specialists for the future professional career.

For the modernization and renewal of the higher education system purposes, professional competence should be considered as an integral indicator of young specialists training quality. Thus, one of the tasks of higher education is to train highly qualified, competitive, resourceful specialists with solid fundamental knowledge that are able to find creative solutions to professional problems and adapt rapidly to the constantly changing requirements of the employment market.

The Law of the Republic of Kazakhstan “On Education” states that “one of the main objectives of the education system is to create conditions for the acquisition of a certain knowledge prescribed by educational programs”. Didactic support of the educational process is among these conditions.

For the purposes of the state program for the development of education and science of the Republic of Kazakhstan for 2020-2025, it is stated: «increasing the global competitiveness of Kazakhstan's education and science, education and training of the individual on the basis of universal values».

This program sets some tasks related to education and science, including:

- ensuring the high status of the teacher's profession, modernization of pedagogical education;
- reducing the gap in the quality of education between urban and rural schools, regions, educational institutions, students;
- ensuring the intellectual, spiritual, moral and physical development of the student;
- equipping educational institutions with digital infrastructure and modern material and technical base;
- we were guided in our research by such tasks as strengthening the intellectual potential of science.

Therefore, mathematics education of the future Mathematics teachers requires qualitative changes. These changes relate to current trends in education, changes in methods and ways of providing educational services, and organization of training with the consideration of rapidly developing Internet technologies and its didactic capabilities in the higher professional education system.

Intensive and widespread development of information technology around the world in recent years has a significant impact on the current generation development. Rapid coverage of new information and advertising on TV, and use of modern sophisticated technologies, such as smartphones and computers, significantly affect the perception of the environment and formation of human intellect.

In connection with the introduction of the updated content of education in Kazakhstani schools, the widespread use of digital education technologies, the issues of improving the methods of professional training of future Mathematics teachers are particularly relevant.

Training of future teachers and the problems of the content of mathematical disciplines are reflected in many research projects of domestic and foreign scientists. For instance, M.T.Tatto, M.C.Rodriguez, M.Reckase, G.I.Sarantsev, L.M.Fridman, M.V.Pototsky, B.B.Baimukhanov, D.Rakhymbek, B.R.Kastayeva, A.Y.Abylkassymova, A.K.Kagazbayeva, O.S.Satybaldiyev, M.I.Moro, Y.M.Kolyagin, A.Nugusova, S.M.Seyitova, E.Z.Smagulov, etc.

According to the research of many scientists as G.Y.Eisenk, G.Gardner, J.Piaget, D.B.Bogoyavlenskaya, L.M.Mitina, S.M.Zhakupov, J.Y.Namazbayeva determined that people with high intelligence occupy a special place in various spheres of society, economy, education and science.

The scientists from far and near abroad, such as H.Eisenk, D.Wexler, R.Gardner, J.Guilford, C.Spearman, R.Sternberg, J. Piaget, etc., have made a great contribution to the study of the concept of “Intellect” and “Intellectual development”. “Intellectual initiative” was studied by D.B.Bogoyavlenskaya, “Intellectual reflexion” was studied by I.N.Semenov and S.Y.Stepanov, “Intellectual activity or dominant search” was studied by Y.A.Ponomarev, “Intellectual decision making” was studied by T.V.Kornilova, “Intellectual variability and consistency” was studied by N.S. Yefimova, “Research initiative” was studied by A.N. Poddyakov, “Intellectual ability” was studied by L.M.Mitina.

Modern psychologists have different theories about the possibility of different structures of intellectual ability. Some believe that intelligence is a complex of abilities of the brain itself; while others hold the view that there is a single common brain ability for intellectual activity on the basis of intelligence.

General-methodical and socio-philosophical aspects of the interdependence of human intelligence development and its guidance in the society are provided in the scientific works of prominent Russian and foreign scientists, such as N.A.Berdyayev, V.I.Vernadsky, N.Wiener, E.J.Durkheim, A.Peccei, P.A.Sorokin, Teilhard de Chardin, A.J. Toynbee, K. Jaspers and others.

Outstanding psychologists L.S.Vygotsky, A.N.Leontiev, Y.A.Ponomarev, B.M.Teplov are the leading researchers on human mental health and thinking

activity, as well as mechanisms of its development. Their works play crucial role for this study.

Problems of intelligence and intellectual development of students were considered in the works of A.Anastasi, H.J.Eysenck, D.B.Bogoyavlenskaya, V.N.Druzhinin, A.N.Leontiev, B.F.Kulagin, S.L.Rubinstein, M.A.Kholodnaya, R.E.Fancher, J.P.Guilford, C.Spearman, etc. They are based on a variety of research methodologies on human cognitive and intellectual abilities.

Certain works of Kazakhstani scientists are of great interest. Among them is the research on psychological structure of learning process and development of intellectual and creative personality (S.M.Zhakypov, Z.Y.Namazbayeva), influence of ethno-psychological concepts on development of intellect and self-esteem (A.Z.Ayaganova), pedagogical conditions for formation of creative abilities of future specialists in higher education institutions (A.B.Ospanova, A.S.Shvaikovsky, S.A.Nurzhanova, R.I.Kadirbayeva, R.S.Omarova), development of an adaptive learning environment in the context of intellectual education (K.U.Kunakova), developing intellectual potential of future educational psychologists (B.T.Kenzhebayeva).

The use of the Internet in education, first of all, is reflected in the research of Russian authors as, A.P.Ershov, A.A.Kuznetsov, M.P.Lapchik, A.V.Mogilyov, N.I.Pak, V.A.Sukhomlin, E.K.Henner and other scientists on informatization of education. Use of information and communication technologies (ICT) in Higher Education, it became the basis of research aimed at solving many problems: the effective organization of the learning process of students and students; the creation and use of software and pedagogical tools for educational purposes (S.A.Beshenkov, E.Y.Bidaibekov, S.G.Grigoriev, V.V.Grinishkun, I.V.Robert, M.I.Shutikova, etc.); the use of information and communication technologies as a means of developing innovative educational technologies (E.Z.Vlasova, I.B.Gosvarev, V.I.Snegurova, etc.).

The modern level of development of science and technology requires from each student high-quality deep knowledge and practical activity in mathematics, their creative work, a high level of thinking. It is known that mathematics occupies a special place in the development of the student's thinking.

One of the means to develop mathematical culture is intellectual games. Thus, an intellectual and creative game called “JIPTO” is available for secondary school students.

This game was developed by G.V.Tomsky in 1987. JIPTO-Jeux Intellectuels de Poursuite pour Tous is Tomsky's intellectual game “Pursuit”. G.V.Tomsky pointed out that JIPTO is not only a game, but also a unified pedagogical system of activation of creative abilities based on the dynamic intellectual game “Pursuit”.

By virtue of the fact that the game is interesting, comprehensible, presented in different variations and strategically diverse, it affects strategic thinking, development of cognitive and analytical skills, fine motor skills and speaking.

This game has spread all over the world, and has been widely used for a long time in the upbringing of the younger generation. The intellectual and creative game “JIPTO” was first widely used in Kazakhstan in Zhetysu University named

after I. Zhansugurov (Kazakhstan, Taldykorgan) and later in schools of the Almaty Region.

The use of WEB technologies in the development of the intelligence of future mathematics teachers is important in the mathematical space. WEB technologies play a fundamental role in the information support of the construction of mathematical models in all sciences. The professional specifics of a modern mathematics teacher is that, in accordance with the goals and priorities established by the state, the main requirement for the professional qualities of a teacher is their novelty, creativity, ability to use teaching methods and technologies, knowledge of the technology of designing teaching aids. Therefore, there is a need to consider the development of intellectual abilities of teachers using WEB technologies.

Analysis of the abovementioned works has shown that the issues of using Web technologies in developing intellectual abilities of future Mathematics teachers are not thoroughly investigated.

Concurrently, based on the analysis of the problem urgency, it becomes clear that there are **contradictions** between the public demand for the use of information technology in future specialists intellectual development in higher education institutions and its theoretical and practical justification in pedagogical science.

1. Between the demand of modern society and insufficient scientific and methodological justification of the means of developing the intellectual abilities of future mathematics teachers;

2. Among the requirements that ensure the specification of ways to develop the intellectual abilities of mathematics teachers with the use of information technology and their effective mastery;

3. Between the need to develop the intellectual abilities of future teachers of mathematics using advanced technologies and the lack of elaboration of his methodology.

The established contradictions determined the research problem, the importance of defining psychological and pedagogical foundations of ways to develop intellectual abilities of future Mathematics teachers using Web technologies, which became the reason for writing the dissertation research “**Methods of using WEB technologies in developing intellectual abilities of future Mathematics teachers**”.

Research objective. Scientific substantiation of the methods of using Web technologies in developing intellectual abilities of future Mathematics teachers.

Object of the research. The process of teaching mathematical disciplines in the system of higher pedagogical education.

Subject of the research. The methods of using Web technologies in developing intellectual abilities of Mathematics teachers.

Hypothesis of the dissertation research: if using Web technologies to develop intellectual abilities of teachers in the process of teaching Mathematics is theoretically justified, and scientific methodology is developed, **then** we can provide a sufficient level of professional and methodological training of future Mathematics teachers, **as** it facilitates to improving the professional training quality of future Mathematics teachers of pedagogical universities.

In accordance with the research objective and on the basis of the hypothesis of the research, the following **tasks** are defined:

The development of the intellectual abilities of mathematics teachers with the use of Web technologies is psychologically and pedagogically justified;

1. Psychological and pedagogical substantiation of the development of the intellectual abilities of mathematics teachers using Web technologies;

2. Determination the ways to develop intellectual abilities of Mathematics teachers using Web technologies;

3. Design methods of using Web technologies in developing intellectual abilities of future Mathematics teachers;

4. Experimental verification of methods for implementing the methodology for developing intellectual abilities of teachers using Web technologies in teaching mathematical disciplines in higher education institutions.

For the purpose of achieving the goal and solving the assigned tasks, the following **research methods** were used:

- general scientific methods of theoretical research: analysis of educational standards, curricula, textbooks, mathematical, psychological, pedagogical and methodological literature based on textbooks and teaching packages, the experience of Mathematics teachers, classification, and generalization of the results;

- social research methods: visiting lessons of Mathematics teachers, interviews with teachers, students, undergraduates and school teachers in oral and written form, conducting questionnaires and testing;

- empirical research methods: conducting a pedagogical experiment to confirm the hypothesis of the study, analysis and processing of the experiment results using statistical investigation methods.

Theoretical and methodological bases of the research:

- issues of formation and development of teachers innovative activities: V.A.Slastenin, V.D.Shadrikov, E.G.Leontieva, S.A.Smirnov, O.P.Podosinnikova, K.R.Rogers, E.Brauswick, A.Bill, E.Bolen;

- the fundamental works of teachers, psychologists, mathematicians-methodologists on future teachers training, methodology of innovation, theory and practice: K.D.Ushinsky, A.A.Komensky, J.Bruner, B.Bloom, L.S.Vygotsky, S.L.Rubinstein, G.V.Tomsky, V.D.Shadrikov, D.Rakhymbek, A.E.Abylkassymova, B.B.Baimukhanov, S.E.Shakilikova, S.S.Maussymbayev, Y.U.Medeuov, S.M.Seitova, B.D.Sydyhov, I.S.Sabyrov, A.A.Moldazhanova, G.R. Alimbekova;

- the works of A.Anastasi, G.Y.Eisenk, D.B.Bogoyavlenskaya, V.N.Druzhinin, A.N.Leontiev, B.F.Kulagin, S.L.Rubinstein, M.A.Kholodnaya, M.A.Fancher, J.P.Guillford, C.Spearman, etc. considered the issues of students intelligence and their intellectual development. They are based on various methods of research of cognitive and intellectual abilities of a person;

- the following research on studying pedagogical conditions for formation of creative abilities of future specialists of higher education institutions: A.B.Ospanov, A.S. Shvaikovskiy, R.I. Kadirbayeva, R.S. Omarova; on

development of the educational environment for specialized education in intellectual education (K.U.Kunakova), and as well as development of intellectual potential of the future educational psychologist (B.T.Kenzhebayeva), are also noteworthy;

- the scientific works of G.I.Sarantsev, M.V.Pototsky, G.M.Berkimbayeva, A.R.Kabulova, G.A.Karayev, G.O.Kozhashev, R.C.Bekturganova, S.M.Kenesbayeva, S.M.Taulanova, M.S.Malibekova highlight the use of innovative technologies in teaching mathematical disciplines.

Sources of the research: The Law of the Republic of Kazakhstan “On Education”, state compulsory standard of higher education, professional standard “The Teacher”, Message of the President to the Nation of Kazakhstan, conceptual foundations of education within the framework of the “Рухани жаңғыру” (“Ruhani Zhangyru”) program, documents related to the field of education, scientific works of domestic and foreign scientists 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.

Scientific novelty of the research:

1. Development of intellectual abilities of Mathematics teachers has been substantiated psychologically and pedagogically;

2. Ways of developing intellectual abilities of Mathematics teachers with using Web technologies have been defined;

3. Methods for developing intellectual abilities of future Mathematics teachers using Web technologies have been designed, their usefulness has been shown.

4. Ways to implement the methodology of developing the intellectual abilities of teachers in teaching mathematical disciplines at the university using WEB technologies, the correctness of the scientific forecast has been experimentally verified and proved.

The theoretical significance of the research results involves correspondence of the ways of developing intellectual abilities of Mathematics teachers using Web technologies based on improving professional training of future Mathematics teachers with the basic requirements of higher pedagogical education.

Practical significance of the research lies in the fact that the dissertation research contains material that can be used by master’s and doctoral students studying in direction 6B015- Teacher Training Programme on Natural Science disciplines “Mathematics”, “Mathematics and Informatics”. The dissertation research examines the main processes and features of Web technologies in training future Mathematics teachers that teaching Mathematics in accordance with the current requirements. In addition, the study can provide methodological assistance to students, school teachers, university teachers and Master-teachers.

Credibility and validity of the research results are ensured by analysing the scientific and educational materials on the investigated problem by using a range of scientific research methods, rationally combining theoretical and

experimental types of research and using mathematical processing of statistical methods to confirm the experimental research results.

The following concepts proposed to defense:

1. The conclusions on development of intellectual abilities of Mathematics teachers from a psychological and pedagogical point of view is the theoretical basis of the study;

2. The ways of developing intellectual abilities of Mathematics teachers using Web technologies may form the methodological basis of the research;

3. Methods for development of intellectual abilities of future Mathematics teachers using Web technologies contribute to improvement of professional training of Mathematics teachers, and also meets the basic requirements of pedagogical education.

Research base: The experimental study was carried out on the basis of Zhetysu University named after I. Zhansugurov and the Kazakh National Women's Pedagogical University, on the basis of the Karatal district Department of Education of the Almaty region.

The main stages of the research: The experimental work was carried out in accordance with the research goals and objectives in the period from 2018 to 2021 in the regular conditions of the educational process and consisted of three stages.

At the first stage (2018-2019), analysis of educational, methodological literature on various aspects of the studied problem was carried out. The features of carrying out development of intellectual abilities of teachers when teaching mathematical disciplines in universities were analyzed. The data obtained during the theoretical analysis of the literature and during the experiment became the basis for goals and objectives formulation, as well as the hypothesis of the study.

At the second stage (2019-2020), Web technologies used in the development of intellectual abilities of Mathematics teachers in future teachers training were methodically presented, and specific recommendations for their application were given (research experiment).

At the third stage (2020-2021), an experiment was carried out on Web technologies used in the development of intellectual abilities of Mathematics teachers, the results were verified. The obtained theoretical and experimental results were processed, generalized and introduced into the process of training future Mathematics teachers (formative experiment)

Approbation and implementation of the research into practice:

The main points and results of the study were heard and discussed at scientific and methodological seminars of the Department of Mathematics and Informatics of Zhetysu University named after I. Zhansugurov, and also found their reflection in the training manual "Web технологиялардың көмегімен мұғалімдердің интеллектуалды қабілетін дамыту". Also, the research results were presented during the scientific internship in Kazakh National Women's Pedagogical University (Kazakhstan, Almaty) at the Department of Mathematics of the Institute of Physics, Mathematics and Digital Technologies;

- the results of the research were presented at the scientific online seminar of the International CONCORDE Academy (France, Paris);

- during the period from January 27 to February 29, 2020, advanced training courses for Mathematics teachers of secondary schools in the city of Taldykorgan and the Almaty Region on the topic “Development of professional competence of the Mathematics teacher in the context of updated educational content” (72 academic hours) were organized and conducted on the base of the Center for Advanced Studies and Additional Education in Zhetysu State University named after I. Zhansugurov.

Publications. The main content of the dissertation was presented together with domestic and foreign scientific consultants in the journal of the Committee for Quality Assurance of Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan and at international scientific and practical conferences. 16 scientific papers were published on the main content of the dissertation.

1. *Scientific papers published in publications based on Scopus* - 1 (percentile- 93, Quartile - Q1);

2. *Scientific works published in publications recommended by the Committee for Control in the Field of education and Science of the Republic of Kazakhstan*- 2;

3. *Scientific papers published at international scientific conferences*-3;

4. *Scientific papers published in foreign peer-reviewed journals*-4;

5. *Scientific papers published at republican scientific conferences*-3;

6. *Textbooks recommended by the Academic Council of the University*-2;

7. *Electronic textbook recommended by the Academic Council of the University*-1;

8. *Copyright certificates* - 2.

The structure and content of the dissertation. The dissertation consists of normative references, abbreviations, an introduction, two chapters, a conclusion, a list of references and an appendix.

The introduction considers the objective of the study, object, subject, scientific hypothesis, goals, theoretical and methodological foundations, stages and methods of the research, research base, scientific novelty, theoretical and practical significance, points for defense, creditability and validity of the results of the research work.

The first chapter entitled “**Theoretical foundations of development intellectual abilities of future Mathematics teachers**”, considers: 1) the issues of development of education informatization and the use of Web technologies in the educational process; 2) development of informatization of education, 3) WEB technologies used in the educational process.

In the second chapter entitled “**Methods of development intellectual abilities of teachers using Web technologies**”: 1) the ways of development of intellectual abilities of Mathematics teachers using Web technologies were presented; 2) methods of creating and using WEB sites that develop the intellectual abilities of future teachers of mathematics; 3) special courses that improve the intellectual abilities of future teachers of mathematics; 4) experiment and quantitative and qualitative processing of the results.

In the conclusion, the main findings on conducting the dissertation research were formulated, as well as recommendations for their further use in studies in the field of methods of teaching Mathematics and Pedagogy, and the prospect of further research were also shown.

In the course of the dissertation research, 140 literature titles were used.

The appendix contains material developed during the study.

The acts of implementation of the research results into the educational process of Zhetysu University named after I.Zhansugurov, Kazakh National Women's Pedagogical University, Center for Advanced Studies at Zhetysu University were submitted, on the basis of the Karatal district Department of Education of the Almaty region.