

## Forming the Basics of Future Mathematics Teachers' Professionalism by Means of Multimedia Technologies

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### ABSTRACT

The purpose of this paper is to specify the essence and the specifics of implementation of the pedagogic technology of forming the basics of future mathematics teachers' professionalism using the potential of multimedia in higher education. The major research method is pedagogical experiment (comprising analytical search, ascertaining, forming, and control stages) aimed at verifying the efficiency of the pedagogical technology of forming the basics of future mathematics teachers' professionalism; statistic methods have also been employed for checking efficiency and reliability of the experimental research results. The participants of the pedagogical experiment have been 290 students (150 students of the experimental group and 140 students of the control group) of the training area 44.03.01 "Pedagogical education", skills profile "Mathematics". Theoretical issues on the nature, structure, criteria, indicators and levels of formation of the basics of future mathematics teachers' professionalism have been disclosed; the notion-category apparatus of the theory of the teacher professionalism has been specified; there has been scientifically grounded and developed the pedagogical technology of forming the basics of future mathematics teachers' professionalism that corresponds to the structure of the holistic pedagogical process and includes: target orientations, conceptual bases and regulations, procedural characteristics, program-methodological support, and an appropriate combination of traditional and multimedia tools. The results of the gradual introduction of the pedagogical technology of forming the basics of future mathematics teachers' professionalism by means of multimedia technologies indicate significant positive shifts in the formation of all the components of the basics of students' professionalism, which was reflected in the positive dynamics of the criteria for all indicators and generally indicates the effectiveness of the proposed pedagogical technology. Research materials can be used to further improve the theory and practice of the professional training, in particular, in the training of future mathematics teachers in the process of qualification improvement and personnel retraining, and in the self-educational activity of teachers.

**Keywords:** professionalism, future mathematics teacher, pedagogical technology, multimedia technologies

#### **Contribution of this paper to the literature**

- For the first time there has been scientifically proved and experimentally verified the pedagogical technology of forming the basics of future mathematics teachers' professionalism in the process of professional training; systemic impact of the ability to use multimedia technologies on students' professional self-development has been proved.
- There has been updated the content of information support of fundamental and professional educational disciplines with certain aspects of the mathematics teacher's professionalism and the didactic potential of multimedia technologies.
- There has been worked out and experimentally tested the integrated special course "Forming the basics of future mathematics teachers' professionalism by means of multimedia technologies" for students of the preparation area 44.03.01 "Pedagogical education", skills profile "Mathematics", as well as its multimedia-didactic support.

## **INTRODUCTION**

### **The Relevance of the Research**

The progressive reforming and modernizing the system of professional education in the Russian Federation, the results of numerous researches in the field of new educational and pedagogical technologies, associated with the problem of forming the basics of professionalism of the mathematics teacher of the new generation, necessitate taking into account all modern requirements in the process of his professional training. Civilizational challenges also have a significant impact, namely: humanization and democratization of the modern society, the growth of the social role of the personality, the development of the personal intellectual and creative potential, deep changes in the system and structure of education, positioning of education as a driving force for the development of the civil society, the dynamics of scientific and technical modernization, the need for rapid adaptation in the conditions of the information-technological society (Gorbunova & Mokeyeva, 2017; Gorbunova & Sabirova, 2017; Levina et al., 2017; Valeeva & Gafurov, 2017). Of the ways of solving the stated problems is creation of educational-methodological support of forming the basics of future mathematics teachers' professionalism based on implementing the technological and competence-based approaches. Their realization will allow for modernization of the professional training of students orientated to satisfy the demands of the modern school practice and will create the conditions of the high quality professional self-realization of specialists.

It is worthwhile noting that while academic courses on pedagogical creativity and skill have already firmly established themselves in the content and technology of the professional training of future teachers, the functioning of the phenomenology of professionalism in mass practice remains outside the educational process of the higher pedagogical school, though introduction of the variable component in the curricula of professional training of bachelors in higher educational institutions opens new opportunities for ensuring continuity and multilevel nature of the pedagogical education through the implementation of an integrated special course on the future teacher's pedagogical professionalism with the use of multimedia technologies. The specific feature of its study on the level of baccalaureate is its bi-functionality – along with providing their further professional pedagogical improvement and enhancing their readiness to pedagogical activity, future teachers acquire knowledge of the general basics of forming the teacher's professionalism, develop their professional culture through philosophical comprehension and reflection of the profession of the teacher, acquire the professional values and innovative technologies for teaching learners.

This actualizes the objective need for the creation of such a system of professional training of future mathematics teacher that, based on the comprehension of the existing historical-pedagogical experience and modern didactic achievements in the development of the teacher's professionalism, will ensure the advancing training of the teachers capable of performing professional activity being guided by new conceptual principles, of realizing the state policy of personality development, of satisfying educational and spiritual-cultural needs of the personality, and of providing the individual with an opportunity to be competitive in the labor market.

### **The Purpose and Objectives of the Research**

The purpose of the paper is to theoretically substantiate, develop and experimentally test the pedagogical technology of forming the basics of future mathematics teachers' professionalism by means of multimedia technologies. The major objectives of the research have been defines as follows: to carry out a retrospective analysis and investigate the current state of the problem of developing future mathematics teachers' professionalism in the process of their professional training basing on historic-pedagogical and methodological resources; to substantiate

methodological fundamentals of forming the basics of future mathematics teachers' professionalism as a scientific category; to characterize the nature and structure of the basics of future mathematics teachers' professionalism as a scientific category; to develop and experimentally test the pedagogical technology of forming the basics of future mathematics teachers' professionalism.

## LITERATURE REVIEW

The fundamentals of the renovation of the higher pedagogical education, development of the theoretical and methodological foundations of the professional pedagogical training of students are revealed in the works by Perevoshchikova (2015), Perminov (2013), Sarantsev (2016), Fedorov and Davidova (2014), Haritonova (2013), Khruyova and Sakhieva (2017) and others. The works of these authors presented the detailed analysis of the problems that existed in certain chronological periods of the country development, as well as concrete suggestions and recommendations for improving the professional training of future and practicing teachers in general, and teachers of mathematics in particular.

The problem of the specialist's professional development, and the emergence of his professionalism in the context of modern humanistic approaches is being successfully worked out in the psychology of labor, acmeology, professional pedagogy, and finds its reflection in the scientific heritage of Derkach and Mihaylov (2001), Zobnina (2006), Povarenkov, Mazilov, and Slepko (2016), Romanov, Kormakova, and Musaelian (2014), Shushara and Khuziakmetov (2017) and others.

The research object of the theory of professionalism embraces various aspects of the pedagogical activity and those of the personality of different categories of employees of the educational sphere (Verbitskiy, 2016), among which the major attention is paid to problems of professional competency (Gluzman, 2014; Masyukova, 2015), of pedagogical creative activity (Vinogradov, Galichenko, & Posokhova, 2014), of pedagogical culture (Kolmogorova, 2008).

At the current stage separate aspects of the problem of training future mathematics teachers in the Russian Federation are being investigated by noted mathematicians, pedagogues and methodologists: Rikhter et al. (2017), Gorev and Kalimullin (2017), Luneeva and Zakirova (2017). In the works by these authors there have been thoroughly analyzed didactic problems and given concrete suggestions and recommendations for improving the professional training of the mathematics teachers.

A substantial number of the researches are devoted to the use of information-communication technologies (ICT) in higher school; these works attempted at solving various issues: those of creating and employing pedagogical program learning tools in the process of teaching school and university students (Privalov, Bogatyriova, & Romanov, 2016); that of employing ICT as a means of developing innovative educational technologies (Gluhova & Bazhanova, 2013; Lin, Sokolova, & Vlasova, 2017); that of the possibility of using multimedia technologies in the teaching process of the higher school (Panfilov & Necrasova, 2014).

The recent decades of the 21<sup>st</sup> century saw and intensified search of the foreign researches in the sphere of various aspects of the theory and practice of the teacher professional training, and technologies of enhancing the level of the teacher professionalism. In particular, the analysis of the links between general educational pedagogical knowledge, self-actualization, professional burnout of teachers, and the level of their professional competency and professionalism has been carried out (Lauermann & König, 2016); the impact of the emotional strain and social support of the teachers on the development of the burnout syndrome of the qualified teachers in Italy and Switzerland has been investigated (Fiorilli et al., 2015); dependence of the effectiveness of co-education and the level of learning achievements on the personality type (Emerson, English, & McGoldrick, 2016), and on genetically determined character traits, not solely on the learners' intellect, has been grounded (Krapohl, 2014); the problems of adult education in the modern world, among them that of school teachers, have been analyzed (Kokkos, 2015; Németh, 2014); the role of social maturity (Nagra & Kaur, 2013) and that of integrating technologies into the practice of school mathematics (Monaghan, 2002; Tabach, 2012) in the development of school teachers' professionalism has been disclosed; the support of co-education through the development of pedagogical knowledge by means of technological support has been investigated (Alayyar, Fisser & Voogt, 2012); dependence of the quality of teaching and developing students on the teachers' professionalism has been proved (Kunter et al., 2013), etc.

Thus, the world community has highlighted, among the priority areas of the functioning and development of education, the teachers' professionalism, the main components of which have been defined as fundamental education, competency, creative initiative, professionally relevant personal qualities, and the tendency of acmeological lifelong learning. It is their effective combination that determines the level of the teacher's professional improvement.

The subject of our research also presupposes carrying out an analysis of some foreign researches directly related to the professional training of mathematics teachers and methodology of their training. These are publications by:

Wilson, Lee, and Hollebrands (2011) studying the impact of special interactive multimedia computer programs on the efficiency of learning statistics by school students and discussing introduction of such teaching programs into the professional training of future mathematics teachers; Öksüz, Uça, and Genç (2009) grounding the methodology of raising Turkish future mathematics teachers' professionalism by means of using a complex set multimedia videocassettes in the context of inability of modern teachers to correctly integrate multimedia technologies into their teaching practice and use them in class systematically; Bitter and Hatfield (1994) presenting the training of teachers of elementary mathematics with the use of interactive multimedia; Miller and Glover (2010) generalizing on the results of their previous works that demonstrate the comparative advantages of the technical skill of employing the interactive board by mathematics teachers and using materials of commercial software for interactive teaching. The scientists Drijvers et al. (2010) prove that the professional teacher will always search for new technological and didactic facilities while choosing between technological skills and pedagogical interactivity.

An important role in the presented research undoubtedly belongs to scientific works of foreign didactic-mathematicians revealing the technological constituent of the professional training of future mathematics teachers.

Thus, the publication by Cavanagh and Mitchelmore (2011) where the authors present the results of teachers' mastering and using online systems of teaching mathematics while conducting their own classes, demonstrate that all the teachers have achieved certain progress in using the system and mastered more effective pedagogical techniques, which has positively affected the results of students' learning and the teachers' professional development.

The research by Sarah (2010) devoted to the problem of inviting teachers to the constructive dialogue within the activity aimed at the professional use of ICT testifies to the existence of both collegial and critical forms of discussion in the online discussion forum. It has been established that collegial discussion is of a more substantial value for developing and supporting teachers' pedagogical skill, while critical discussion has a major role in transforming and correcting teachers' professional beliefs.

The paper by Gorev and Gurevich-Leibman (2015) describes the experience of integrating technological tools into teaching mathematics (both mathematics proper and didactic courses) to future teachers. In the research context there have been used various technological tools (for example, dynamic software, hypertexts, video, and applets). At the initial stage of the experiment the preference was paid to dynamic software; at the next stages introduction of applets had a greater role. Eventually, the students got convinced in the didactic potential of applets for effective teaching mathematics.

An interesting research has been carried out by Polly et al. (2017) who studied the impact of teacher participation in the project of professional development on their personal professional achievements and learners' academic performance. The multilevel analysis of the learners' academic performance showed higher results of the students whose teachers realized in the teaching practice professional techniques mastered within the project in comparison with the results of the students whose teachers did not use such techniques.

The publication by Watson (2006) presents ample facilities of the project "Western Virginia-12 RuralNet" for training inspector-teachers to integrate the Internet into the science and mathematics curriculum. The program included training inspector-teachers through an intensive summer seminar and additional online courses. The authors' conclusions testify that the teachers raised their professionalism level and were able to realize it for many years after their participation in the program.

It will also be right to consider the point of view of Alsawaie and Alghazo (2010) on the fact that the recent years have seen the increasing use of video for pedagogical education and professional development of teachers. The authors conclude that video should be used at events in which the foundations for professional, technological and logical-information thinking are being laid and future teachers' professional competences are being formed.

Thus, all the mentioned scientific and methodological words emphasize that learning any mathematical course by future mathematics teachers should combine in the optimal way with answering the needs of the future professional activity and ensure preparation of highly qualified personnel in the sphere of using multimedia tools and methods of teaching school students.

## MATERIALS AND METHODS

### Theoretical and Empirical Methods

In order to achieve the purpose and solve the objectives stated above the following research methods were employed at various stages of the research:

- *theoretical*: retrospective analysis of the professional and psychological-pedagogical literature, generalization, classification, and systematization of home and foreign scientific literature -for determining major directions of the research and the state of mathematics teachers' professional training; comparison,

analogy, systematization of the conceptual postulates, modeling – for working out and substantiating the pedagogical technology of forming the basics of future mathematics teacher’s professionalism;

- *empirical*: observation, questioning, interviewing, conversation, diagnostic standardized procedures – aimed at revealing qualitative changes in the level of formation of the basics of students’ professionalism, singling out pedagogical conditions of forming the basics of future mathematics teacher’s professionalism.

### Stages of the Research

The pedagogical experiment was carried out in four stages: analytical search, ascertaining, forming, and control stages.

Analytical search stage was aimed and substantiating theoretical and methodological concepts of forming the basics of future mathematics teacher’s professionalism in the process of the professional training. At this stage the retrospective analysis of pedagogical and scientific literature on the theory and practice of future mathematics teachers’ professional training, as well as the results of questioning 120 mathematics teachers of the Republic of Crimea allowed for determining the nature and constituents of the basics of the mathematics teacher’s professionalism, singling out the essential professional skills and qualities of the mathematics teachers, determining the main direction of the effective organization of the process of forming the basics of professionalism of the students of the training area 44.03.01 “Pedagogical education”, skills profile “Mathematics”.

The ascertaining stage of the experiment was aimed at determining the initial level of the formation of forming the basics of professionalism of the students of the training area 44.03.01 “Pedagogical education”, skills profile “Mathematics”, and of the practicing teachers, as well as at substantiating the pedagogical conditions of forming them by means of multimedia technologies.

The forming stage of the experiment was connected with testing the author program of the integrated special course “Forming the basics of future mathematics teachers’ professionalism by means of multimedia technologies”, implementing the pedagogical technology of Forming the basics of students’ professionalism and its scientific-methodological support, observing, interviewing, testing and conducting conversation with the experiment participants, analyzing the results of the activity, rating estimation, monitoring, employing the comparative method for quantitative-qualitative processing the results of the undertaken control tests.

At the control stage there was fulfilled the analysis and generalization of the results of the experiment, registration the results of the experiment, implementation of the methodological materials on forming the basics of future mathematics teachers’ professionalism into the practice of the pedagogical higher educational institutions, presenting the research materials in the author’s publications and reports at scientific conferences.

### Estimation Criteria

To carry out the diagnostics, the components, criteria, indicators of the levels of the basics of future mathematics teachers’ professionalism have been identified. The state of the formation of the learners’ competences, in particular, that of the professional-specific, professional-technological, and professional-personal ones have been chosen as the criteria of estimating definite components of the basics of future mathematics teachers’ professionalism (motivational-axiological, cognitive, technological, reflective), and their knowledge, abilities and skills emerging in the mathematics teacher’s professional activity have been chosen as indicators of every criterion. For the three criteria there have been singled out twelve indicators according to which the state of the formation of the competences of the basics of future mathematics teachers’ professionalism has been investigated (**Table 1**) and the levels of the formation of the phenomenon under study have been identified: initial (adaptive), basic (reproductive), optimal (fundamental with elements of creativity) and high (individual-creative).

### Procedure and Description of the Experiment

The research was conducted on the basis of the higher educational institutions: Yevpatoria Institute of Social Sciences (branch) and Humanities and Education Science Academy (branch) of V. I. Vernadsky Crimean Federal University in 2012-2017. Total sample size of subjects was 410 persons, among them 120 mathematics teachers aged 28-35 with the pedagogical activity experience of not less than 5 years. The research was carried out on the basis of informed consent. The first experimental group (EG) was comprised by the students of Yevpatoria Institute of Social Sciences (branch) of V. I. Vernadsky Crimean Federal University – 150 persons; the second control group (CG) was comprised by the students of Humanities and Education Science Academy (branch) of V. I. Vernadsky Crimean Federal University– 140 persons.

**Table 1.** Competences (criteria) and indicators of the formation of the components of the basics of future mathematics teachers' professionalism

Competences	Basics of future mathematics teachers' professionalism (components)			
	Motivational-axiological	Cognitive	Technological	Reflective
Professional-specific	– demonstrates professional-pedagogical motivation	– shows a considerable amount of special knowledge of the basics of future mathematics teachers' professionalism	– possesses professional skills and analytical habits of the professional activity of the mathematics teacher	– models his own conception "Professional self" as a teacher with a certain level of professionalism
Professional-technological	– displays positive attitude towards the use of innovative and multimedia technologies for teaching mathematics in professional activity	– possesses knowledge of the nature of innovative and multimedia technologies, the possibility of using them in the process of teaching mathematics to secondary school students, the difficulties of working with them	– possesses research skills in designing and technological development of the professional activity of the mathematics teacher	– directs professional activity and professional behavior at reflection, self-development, accumulation of practical experience in organizing technologically directed teaching of mathematics in the secondary school
Professional-personal	– realizes the importance of the formation and development of his own professionalism as self-improvement of a modern mathematics teacher's professional activity	– demonstrates the basic pedagogical, socio-psychological knowledge as the basis for the professionalism of mathematics teachers	– rationally applies organizational and communicative skills in the professional activity	– shows professional competency, the content of which is creative and non-standard actions; plans self-improvement in his own professionalism

## RESULTS

### The Analytical-Search Stage of the Experiment

At the analytical-search stage, the specifics of the professional activity of the teacher of mathematics was defined based on the analysis of scientific literature on the theory and practice of the professional education in the field of the pedagogy of mathematics; the results of questioning 120 mathematics teachers of the Republic of Crimea were obtained. After processing the results of questioning with the method of content analysis, when similar in content utterances were taken for a unit of analysis, there were singled out professional skills and qualities of the teacher of mathematics most expected by the subjects.

### The Ascertaining Stage of the Experiment

At the ascertaining stage there was revealed the state of the formation of the basics of mathematics teachers' professionalism of future and practicing teachers with the help of diagnostic measurements presupposing both methods of complex expert assessment and self-assessment of the level of the basics of professionalism after the author questionnaires, and methods that allowed for assessing individual components of this characteristic (pedagogical observation, questioning, psychological-pedagogical testing, a survey on Karpov's (2003) method of assessing the reflection, and diagnostics of professional competence by Zeyer, Pavlova, and Simanyuk (2005), programs of self-assessment of professional activity; method of expert evaluation). In particular, the high level was diagnosed in 1.3% of the students of the experimental group and in 1.9% of those of the control group. The optimal level was reached by 17.8% of future mathematics teachers of the experimental group and by 18.1% of those of the control group. 46.8% of the students of the experimental group and 46.3% of those of the control group demonstrated the basic level of the formation of the basics of professionalism. The initial level was recorded for 34% of the students of the experimental group and 33.7% of those of the control group (Table 2).

In the process of the ascertaining stage of the experiment it was revealed that the majority of students have an insufficiently clear idea of the specifics of the mathematics teacher's professional activity, do not focus on the implementation of innovative and multimedia technologies in their future pedagogical activity; students do not realize the content and structure of the basics of the mathematics teacher's professionalism and, accordingly, do not focus their attention on it; the level of formation of the student's basics of professionalism is insufficient; in practical and seminar classes teachers focus mainly on checking students' skills to reproduce theoretical issues acquired by them; systematic and purposeful work on forming future mathematics teachers' skills of using

**Table 2.** General characteristics of the levels of formation of the basics of professionalism of students and practicing teachers at the ascertaining stage of the experiment

Subject groups	Levels	Components							
		Motivational-axiological		Cognitive		Technological		Reflective	
		abs.	%	abs.	%	abs.	%	abs.	%
EG	High	3	2.0	1	0.7	2	1.1	2	1.6
	Optimal	37	24.7	25	16.4	21	13.8	25	16.4
	Basic	62	41.1	80	53.1	73	48.4	67	44.4
	Initial	48	32.2	44	29.8	54	36.7	56	37.6
CG	High	3	2.4	2	1.2	2	1.4	4	2.6
	Optimal	35	25.0	24	16.9	19	13.3	24	17.1
	Basic	61	43.8	73	52.4	69	49.3	56	39.8
	Initial	41	28.8	41	29.5	50	36.0	56	40.5
Practicing teachers	High	30	24.7	26	21.4	19	15.6	23	19.2
	Optimal	60	50.3	63	53.3	54	45.0	54	45.3
	Basic	27	22.5	26	21.4	39	33.0	34	28.3
	Initial	3	2.5	5	3.9	8	6.4	9	7.2

innovative and multimedia technologies is practically not undertaken. The results obtained confirmed the assumption that the traditional system of the professional training of mathematics teachers is not sufficiently adequate to the task of forming the basics of their professionalism.

### The Forming Stage of the Experiment

The program of the forming stage of the experiment supposed stage-by-stage realization of the pedagogical technology of forming the basics of future mathematics teachers' professionalism with the use of multimedia technologies.

The preparatory stage supposed realization of the first condition – forming students' motivational-axiological attitude to mastering the basics of mathematics teachers' professionalism, that is, provided the formation of the motivational-axiological component of the basics of professionalism. In accordance with objectives of this stage, the content of fundamental and professional disciplines ("Pedagogy", "Psychology", "History of pedagogy", "Sociology", "Ethics", "Aesthetics", "Educational technologies", "Pedagogic skill", "Ethnic pedagogy") was enriched with the material disclosing separate aspects of the mathematics teacher's professionalism. Students' activity was ensured by implementing interactive and multimedia teaching technologies. There was established effectiveness of problem discussions, disputes, debates on the issues of teacher professionalism, solving professionally focused tasks, execution of projects using web-quests technology ("Teacher, in honor of your name...", "21<sup>st</sup> century school", "The way I see the image of an ideal teacher", "To be or to look professional?", "Great mathematicians-pedagogues", etc.), tasks with elements of scientific research activity ("Online resources of the mathematic sphere", "Being an expert at...").

In accordance with objectives of the content stage, which realized the pedagogical condition of improving the information support of the system of future mathematics teachers' professional training, the attention was focused at the formation of the cognitive component of the basics of professionalism. Students were mastering social-psychological, general cultural, mathematical, didactic-methodological knowledge in the process of studying the renewed content of academic disciplines ("Methodology of teaching mathematics", "Methodology of teaching information theory", "Modeling information computer systems", "Computer nets", "Programming languages", "Web-programming", "Elementary mathematics", "Mathematical analysis") and the integrated special course "Forming the teacher's professionalism by means of multimedia technologies" that disclosed the issues of the nature, content, and constituent stages of forming the basics of pedagogical professionalism, variability of actions in the independent search for information, the ways of the teacher's professional self-development, achievement of positive personal changes. The students were involved in the work of net professional communities ("Intel Education Galaxy", "Nachalka.com" and others) acquiring experience of professional interaction with practicing teachers, methodologists, specialists of education management bodies, scientists, etc.; in designing projects ("Model of the system of lessons on a particular theme of the school course of mathematics"); in solving professionally focused tasks, etc. All these activities helped focusing future mathematics teachers on global professional problems of today, revealing practical value of the acquired knowledge.

Realization of the activity stage of the technology was directed at forming the technological component of the basics of future mathematics teachers' professionalism due to attracting students to quasi-professional activity using interactive and multimedia technologies. This was helped by realization of the pedagogical condition of involving future mathematics teacher in innovational activity.

**Table 3.** Dynamics of the indicators of the levels of the formation of the basics of professionalism in students of the control and experimental groups (% of general quantity)

The level of formation of the basics of professionalism	Group of students							
	CG (140)				EG (150)			
	Stage of the experiment							
	Ascertaining		Control		Ascertaining		Control	
	Q	%	Q	%	Q	%	Q	%
High	3	1.9	4	2.9	2	1.3	12	8.3
Optimal	25	18.1	27	19.5	27	17.8	49	32.8
Basic	65	46.3	72	51.0	70	46.8	60	39.8
Initial	47	33.7	37	26.6	51	34	29	19.1
Criteria statistics T					T <sub>1</sub> =0.28087996 T <sub>2</sub> =12.09858548			

The students acquired the experience of using multimedia technologies while taking part in video-conferences in Skype ("The content and structure of pedagogical professionalism"), creative polemics in Skype ("The new stage of the development of mathematical education: the experience of implementing competence-based and technological approaches"), web-quests ("Interactive teaching technologies in mathematics lessons", "Realization of the main principles of the technologies of differentiated teaching in mathematics lessons"), wiki-projects ("Innovative educational institution"), terminological discussions with the help of the Wikipedia site ("The mathematics teacher's professionalism in the system of scientific notions"), developing web-portfolio ("Modeling the mathematics teacher's professional pedagogical career"), discussing propositions on the interactive board Smart Board, etc. The enumerated activities activated students' autonomy, their responsibility for their personal results, stimulated their innovation activity associated with the rejection of professional stereotypes and the search for new ways of solving pedagogical problems.

The resulting stage was aimed at the formation of the reflective component of the basics of students' professionalism, realization of the pedagogical condition of creating a reflective environment with the purpose of satisfying future mathematics teachers' need of professional self-improvement. Students were encouraged to analyze situations, video records of lesson fragments based on the real events of the learners' pedagogical practice; to search for ways of solving professional problems with further discussing them collectively; to reflect on their own position, its relation to other students' and teachers' views ("My achievements - what are they?", "What have I done to improve the level of my professionalism?", "Why did I behave this way?"); to participate in business and imitation games, solution of simulated problem situations and group analysis of actions, etc. The results of realizing this stage were: reflection of the processes and results of pedagogical activity, in particular, the experience of using interactive and multimedia technologies, awareness of their own position with regard to the further development of the basics of professionalism, orientation of students at creative pedagogical activity.

Implementation of the pedagogical technology of forming the basics of future mathematics teachers' professionalism supposed different types of students' pedagogical practice, which allowed students to master the main functions and content of the activity of the secondary school mathematics teacher, and variety of teaching technologies, to adapt to the profession.

The developed and realized program of the pedagogical practice supposed solution of scientific and practical problem projects in the real conditions of the secondary school aimed at self-development, self-cognition, reflection, personal professional self-fulfillment, differentiation and individualization of the research project tasks with the account of learners' professional orientation, levels of their professional and methodological-mathematical preparation, and individual peculiarities, ensured developing future mathematics teachers' individual working style, and the basics of their professionalism.

### The Control Stage of the Experiment

The generalization of the results of the pedagogical experiment took place at the control stage. The relevance and expediency of stage-by-stage introduction of the pedagogical technology of forming the basics of future mathematics teachers' professionalism was confirmed by the results of the research and their statistic processing. It was established that the experimental group showed essential changes with the positive tendency of growth in the levels of the formation of the basics of future mathematics teachers' professionalism. The comparative analysis allowed for concluding that the formation of the components of the basics of professionalism at the high and optimal levels in the experimental group increased 7% and 15% (in the control group 1.0% and 1.4% correspondingly) (Table 3).



Thus, on the basis of comparison of the results, their quantitative and qualitative analysis it has been revealed that realization of the technology of forming the basics of future mathematics teachers' professionalism by means of multimedia technologies has resulted in essential statistically significant changes in the level of formation of the basics of professionalism in students of the experimental group.

Generalization of the results obtained allows for stating that the research purpose is achieved, while the carried out tasks and the confirmed hypothesis allow for formulating general conclusions.

## DISCUSSIONS

On the basis of the retrospective analysis of future mathematics teachers' professional training within the framework of development and formation of the basics of professionalism there has been traced the genesis of scientists' socially productive and professionally relevant priorities in understanding the essence and structure of the teacher's professionalism, its system-forming factors (pedagogical skill, pedagogical creativity, pedagogical culture), general requirements to pedagogical activity, characteristics of its perfection; there have also been disclosed scientific approaches to forming mathematics teachers' professionalism at different stages of the development of the system of their professional training, as well as tendencies of further development of future mathematics teachers' professionalism in higher school associated with developing and implementing new standards of the higher professional education, personality-centered and competence-based paradigms of education.

It has been established that multifaceted and interdisciplinary character of the teacher's professionalism, in particular that of the mathematics teacher predetermines the choice of the complex approach in the system of scientific knowledge to determining methodological strategies of its study.

In accordance with the chosen general and special scientific methodological way marks there have been defined the fundamentals of understanding the essence of the basics of the mathematics teacher's professionalism and those of the process of their forming: combining systemic, synergetic, competence-based, acmeological, culture-focused, technological approaches.

The basics of future mathematics teacher's professionalism have been defined as an integrative characteristics of the personality that functions as the system of professional-specific, professional-technological and professional-personal competences reflecting the high level of the teacher's professional competency, pedagogical skill, profession-focused qualities, creative approach to organizing pedagogical activity, ability to reflection, readiness to constant self-development and self-perfection.

There has been theoretically substantiated the pedagogical technology of forming the basics of future mathematics teachers' professionalism based on the systemic, synergetic, acmeological, culture-focused technological approaches and presupposing realization of pedagogical conditions ensuring the effectiveness of forming the components of future mathematics teachers' professionalism by means of interactive and multimedia technologies (forming students' motivational-axiological attitude to mastering the basics of the mathematics teacher's professionalism; encouraging future mathematics teacher to innovation activity, improving informational support of the system of future mathematics teachers' professional training, creating the reflective environment with the purpose of satisfying future mathematics teachers' need for professional self-development) and comprises the following stages: preparatory, content, activity and resulting stages.

It has been experimentally proven that implementation of the worked out pedagogical technology has positively affected the effectiveness of forming the basics of professionalism in students of the experimental group. Dynamics of the level characteristics of the development of the basics of professionalism proves that the positive changes that have occurred in the experimental group are significantly higher than those in the control group, namely: the number of learners with the high level of the formation of the phenomenon under study has increased 7.0%, with the optimal level has grown 15.0%, correspondingly, the number of students with the basic level has decreased 7.0%, and that of the students with the initial level has dropped 14.9%. The analysis of the results of the experimental testing of the technology of forming the basics of future mathematics teachers' professionalism, in particular by methods of mathematic statistics (criterion  $\chi^2$ ) has proven pedagogical practicability of the implemented author developments. Consequently, there is every ground to believe that the objectives of the research have been accomplished and its purpose achieved.

Thereby, investigation of the general dynamics in the change of the levels of the formation of the components of the basics of future mathematics teachers' professionalism has allowed for revealing the unevenness of this process and for formulating general recommendations for its effective implementation. In our opinion, there is direct interrelation between the degrees of the formation of the motivational sphere, professional-specific, professional-technological and professional-personal competences. This fact can be regarded as one of the regular patterns of the development, according to which the first component to emerge in the structure of the basics of professionalism creates a base for developing the next component in accordance with the stages of the professional

development of future mathematics teacher's personality. First of all, motivational-axiological attitude to professionalism as the foundation of the ways of organizing pedagogical activity is formed, followed by the interest to the future profession of a mathematics teacher, understanding of its importance, the need to master it. After that the necessary volume of theoretical knowledge is accumulated, both of the professional cycle and of the special one – on the issues of pedagogue's professionalism and using the means and technologies of multimedia. This knowledge, in its turn, functions as the ground for forming professional skills, developing reflective skills, which, taken together, comprise the special competency of future mathematics teachers in the sphere of pedagogical professionalism. Such stage-by-stage complex nature of the technology ensures the integrity of the formation of the basics of future mathematics teachers' professionalism as a new sophisticated personal quality, all components of which are interconnected.

## CONCLUSION

In the process of the conducted experiment there has been theoretically substantiated and experimentally tested the pedagogical technology of forming the basics of future mathematics teachers' professionalism directed at learners' mastering the structural components of the basics of future mathematics teachers' professionalism: motivational-axiological (persistent focus on the profession of the mathematics teacher, presence of professional-pedagogical motivation), cognitive (completeness of knowledge on the basics of professionalism, technologies of teaching mathematics, the content of future professional activity), technological (the level of knowledge of modeling and technological development of the mathematics teacher's professional activity), reflective (the level of formation of reflection, an understanding of responsibility for the results of the professional activity).

In accordance with the pedagogical technology the content of fundamental and professional academic disciplines ("Pedagogy", "Psychology", "History of pedagogy", "Sociology", "Ethics", "Aesthetics", "Educational technologies", "Pedagogic skill", "Ethnic pedagogy") was supplemented with: problem discussions, disputes, debates on the issues of teacher professionalism, a complex of professionally focused tasks, execution of projects using web-quests technology, tasks with elements of scientific research activity requiring the use of online mathematical resources, interactive and multimedia technologies.

There has been worked out the content and multimedia technological support of the following teaching events for future mathematics teachers: the videoconference in Skype "The content and structure of pedagogical professionalism", the creative polemics in Skype "The new stage of the development of mathematical education: the experience of implementing competence-based and technological approaches", the web-quests "Interactive teaching technologies in mathematics lessons", "Realization of the main principles of the technologies of differentiated teaching in mathematics lessons", the wiki-project "Innovative educational institution", the terminological discussion with the help of the Wikipedia site "The mathematics teacher's professionalism in the system of scientific notions", developing web-portfolio "Modeling the mathematics teacher's professional pedagogical career", etc.

There has been developed and experimentally tested the integrated special course "Forming the basics of future mathematics teachers' professionalism by means of multimedia technologies" that determines the theory and methodology of realization of the future mathematics teachers' professional training, informs the learners about the trends of modernizing of multimedia education in the pedagogy of mathematics, discloses the structure of the basics of future mathematics teachers' professionalism, forms its constituents. The materials of the research can be used by pedagogues of the institutions of higher education for further improvement of the theory and practice of professional training, in particular, training of future mathematics teachers in the refresher and retraining courses, in the teachers' self-education activity.

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