E-learning
Vol. 9
Effective Development of Teachers' Skills in the Area of ICT and E-learning

Scientific Editor
Eugenia Smyrnova-Trybulska

Katowice – Cieszyn 2017

E-learning

Vol. 9

Effective Development of Teachers' Skills in the Area of ICT and E-learning

University of Silesia in Katowice,
Faculty of Ethnology and Sciences
of Education in Cieszyn

E-learning

Vol. 9

Effective Development of Teachers' Skills in the Area of ICT and E-learning

Monograph

Scientific Editor

Eugenia Smyrnova-Trybulska

Katowice - Cieszyn 2017

ISSN: 2451-3644 (print edition) ISSN 2451-3652 (digital edition) ISBN 978-83-60071-96-0
Published by: Studio NOA for University of Silesia in Katowice
Faculty of Ethnology and Sciences of Education in Cieszyn
Printed in Poland

The E-learning series is indexed in Journal Factor http://www.journalfactor.org/, Academic Research Index https://www.researchbib.com/, JIFACTOR.ORG, ceon.pl, Polska Bibliografia Naukowa https://pbn.nauka.gov.pl

The E-learning series web-sites: http://weinoe.us.edu.pl/nauka/serie-wydawnicze/seria-e-learning/seria-e-learning http://www.ig.studio-noa.pl/pubusc.html

Scientific publication co-financed by funds for scientific research in the years 2014–2017 granted by the Ministry of Science and Higher Education for the implementation of the co-financed international project IRNet and from statutory funds for research.
The research leading to these results has received funding from the People Programme (Marie Curie Actions) of the European Union's Seventh Framework Programme FP7/2007-2013/ under REA grant agreement No 612536

TABLE OF CONTENTS

TRAINING FOR PRIMARY SCHOOL TEACHERS IN TEACHING MATHEMATICS USING INFORMATION TECHNOLOGIES

Svetlana Skvortsova
South Ukrainian National Pedagogical University named after K.D. Ushynskyi
Odesa, Ukraine
skvo08@i.ua

Marina Haran
Kherson State University, Kherson, Ukraine
m.s.garan3009@gmail.com

Abstract: *The thesis focuses on the possibility of solving the problem of using information technologies in mathematics teaching training for pre-service primary school teachers which involves teaching mathematics by the means of multimedia methodical complex of the discipline «Teaching methodology of the educational branch "Mathematics"». The structure of multimedia methodical complex is presented as a constructor of video presentations of lectures, bank of multimedia materials of laboratory and practical tasks, bank of multimedia materials for students' independent work, tests' bank. The pedagogical experiment proved the efficiency of the multimedia methodical complex in forming all of the components of future primary school teachers' methodical competency in teaching mathematics.*

Keywords: methodical competency, informational technologies.

INTRODUCTION

The level of mathematical education determines the economic, social and, above all, intellectual potential of the society. It is entirely reasonable to have the mathematical competency in the list of the eight key competences recommended by the European Parliament and the Council of Europe. Forming pupils' mathematical competency as a key one must take place at primary school. This fact emphasises the problem of finding not only effective ways of teaching mathematics to primary school pupils, but also training of future primary school teachers to implement such a process.

The issue of training for pre-service primary school teachers in teaching mathematics is the subject matter of research carried out by many leading Ukrainian and Russian

scientists (O. Borzenkova, Ya. Haievets, N. Hluzman, O. Komar, L. Koval, Y. Korol, Ye. Lodatko, O. Mytnyk, R. Romanyshyn, S. Skvortsova, etc.), who emphasize the need to form a professional, in particular, methodical competency. The methodical competency of a teacher in teaching Mathematics to pupils was studied by I. Akulenko, Ya. Haievets, A. Kuzminskyi, O. Larionova, A. Liebiedieva, I. Malova, O. Matiash, V. Motorina, S. Skvortsova, N. Tarasenkova and others, who understand it as an integrative professional skill of the individual, realized in the theoretical readiness and practical ability to perform all types of methodical activity, as the ability to solve standard and problem methodical tasks.

One of the ways to increase the effectiveness of methodical training for pre-service primary school teachers is to apply information technologies (IT) in the university educational process. The research conducted by V. Imber, V. Kotkova, L. Petukhova, O. Spivakovsky, O. Sukhovirsky, V. Chychuk and others is devoted to this issue. V. Viun, I. Huz, A. Demydenko, M. Shyshlakov, S. Mezhenska, M. Kalashnikov, S. Ryzhenko and others pay attention to the possibilities of using multimedia as modern information technologies.

Despite rather thorough presentation in the scientific literature of common approaches to using IT in pre-service teachers' training, the spectrum of multimedia means of teaching is still quite limited, in particular, the issue of their use in the course of mastering the academic discipline «Teaching methodology of the educational branch *Mathematics»* remains unresolved; the components and structure of the multimedia methodical support of this course are not substantiated.

1. THE THEORY AND PRACTICE OF PRE-SERVICE PRIMARY SCHOOL TEACHERS' TRAINING IN USING INFORMATION TECHNOLOGIES

1.1. Methodical competency in teaching mathematics as the goal and result of pre-service primary school teachers' training

In our study, based on the definition of S. Skvortsova and Ya. Gaieves (Skvortsova, 2013) we interpret the methodical competency of a primary school teacher in teaching mathematics to students as a system of personal formation, reflected in the ability to organize and conduct the process of teaching mathematics to pupils of the grades 1-4 at the level of modern requirements, the ability to solve methodical issues successfully, based on theoretical and practical readiness to teach the subject.

We understand the complex of components – competencies of the lower order: normative, variative, special-methodical, technological, design-modelling, control and evaluation in the structure of the methodical competency of future teachers in teaching mathematics to primary school pupils (Skvortsova, 2015).

The normative component of the teacher's methodical competency in the field of teaching the subject is prevalent among the others and is shown as the ability to realize the goals and objectives of the subject training, regulated by the State Standard of Basic Primary Education and the program based on the readiness of a teacher to use the normative documents.

Variable competency of a teacher means the readiness of a teacher to work with any learning and teaching set; the ability to choose the most effective learning and teaching set for achieving the goals and objectives of teaching a certain subject, approved by the State Standard and the curriculum.

Special methodical competency is characterized as the ability to form pupils' all the elements of the content of the subject, based on the theoretical and practical readiness to teach pupils any program issues.

The activity of a teacher involves constant monitoring of the quality of education, therefore, the control and evaluation competency is identified, it is in the readiness of a teacher to implement the criteria of assessing the academic achievements of pupils and the ability to assess the educational achievements of pupils adequately.

Qualitative Mathematics teaching is impossible without the introduction of modern educational technologies, innovative approaches to the study of certain issues of the course, advanced pedagogical experience, therefore the technological component is based on the knowledge of modern educational technologies, innovative methodical approaches, advanced pedagogical experience, and the ability to apply them.

The normative, variative, special-methodical, control and evaluation and technological components of methodical competency serve as the basis of designing the systems of lessons and individual lessons, during which they realize a certain goal and tasks, they find appropriate means, methods, forms of organization and teaching methods. The design and modelling component of the teacher's methodical competency is the ability of a teacher to design the process of teaching a subject during the school year, to design lessons for different teaching sets, in accordance with modern requirements, the ability to model the activities of a teacher and the activities of pupils at each stage of the lesson, aimed at achieving educational outcomes.

We emphasize that each of the components of methodical competency has its complex structure and contains the motivational-value, cognitive, activity and reflexivity-building components.

1.2. The course «Teaching methodology of the educational branch *Mathematics*» and its methodical support

Training pre-service primary school teachers in teaching mathematics is understood by us as one of the aspects of the general system of training, namely, as the process of methodical training, which is carried out, in particular, during pupils' mastering of the discipline «Teaching methodology of the educational branch *Mathematics*» , its purpose is to form pre-service teachers' methodical competency.

The clarification of the status of the training of pre-service teachers in teaching mathematics, carried out by us within the framework of the conducted experiment by studying the normative programs of the discipline «Teaching methodology of the educational branch *Mathematics*» at 12 universities of Ukraine, testifies to differences in the distribution of the academic load for classroom and independent work even for the same total academic hours for mastering the discipline; in the number of lectures and practical / laboratory classes as in the whole course, as well as in separate content modules; in the content of the discipline and its distribution by modules.

Paying attention to the autonomy in the activities of the university, the content may vary, the university has the right to license and approve at the Ministry of Education and Science of Ukraine its standard, which allows certain differences in the content of the course at various universities. However, the content of the discipline should reflect the content of the educational branch "Mathematics" in accordance with the State Standard of Primary Education clearly, therefore it is essential that there is an invariant core that provides the formation of general competencies and special professional competencies, including methodical competency.

As a result of the study dealing with the analysis of the branch standard of the specialty 6.010100 "Primary Education" of the direction of training 0101 "Pedagogical Education" and the State Standard of primary general education, the rational content of this discipline is proved (Skvortsova, 2015). It includes the following sections: 1) "General questions of the methodology of teaching mathematics at primary school"; 2) "Modern lesson of mathematics at primary school: a technological approach"; 3) "Method of training content lines: numbers, actions with numbers; quantities; mathematical expressions, equations and inequalities; plot tasks; spatial relationships, geometric shapes". This content meets the requirements of the Branch Standard, reflects the content of the educational branch "Mathematics" of the State Standard of Primary General Education and the curriculum of mathematics for grades 1-4, and is aimed at forming all the components of methodical competency of pre-service primary school teachers in the teaching of mathematics, although it may be structured in content modules differently.

1.3. Using multimedia in the process of studying the course «Teaching methodology of the educational branch *Mathematics*»

It has been scientifically proved that using IT is an effective means of activating educational and cognitive activity of students in the educational process of higher education institutions (Heba, 2009). In the context of our study, we understand training for pre-service primary school teachers in ~~for~~ teaching mathematics with the use of IT is the process of methodical training, which is carried out when students study the discipline «Teaching methodology of the educational branch *Mathematics*» with the appropriate use of IT. Information technologies, which involves integrating audiovisual information in a computer system in various forms

and using it in the form of an interactive dialogue with the possibility of choosing the line of development of the given plot or situation, is understood by us as multimedia (Kostolányová, 2009).

To find out about the possibilities of using multimedia in the teaching process «Teaching methodology of the educational branch *Mathematics*» and the relevance of creating multimedia provision of this discipline, within the framework of the ascertained experiment (2012-2014), 20 questionnaires were distributed as part of the survey conducted among the teachers of this discipline (Skvortsova, 2016).

As a result of processing the responses to the questionnaires, it was found that all the teachers of this discipline (100% of the respondents), without exception, feel the need to use information technologies during teaching pre-service primary school teachers to teach mathematics. Thus, most teachers are convinced of the expediency of using information technologies during lectures (95%) and practical classes (95%), control measures (80%), independent work (70%). Significantly fewer respondents (40%) see the need for information technologies to be used during laboratory studies, which may be due to the lack of planning of this type of training in the higher education programs of the educational discipline of TMEBM. Despite the teachers' awareness of the necessity and expediency of using information technologies in the process of teaching TMEBM, only 20% of them confirm that they always use them during in-class work, 55% of the respondents do this quite often, 25% – sometimes. In our opinion, this is due primarily to the fact that not all teachers understand the possibilities of using information technologies during classroom work for students to master this discipline completely. So, 90% of the respondents consider information technologies as a means of video demonstration of a lesson; as the means of presenting academic content in the structured form – 80% of the teachers; as the means of demonstration of videos of reasoning of real students in the classroom – only 45% of those who answered; as the means of work with electronic versions of current textbooks on mathematics – 35%, with electronic versions of normative documents – 30%; as the way of presenting task–resolution entries using animations – 30% of the respondents.

Almost all teachers of the methods of teaching mathematics (95%) have confirmed that they use information tools to ensure the independent work of students of the discipline. Most of them consider it expedient to use electronic documents (60%); Internet sites (60%); audio video files (60%); E-books (55%) for that. A much smaller proportion of methodologists seek to apply distance courses (40%); curriculum (35%); electronic test systems (30%); interactive tutorials (25%). In our opinion, these indicators are primarily related to the absence or limited access to such facilities.

Regarding the use of information technologies during monitoring activities, it should be noted that although most teachers (95%) use testing among other forms of control, not all do resort to computer tests to assess the academic achievement of students in the studied discipline. Thus, the results of the questionnaire showed that only 10%

of the teachers, while conducting a survey in a test form, always use computer tests; 20% of the respondents indicated that they often conduct tests in a computerized form; 50% of the respondents confirmed that they sometimes use computer tests to assess the academic achievements of students in the discipline TMEBM; 20% – never practice this form of control. However, the majority of teachers are convinced that computer tests will enable the process of training students for practical classes, and the teacher – to control its level effectively among students, which in its turn will reduce the number of students who appear on a practical lesson without proper training.

All the teachers who participated in the survey (100%) agreed to use presentations during classes as part of TMEBM. The results of the conducted survey indicate that teachers already demonstrate presentations of lectures, teaching TMEBM (80% of the respondents); however, the majority does not do that regularly – only 20% of the respondents confirm that they always use presentations during lectures. Despite using presentations of lectures by the majority of lecturers, according to the results of the questionnaire, the presentations are the title slide with the theme (100%); lecture plan (100%); problem issues (70%); literature (85%); the main content of the topic in the form of abstracts (65%) or in full measure (5%); reflection (50%). Quite often, teachers include in their presentations video extracts of mathematics lessons taught at primary school (65%); fragments from the current mathematics textbooks (60%); fragments of normative documents (55%); examples of done task solutions (55%). Significantly, fewer teachers of methods of teaching mathematics use visual means in presentation (40%) or visual means, with simulation of work using animation effects, with a dynamic demonstration (25%); examples of the teacher's work on individual tasks with visual fixing of the steps of the teacher (40%) or examples of solving tasks that are deployed in animation dynamically (15%); real pupils' pictures at mathematics lessons (30%). This, in our opinion, is not very optimal using possibilities of presentations during lectures, first of all due to the fact that most of the teachers do not have enough knowledge about the program «Microsoft Power Point» for their creating (this program, according to the results of the survey, is used by 100% of the respondents to create, view and demonstrate presentations). So, only 30% of the teachers have thorough knowledge of the program; the rest use only the basics of «Microsoft Power Point»: they use templates (65%); add texts to slides (75%); add tables, graphs, charts (65%); adjust the animation of the transition between slides (50%); adjust the animation of the text (45%); add and format images (45%); add hyperlinks and controls (45%); use SmartArt objects (40%); add video and sound (35%); apply animation effects in the records of solutions (35%). Most teachers cannot customize animation on presentation slides, but they consider animation effects that illustrate actions with visibility, or the process of solving tasks that significantly increase the rate of lectures, visualize its content, facilitate better understanding of the information by students (Smyrnova-Trybulska, 2012). In addition, it is concluded that those teachers who already use presentations at TMEBM lectures mainly created them on their own and submitted the main theses of the lecture on the presentation slides, but

did not use the means of structuring the theoretical material (tables, flowcharts, "SmartArt" objects, etc.), although 90% of the teachers agreed that the structuring of educational material in schematic form facilitates students' perception and comprehension of educational information significantly.

The problem of using presentations at practical and laboratory classes is open, despite the fact that most of the training time for these studies should be planned to imitate the teacher professional work and analysis. Instead, information technologies allow at practical / laboratory classes in terms of classroom to watch video of the best lessons in mathematics or their fragments for analysis of the teacher's activity, clarifying goals of pedagogical influences, used by him at certain stages of the lesson, finally, selecting the most attractive educational strategy of organizing a mathematics lesson and organizing communication with pupils. 80% of the interviewed teachers use in the process of teaching TMEBM video materials (video recordings of fragments of mathematics lessons). Only 10% of the respondents confirmed that already have all the necessary video lessons in mathematics, and the rest (90% of the teachers) would like to have a bank of video to improve mastery of the discipline TMEBM (images of individual phases of lessons, use of learning technologies in the mathematics lessons, forms of work or individual methodical approaches, etc.).

As a result of analysis of the responses of teachers to questions about the use of lecture presentations, use of the bank of video lessons, electronic textbooks, etc., we found that only 30% of the teachers are satisfied with their own multimedia software of the discipline TMEBM, 20% – partially satisfied and 50% of the respondents are not satisfied with the available multimedia courseware. Most of the teachers (85%) expressed the wish to have an electronic educational and methodical discipline, only 10% of those polled already have it, 5% have not been determined yet, their wish will depend on the quality of the product. Most teachers would like to have a part of multimedia software: presentation slides of lectures with animation, with the possibility of independent design of lectures (presentations, lectures designer; 85%); a bank of multimedia materials for practical classes (85%); video recording of real math lessons (80%); computer tests (80%); presentations of practical classes (75%); electronic teaching sets (60%); electronic textbooks on the methodology of teaching mathematics (55%); video lectures or presentations of lectures with audio (55%); Legal documents in electronic form (50%); Electronic textbooks on mathematics 1 – 4 grades (40%); 5% want to have other materials for control. Therefore, the analysis of questionnaires and interviews with teachers of the discipline TMEBM can be summarized by stating that efficient organizing the training process with the discipline TMEBM now is impossible without the use of educational means, developed on the basis of information technologies (Smyrnova-Trybulska, 2016).

The analysis of the ascertained experiment became the grounds for separation of components of multimedia software of the discipline «Teaching methodology of the educational branch *Mathematics*» and allow one to determine its components: the

designer of multimedia presentations, lectures (created with the help of the program MS PowerPoint) with a possibility of choosing individual slides by the teacher and creating own lecture presentation on their basis; bank of multimedia materials for practical / laboratory work (videos, electronic versions of textbooks, regulations, manuals for teachers, etc.); bank of multimedia software for independent work of students (electronic textbooks, video presentations of lectures, online resources, etc.); test bank (created in Moodle). All these elements form the media and methodical complex of the discipline «Teaching methodology of the educational branch *Mathematics*» (hereinafter – MMC) (Skvortsova, 2016).

2. THE MULTIMEDIA METHODICAL COMPLEX AS THE MEANS OF TEACHING THE DISCIPLINE «TEACHING METHODOLOGY OF THE EDUCATIONAL BRANCH *MATHEMATICS* »

2.1. General requirements for the multimedia methodical complex of educational discipline «Teaching methodology of the educational branch *Mathematics* »

Understanding the fact that the MMC should perform the function of facilitating the perception, comprehension and memorization of educational information by students, should have an effective influence on the formation of methodical competency and should be organized in a special way, we have identified a number of general requirements – psychological, didactic, methodical, organizational (Skvortsova, 2016).

We understand the psychological requirements to the MMC as the requirements for the design of its components in accordance with the psychological patterns of educational knowledge and age characteristics changes of students' cognitive processes: taking into account the structure of educational and cognitive activity, adaptability and emotional saturation of education.

Didactic requirements for the MMC contain requirements to the detailed content of multimedia means, which is manifested in the features of the structure of individual components of the complex, and the requirement for the methods of organizing the educational and cognitive activities of students: competency orientation, scientific, systematic and consistent, accessibility, visualization and presentation, professional orientation, interactivity , ensuring conscious getting of knowledge, activity and independence of students.

The methodical requirements for the MMC provide consideration in the detailed content of the specifics and features of the educational discipline, its conceptual apparatus, methods and regularities of its knowledge: the focus on the formation of individual components of methodical competency, quasi-professional activity.

We understand the organizational requirements for the MMC as the requirements to organizing the structure of the complex, revealing the peculiarities of the ordering of its components and the structural features of each of them, and are manifested in

ensuring the completeness of the discipline teaching cycle, the hierarchy of the structure of the complex, the variability of the forms of presentation of educational information; requirements to organization of the work with the MMC, providing for the provision of instructions and equipment.

The main means by which students are acquainted with the content of the discipline «Teaching methodology of the educational branch *Mathematics*» are multimedia presentations of lectures. According to this, we specify the general requirements for the MMC (taking into account psychological peculiarities of perception, awareness and memorization of educational material by students in accordance with their training, age and even gender characteristics), the requirements for the structure and content of presentation slides, use of fonts, colours are formulated, etc., as well as requirements for the visual and sound series, text, design and navigation.

2.2. The structure of the multimedia methodical complex of the educational discipline «Teaching methodology of the educational branch *Mathematics*»

The components and structure of the MMC are given in Figure 1. The complex has a two-tier structure: the multimedia support is structured in accordance with the organizational forms of training and in accordance with the appropriate content of the discipline. Each of the elements which is a part of the MMC promotes the formation of methodical competency in general or its individual components (Figure 2) (Haran, 2016).

The constructor of presentation of lectures – the catalogue of files structured according to the three thematic sections in accordance with the reasoned content of this discipline is given for multimedia support of lectures on the discipline «Teaching methodology of the educational branch *Mathematics*» in the MMC.

The constructor of presentations of lectures is a clear hierarchical structure, in which the levels of the lower order are separate presentations, detailing the content of the subject and can be used by the teachers to create their own multimedia presentations of lectures.

We understand the multimedia presentation of the lecture on the discipline «Teaching methodology of the educational branch *Mathematics*» as the presentation in which the educational content is presented in structured form; methodical approaches are illustrated with the help of using colour and animation effects; the method of work on certain mathematical issues is given by the means of dynamic deployment of the solution; the natural visuality is replaced by electronic and the technique of work with it is demonstrated with the help of animation effects; hyperlinks to electronic versions of normative documents and mathematics textbooks of primary school, to video fragments of real mathematics lessons at primary school, illustrating an appropriate element of educational content (the structure of the lesson, teaching technologies, etc.), as well as video fragments with the arguments of pupils demonstrating the ways to calculate, work on tasks, etc. (Skvortsova, 2016).

To organize a lecture, a teacher can use the multimedia presentation of the lecture offered in the presentation designer for each topic in the completed form, or select a question from the proposed list and the necessary slides to create his own presentation. The method of organizing the lecture using the presentation designer is presented as a step-by-step arrangement and demonstrated on specific examples of guidance papers of lectures.

The multimedia materials bank for practical / laboratory classes on the discipline «Teaching methodology of the educational branch *Mathematics*» is provided for multimedia support of practical and laboratory classes the MMC, it is understood as a set of files containing the following blocks: video materials; textbooks; normative provision of the educational branch "Mathematics"; multimedia presentations. Each block can be used by a teacher for multimedia support for a particular stage of practical or laboratory work or included in a presentation that will be used during the class (Skvortsova, 2016). The methodology of organizing practical and laboratory classes is illustrated by examples of methodical developments of these organizational forms of study.

The bank of multimedia materials for independent work of students is the expanded bank of multimedia materials for practical / laboratory classes, including such blocks: textbooks and teaching and methodical manuals on the discipline «Teaching methodology of the educational branch *Mathematics*»; video presentations, video records of comments on specific questions of the Math program for the 1-4 grades, etc (Skvortsova, 2016). Bank materials can be used by students for preparation for training sessions and control activities, as well as for the self-mastering of the content of the topic.

The MMC has the bank of test tasks in order to provide control measures, it contains a set of test tasks on specific topics of discipline, sorted by categories according to the given above appropriate content of the discipline «Teaching methodology of the educational branch *Mathematics*» (Skvortsova, 2016). Using this bank, a teacher can create the necessary test for a certain course topic by selecting questions from the proposed list and choosing the settings for the duration of the test, the method of evaluation, etc.

The methodical recommendations for using the materials of the complex by the teachers of the academic discipline (Haran, 2016) is created in order to regulate the organization of work with the MMC. The recommendations contain guidelines for the activities of the teacher to create his own presentation of the lecture with the help of the designer of presentations of lectures, the development of a practical / laboratory class using the bank of multimedia materials and the bank of test tasks; description of the opportunities provided to students in case of using the bank of multimedia materials for their independent work.

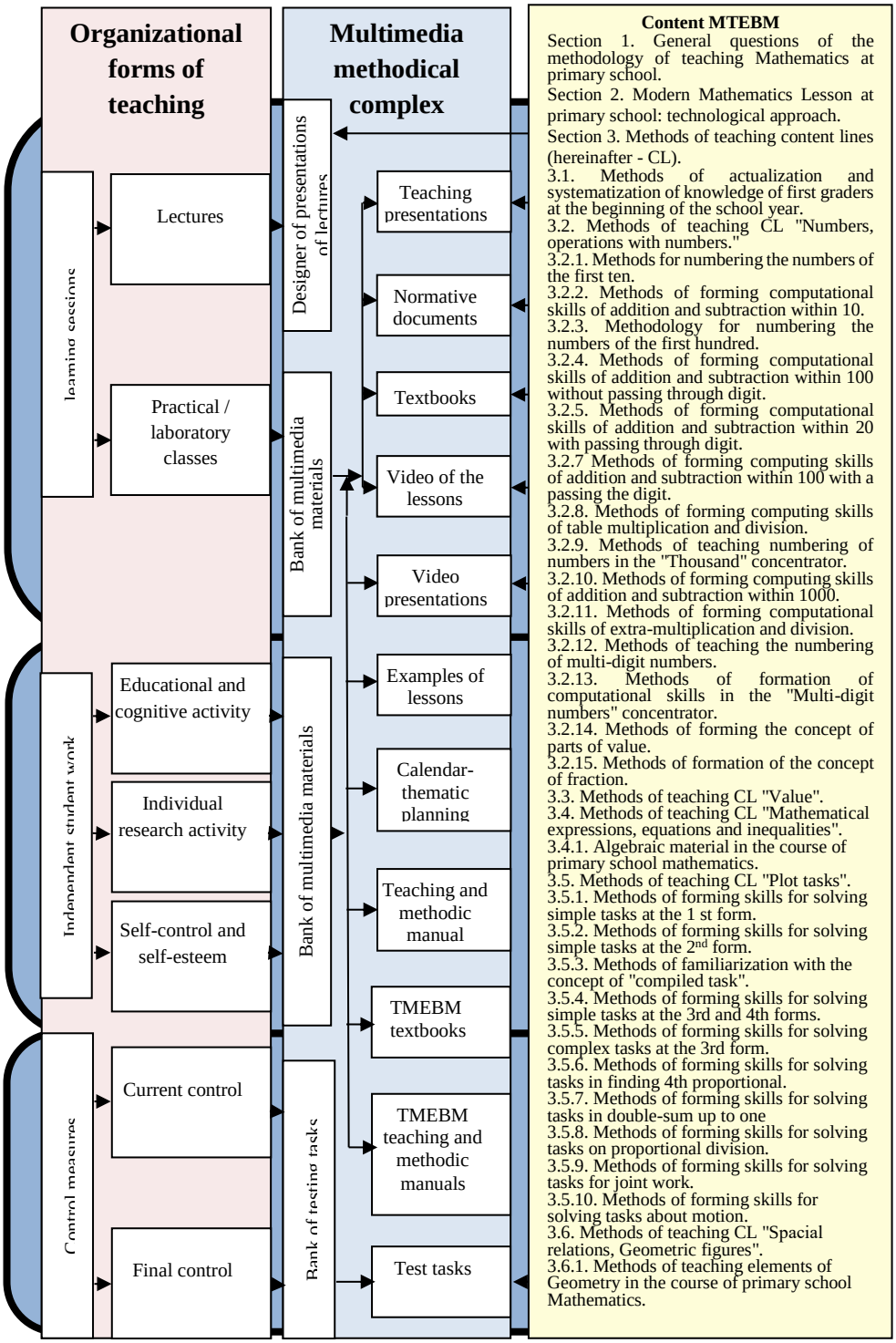

Figure 1. The structure of the multimedia methodical complex on the discipline «Teaching methodology of the educational branch *Mathematics*» (TMEBM)

Source: Own work

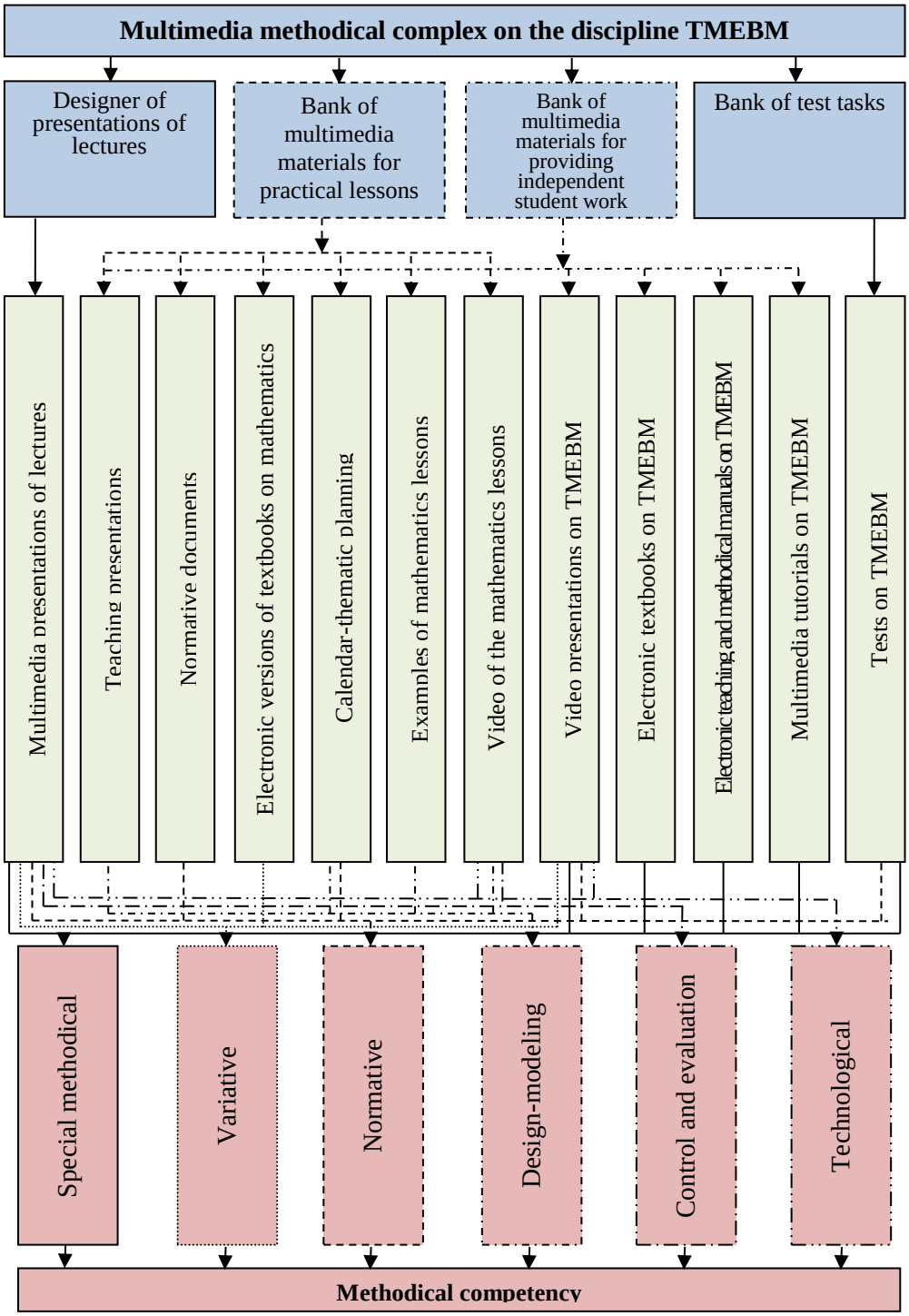

Figure 2. Scheme of the methodical provision of the process of forming methodical competency of future teachers of primary school in the discipline «Teaching methodology of the educational branch *Mathematics*» (TMEBM)

Source: Own work

3. EXPERIMENTAL TEACHING OF THE COURSE «TEACHING METHODOLOGY OF THE EDUCATIONAL BRANCH *MATHEMATICS* WITH USING THE MULTIMEDIA METHODICAL COMPLEX

Experimental efficiency testing of the developed multimedia methodical complex for the training of future primary school teachers in mathematics teaching was carried out from 2012 to 2016 in the process of the pedagogical experiment that was implemented in three stages.

At the ascertained stages of the experiment (2012-2014), the Branch Standard analysis was conducted. Also normative programs of the discipline «Methodology of teaching of the educational branch *Mathematics*» at higher educational establishments of Ukraine that train pre-service primary school teachers was conducted; the methodical support of this educational discipline available in Ukraine was analysed; the questionnaire for the lectures of the course «Teaching methodology of the educational branch *Mathematics*» in the higher educational establishments of Ukraine was conducted with the aim to determine the condition of the usage of multimedia facilities in the training practice.

The search stage of the pedagogical experiment, the purpose of which was to develop the MMC and the methods of its usage, lasted during 2012-2014. At this stage, the components and the structure of the multimedia support of the educational discipline were specified; the requirements that the MMC of this discipline is up to quality, were determined; according to the specified requirements, the MMC was developed; the method of usage of the MMC individual components was proved.

The efficiency checking of the usage of the developed MMC took place in the process of methodical training for pre-service primary school teachers in mathematics teaching. It was carried out during the forming stage of the experiment, that lasted during the academic years 2014-2015, 2015-2016.

The uncovering of efficiency of the MMC in the training process of pre-service primary school teachers included: the conducting of student incoming diagnosis to form control and experimental samples; statistical grounding of the samples; the development of criterial-level study instrument; to determine how to divide students according to the levels of formation of certain criteria (motivational, content and operational-activity) components of the methodical competency; the comparison of student distributions of experimental and control samples; the statistical grounding of differences in distributions.

Experimental verification of the efficiency of the usage of the developed multimedia methodical complex and its work methods took place while students are obtaining the specialty 013 Primary education of the educational discipline «Teaching methodology of the educational branch «Mathematics»».

325 students participated in the experiment: 154 students were in the experimental group (students of the K. D. Ushynskyi South Ukrainian National Pedagogical University and Kherson State University) and 171 students were in the control group (students of the V. V. Sukhomlynskyi Nikolayev National University and the P. Tychyna Uman National Pedagogical University).

During the forming experiment, the MMC TMEBM was used in the educational process of the EG according to the methodical recommendations. In particular, during the lectures teachers of TMEBM used the materials of the construction of lectures' presentations. During practical and laboratory classes the materials of the bank of multimedia materials for practical / laboratory classes were used. In the process of independent work of students, the teachers offered them materials of the bank of the multimedia materials for maintenance of their independent work. Students were offered training and control tests for checking and self-testing the knowledge, developed on the basis of the test bank materials. In CG, the training for students in teaching mathematics was traditional without the introduction of the information technologies.

The efficiency of pilot testing is evaluated according to motivational, content and operational-activity criteria in accordance with the following exponents: aspiration, knowledge and skills that correspond to the components of the methodical competence of the primary school teacher in mathematics teaching. The differences in the performance of exponents (by the persistence of aspirations, the fullness and generality of methodical knowledge, by the awareness of methodical skills of students, etc.) are put to the basis of the characteristics of the levels of the methodical competency formation of primary school teachers - low, medium, sufficient and high. The low level testifies to the existence of a discrepancy between the development of methodical competency and the requirements of methodical activity; the medium level of methodical competency allows the teacher to perform professional functions only partially according to the examples of methodical activity that he has; the sufficient level testifies that the primary school teacher has the ability to carry out methodical activity and achieve the intended purposes of teaching and developing of students; the high level provides that the teacher has a creative approach to mathematics teaching to pupils, the ability to create innovative methodical approaches and his proprietary technology.

After the experimental study had been finished, the student survey was conducted in order to determine the level of methodical competency formation according to motivational criterion. The survey has shown the increase of the corresponding indicators of the experimental sample compared with the control sample. This testifies to the existence of the positive influence of the application of the developed MMC on the formation of all components of the methodical competency (based on the motivational criterion). The differences in distributions were confirmed by the statistical processing according to Fischer's criterion. In addition, students of the experimental groups have demonstrated a stable desire to use IT in the process of their own pedagogical activities.

In order to identify the level of the formation of methodical competency under the content and operational-activity criteria, the testing was carried out. The test tasks were aimed to diagnose all the components of methodical competency: normative, variative, special-methodical, technological, design-modelling and control-evaluation. The formation level of each of these components was higher in the experimental group than in the control group. The summarized results of diagnostic tasks performing (Figure 3) testify that the developed MMC has a positive influence on the level of the methodical competence formation. The absence of high level of the methodical competence formation is quite logical, since this level involves a creative approach to mathematics teaching to pupils and the ability to create innovative methodical approaches. Therefore, it can only be achieved by some teachers in the process of professional development.

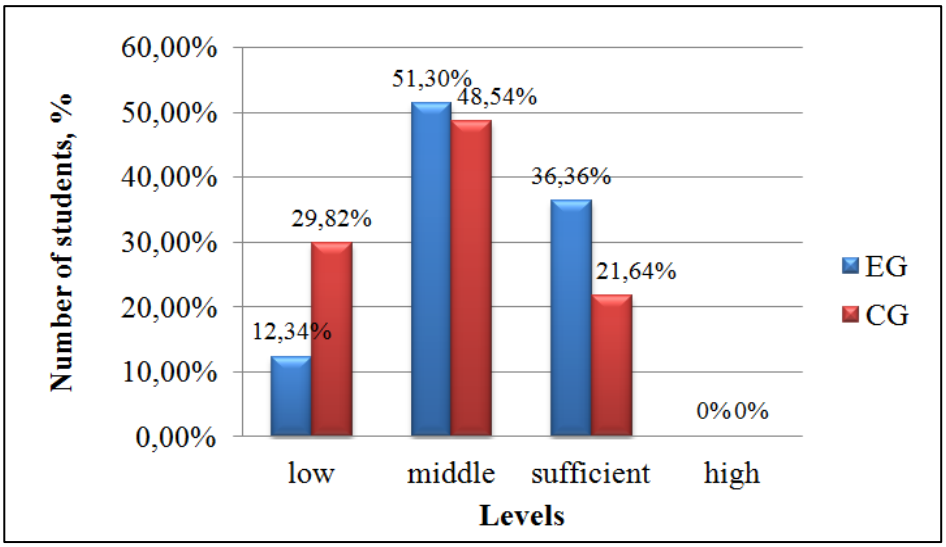

Figure 3. Distribution of students of the experimental and control groups according to the levels of the methodical competency formation

Source: Own work

As a result of the statistical justification of differences in student distributions, according to the Pearson criteria ($\chi 2$), the value $\chi^2_{exp} = 17,77$, was obtained, while $\chi^2_{cr} = 5,99$. Thus, $\chi^2_{exp} > \chi^2_{cr}$, this indicates that there are statistically significant differences in the respondents' distribution in the control and experimental samples (Haran, 2016).

Thus, there are grounds to conclude that the statistical differences are valid as to the distribution of students of the experimental and control groups according to the levels of the methodical competency formation. The mentioned above gives us the possibility to confirm that these differences are the result of the MMC introduction in experimental groups and it proves the hypothesis of our research.

CONCLUSION

The efficiency of acquisition of the discipline content «Teaching methodology of the educational branch *Mathematics*» by students is provided through the escalation of the educational process, the presentation of information in various forms and the use of information in the form of interactive dialogue, that is provided through multimedia means of teaching. As part of the multimedia methodical complex of educational discipline, the presence of the presentation designer of lectures is provided; the bank of multimedia materials for practical / laboratory classes (video records of mathematics lessons, electronic versions of current mathematics textbooks for grades 1-4, the normative documents for primary education, the methodical aids for teachers, etc.); the bank of multimedia materials to provide students with self-guided work (video records of lessons, electronic versions of current mathematics textbooks for grades 1-4, the normative documents for primary education, the methodical aids for teachers, electronic textbooks and manuals for students, video records of lecture presentations, video records of comments on specific aspects of the program, links to the resources on the Internet etc.); the bank of test tasks.

The multimedia methodical complex of educational discipline «Teaching methodology of the educational branch *Mathematics*» satisfies the set of requirements: psychological, didactic, methodical and organizational ones. The observation of these requirements enables the effective formation of methodical competence of future primary school teachers in mathematics teaching with means of multimedia.

The two-level structure of the multimedia methodical complex is offered: according to the content of the educational subject (under three sections, and there are units in every section that contain separate topics and these topics are developed through the system of questions) and according to forms of organization of the educational process (lectures, practical / laboratory classes, student self-guided work).

As a result of conducting the formative experiment, during which the multimedia methodical complex of educational discipline «Teaching methodology of the educational branch *Mathematics*» was introduced and as well as the method of its usage, the statistically significant changes in the levels of formation of methodical competence of pre-service teachers in Mathematics teaching were recorded in the experimental groups. It has also been found out that students of experimental groups have more opportunities to use IT in Mathematics teaching to pupils and show the steady aspiration to do that. According to the analysis of the experimental data obtained, the conclusion on the efficiency of the developed multimedia methodical complex for future primary school teachers in Mathematical teaching was made.

The conducted research does not cover all aspects of the problem of using IT in the process of pre-service primary school teachers' training in mathematics teaching to

pupils. The perspectives of further research may deal with the improvement of the multimedia methodical complex of the educational discipline «Teaching methodology of the educational branch *Mathematics*» due to the improvement and development of its components.

REFERENCES

Haran M., 2016: *Checking the effectiveness of the use of multimedia methodical complex in the process of methodical preparation of future primary school teachers to mathematics training*. Pedagogy and psychology: the current state of development of scientific research and prospects, Zaporizhzhia, 2016, P. 43-47.

Haran M., 2016: *Method of multimedia methodical complex using for educational subject «Teaching methodology of the educational branch «Mathematics»»: [methodical recommendations]*. Kherson: PE Vyshemyrskyi V., 2016, 108 p.

Haran M., 2016: *Requirements to multimedia didactic and methodical complex of the discipline Methods of teaching of the educational branch «Mathematics».* Vzdelávanie a spoločnosť, Prešov, 2016, P. 151-164.

Heba A., 2009: *Information and Communication Technologies in the Process of Developing Mathematical Competences among High School Students In:* Theoretical and Practical Aspects of Distance Learning, edited by E. Smyrnova-Trybulska, Cieszyn: Studio TK Graphics for University of Silesia, 2009, p. 308. ISBN: 978-83-925281-4-2. P. 169-179.

Kostolányová K., 2009: *New Approaches of Information Technology Applied in Education.* Theoretical and Practical Aspects of Distance Learning, Cieszyn, 2009, P. 60-65.

Skvortsova S., Haran M., 2016: *The using multimedia means in the training of primary school teachers in Ukraine: realities and prospects*. Science and Education a New Dimension. Pedagogy and Psychology, IV (43), Issue 88, Budapest, 2016, P. 41-45.

Skvortsova S., Haran M., 2015: *Training of primary school teachers for teaching mathematics pupils*. Mountain School of Ukrainian Carpaty, № 12–13, Ivano-Frankivsk, 2015, P. 209-215.

Skvortsova S., Haran M., 2016: *Multimedia support of the discipline"Methods of teaching educational branch "Mathematics" (MTEBM) as a means of forming methodical competency of future primary school teachers.* Bulletin of Chernihiv National Pedagogical University named after T.G. Shevchenko, № 137, Chernihiv, 2016, P. 284-288.

Skvortsova S., Haran M., 2016: *The consideration of psycho-physiological peculiarities of students as a requirement for presentation of educational*

information in presentations of lectures. Social and Economic Priorities in the Context of Sustainable Development : Monograph, Opole, 2016, P. 371-377.

Skvortsova S., 2015: *Structural and functional model of the methodical competency formation of future Mathematics teachers in teaching primary school pupils.* Pedagogical sciences: a collection of scientific works, Issue 6, Kherson: KSU, 2015, P. 270-276.

Skvortsova S., Haievets Y., 2013: *Future primary school teachers' training for teaching primary school students to solve narrative mathematical problems: monograph.* Kh.: Ranok-NT, 2013, 332 p.

Smyrnova-Trybulska E., 2012: *Teachers' Competence in Using Information and Educational Internet Resources in the Education Process.* In: *Distance Learning in Applied Informatics DIVAI 2012*, 9th International Scientific Conference on Distance Learning in Applied Informatics, 2012. Conference Proceedings. *Editors:* Martin Cápay, Miroslava Mesárošová, Viera Palmárová. Constantine the Philosopher University in Nitra, Nitra-Sturovo, Slovakia, 2012, p. 289–300. ISBN: 978-80-558-0092-9. <http://conferences.ukf.sk/index.php/divai/divai2012/paper/view/901>

Smyrnova-Trybulska E., Ogrodzka-Mazur E., Szafrańska-Gajdzica A., M. Drlík, Martin Cápay, J.Tomanová, P. Švec, N. Morze, R. Makhachashvili, M. Romanyukha, M. Nakazny, L. Sorokina , T.Issa, T. Issa, 2016: *Recommended Applications for Making Presentations and Didactic Videos. Some Research Results*. In: DIVAI 2016 – Distance Learning in Applied Informatics. 11th International Scientific Conference on Distance Learning in Applied Informatics Conference Proceedings, 2–4 May 2016. Editors: Milan Turčáni, Zoltán Balogh, Michal Munk, Ľubomír Benko, Constantine the Philosopher University in Nitra, Faculty of Natural Sciences, Department of Informatics, Editors Nitra, Publisher: Wolters Kluwer, p. 235–246. ISBN 978-80-7552-249-8. ISSN 2464-7470 (Print) ISSN 2464-7489 (Online).