

MODERN STATE AND CHANGES IN MATHEMATICS TEACHER TRAINING IN RUSSIAN FEDERATION

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ABSTRACT

Serious changes in social and economical life in Russian Federation during the last decade had remarkable impact also on mathematics teacher education. Instead of strict and uniform curricula for mathematics teacher preparing, new standards have been elaborated by the Ministry of Education and since 1996 are being adopted by pedagogical universities. On the basis of these standards, universities construct their curricula for themselves. The example of a new course “Psychological and pedagogical foundations of mathematics teaching» within the new teacher education program at the Moscow State Pedagogical University is described.

Keywords: mathematics education, teacher education, curricula development, Psychological foundations of mathematics teaching

1. Overview

Serious innovations in educational system and, generally, the steps to the educational reforms were caused by crucial changes in political and social life during the last 10-15 years.

The Ministry of Education declared many good intentions.

First, two problems were stated:

1) To formulate a purpose of school education which is not reducible to preparing pupils for entering universities and colleges.

2) To give a priority to the developing function of education, to teaching pupils for the life in conditions of democracy.

New slogans were raised: openness, democratization, decentralization and humanization.

In curricula elaboration, the decentralization meant:

1) the rejection of the centralization of the process of elaboration of curricula.

2) the permission to use alternative curricula, textbooks, teaching methods etc.

3) the reflection of the regional and national specific in curricula.

The humanization demanded the turn towards needs of children and, in particular, abolition of the compulsory character of homework.

Also, the humanization asked for the differentiation of education, especially at the upper secondary level.

The differentiation is the central part of discussions on the reforms which continue since 1990 till today. Two kinds of the differentiation are being discussed:

1) w.r. to the amount of mathematics to be studied;

2) w.r. to the inclination of classes: mathematical, for engineering and natural sciences, for the humanities.

Now the process of the differentiation of schools and higher education takes place. Many of schools are converted into gymnasiums, "lycee"s, vocational schools etc. Various supplements to programs, special and optional courses are included in curricula of schools.

Serious changes in social and economical life in Russian Federation during the last decade had remarkable impact also on mathematics teacher education. Generally, approaches to the higher (university) education have changed. Instead of strict and uniform (all over Soviet Union) curricula for mathematics teachers training, new (preliminary) standards have been elaborated by the Ministry of Education and since 1996 are being adopted by pedagogical universities. On the basis of these standards, universities construct their curricula for themselves. Many pedagogical and other institutes are converted into pedagogical universities, technical universities, agricultural academies etc. In some of pedagogical universities, two-stage curricula have been elaborated: after first 4 years, students become Bachelors and may teach at lower secondary schools. After 2 years of additional studies, they become Masters and have the right to teach at upper secondary schools.

Obligatory assignments to institutes for annual production of young teachers, percent of satisfactory marks etc. are abolished. Institutes can almost independently work out their curricula.

As earlier in Communist times, mathematics teacher education programs cover all contents, issues, methods and resources one can only imagine.

Although, generally, higher education is now more popular among young people, teacher's profession is not popular because of bad employment possibilities, low salaries (15-40\$ depending on region, experience and loading) which are, moreover, often delayed for many months. On the other hand, it is difficult for young graduates of pedagogical universities to find a job, because most of old teachers do not want to retire. Most popular in our country are now professions of

finance managers, bankers, bookkeepers and lawyers. Many new private universities aimed at preparing for these professions appeared. Most of them compromise the idea of private educational institutions by their low level of organization and teaching. However, teachers are being prepared only at state universities, and thus rather high standards of teacher education are saved. The serious problem is the bad financing of educational institutions and low salaries of university teachers.

2. The structure of curricula

Generally, in standards recommended by the Ministry of Education in 2000, the amount of classroom hours for the whole course on pre-service teacher education program is about 4000, half of which (about 2000) are devoted to mathematical disciplines, one quarter (about 1000) to general cultural (e. g. social, philosophical and medical) sciences and one quarter (also about 1000) to psychological and pedagogical (including mathematics education) disciplines. However, the total amount of mathematics education is usually only about 170 hours (i.e. less than 5% of the whole program). The standards are used both in traditional 5-year course and in new two-level 6 year courses completing with magister's degree. The most remarkable features of these standards are greater freedom in distributing the classroom hours (which are assigned by standards only to whole blocks such as mathematical block or general cultural block) between different subjects, larger place for alternative special courses that can be freely chosen by students, larger amount of independent work of students.

However, democratical traditions are not very strong in Russian universities yet, and often such distribution (of classroom hours) and, generally, elaboration of particular curricula for concrete faculties is being authoritatively accomplished by deans. In conditions of freedom in composing curricula specialists in calculus who constitute a majority in mathematical departments are now reducing amounts of algebra and geometry lectures. Generally, both in school and pedagogical institutes' curricula the whole amount of hours devoted to mathematics is gradually lowering. The amount of lectures and seminars at universities has decreased, and the amount of hours for the independent studying by students has increased. Thus, the Government obtained the possibility to decrease the number of university teachers. On the other hand, university teachers find new possibilities to teach in many new private universities and institutes.

We will consider the new approaches to pre-service teacher education in a leading pedagogical university in Russia – in the Moscow State Pedagogical University.

3. The pre-service teacher education program in the Moscow State Pedagogical University

a. New approach to pre-service mathematics teacher education.

The well-realized by the Russian community need of inclusion of the educational system of Russia into world educational space compels us to think over the perspectives of the taking into account the world standards, federal, regional and national components of teacher education, that can be expressed in the international approach to the concept of professional competence of the prospective teacher.

In Russia, traditionally always rather serious attention to the teacher preparation has been given. There is a well-established system of the continuous pedagogical education: professional orientation at school (pedagogical circles at pedagogical institutes, classes with a pedagogical bias at schools), preparation of the elementary school teachers at pedagogical colleges; a system of

preparation of the secondary school teachers at classical universities, at pedagogical universities and institutes.

During the last years some modifications in this preparation are taking place connected with multilevel structure of higher education: two-years' incomplete education, four-years' study for the Bachelor's degree; additional two-years' preparation to the Master's degree; alternative (traditional) way is five years' professional training for obtaining teacher's diploma. Besides, the rather important role belongs to three-years' graduate study, three-years' post-graduate study, and also to the ramified system of in-service professional training of each school or university teacher (ideally - once every five years of work).

The new system of continuous education for teachers is only arising, but both in traditional and modern systems there is a lot of unsolved problems, which are caused by the lack of the complex approach to the development of the professional competence of teachers. For the solution of these problems, at the Moscow pedagogical state university the international scientific conference "Pedagogical education for the 21st century" was held. There were many treatments and approaches to the model of the 21st century's teacher. Here are some parameters of such model having explicitly expressed communicative character:

- Our society and higher school will choose as a priorities democratic development in social life and market relations in the economic sphere, therefore giving up many traditional stereotypes;

- Generally, the importance of education is being realized now, that raises new demands on the system of teacher education;

- The transition to the preparation of the teacher-humanitarian will be gradually carried out; the thinking will promote the establishment of humanistic education.

For the last few years at the Moscow pedagogical state university the problems connected to the realization of the complex approach to mathematical, psychological, pedagogical and methodological preparation of the mathematics teacher have been studied.

In particular, the program of a course "Psychological and pedagogical foundations of mathematics teaching" is elaborated. This course has already been taught for several years to the students of the third year of study (i. e. to students having certain amount of knowledge on special mathematical disciplines, on pedagogy and psychology). The purpose of this course is the complex approach to the education of the teacher of mathematics.

Let's describe some features of the structure and contents of the course.

b. The general conception of the course.

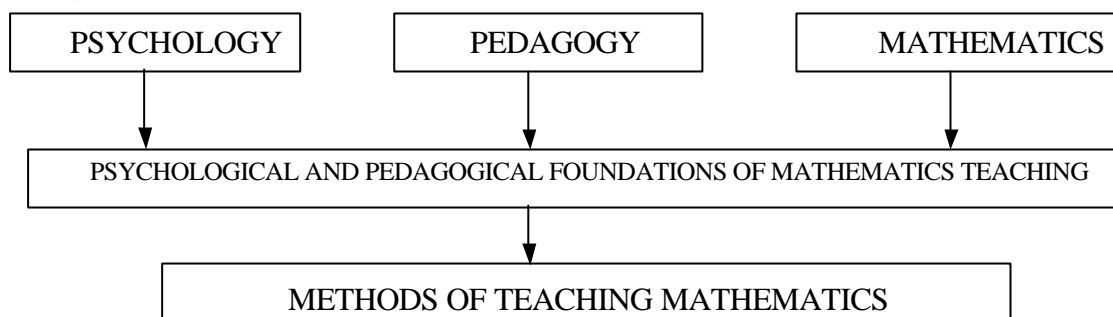
1) It is possible to speak about three theories of teaching (or about three levels of the theory of teaching): psychological (the pedagogical psychology), general pedagogical (didactics) and methodological (methods of teaching a subject).

Traditionally, the course on methods of teaching mathematics is divided in two parts: general and particular (special) methods, but the experience has shown, that such division is not very useful. Essentially, the traditional general methods duplicate didactics, not concerning at all psychology of teaching. On the other hand, the particular methods consist of exact prescriptions for teaching certain themes of school mathematics, sometimes simply describing the school course. This is the really existing situation not providing pre-service teachers with necessary professional training.

Necessity of the intermediate course, serving as a bridge between psychology, pedagogy and mathematics, on the one hand, and methods of teaching of mathematics, on the other hand, is

obvious. This necessity is caused by the impossibility of effective reference to general psychology and pedagogy.

2) It is assumed that the course “Psychological and pedagogical foundations of mathematics teaching” will be studied by the students, that have already learnt psychology, pedagogy and some part of mathematics, before the course on methods of teaching mathematics (see the scheme below):



In accordance with its purposes, the course “Psychological and pedagogical foundations of mathematics teaching” only briefly reminds the essence of already learnt concepts and statements of psychology and pedagogy, paying attention to their concretization in view of specific properties of mathematics. Therefore, the course “Psychological and pedagogical foundations of mathematics teaching” essentially differs from general courses on psychology and didactics. It is also essentially different from the course on methods of teaching mathematics, the base for which it constitutes.

3) The main contents of the course “Psychological and pedagogical foundations of mathematics teaching” consist of the series of the extremely important and interesting concepts: the purposes of teaching mathematics directed on all-round development of the personality of the pupil; theoretical foundations of the individualization and differentiation of teaching mathematics; the theory of abilities and, in particular, mathematical abilities; thinking, means of thinking, mathematical thinking; the activity approach to teaching mathematics; mathematical learning activity; the essentials of the developing instruction, mathematical development of the pupils etc.

The traditional preparation of the mathematics teacher actually does not give a possibility to study the above-mentioned concepts: in courses on pedagogy and psychology they are not considered, because teachers of these disciplines are not familiar with mathematics and its methods; on the other hand, mathematicians can not deeply study these problems, because they do not have a good knowledge of psychological and pedagogical theories.

4) The course “Psychological and pedagogical foundations of mathematics teaching” inevitably should include also logical foundations of teaching mathematics, because a separate course on logic is not present in curricula (the course on mathematical logic has other purposes). At the same time, the logical foundations are inseparable from psychological. For example, the process of learning concepts is connected partly to psychology and partly to logic. Searching for a proof is a complicated psychological process, but a proof itself is a logical construction.

5) The course “Psychological and pedagogical foundations of mathematics teaching” consists of lectures and exercises. Taking into account the fact that this course lies on the crossroad of scientific disciplines, it seems useful to stimulate also conducting research by the students, writing by them term and final research papers on psychological and pedagogical foundations of teaching mathematics.

c. The contents of the course.

1) The course “Psychological and pedagogical foundations of mathematics teaching”, its interrelations with other subjects (psychology, pedagogy, mathematics).

2) Mathematics as a science and as an educational subject. Methodological foundations. Teaching mathematics and development of the personality of the pupil. The purposes of teaching mathematics at school.

3) Thinking. Psychology and logic of thinking. Kinds of thinking. Mathematical thinking. Levels of mathematical thinking on various stages of learning mathematics at school. Means of thinking. The role of mathematics teaching in developing of basic means of thinking.

4) Process of teaching/learning. Psychological, informational, logical and didactical aspects. A model of process of teaching mathematics. Activity: the teaching activity of the teacher, the learning activity of the pupil. The activity approach to learning mathematics. The cognitive activity in the field of mathematics. A model of learning mathematical activity. The individualization of learning mathematical activity. Didactical principles in teaching mathematics.

5) Methods of teaching. The problem of methods of teaching. Reproductive, empirical, logical methods in teaching mathematics. Psychological and pedagogical foundations of differentiation of teaching mathematics. The problem method of teaching. Problem situations. Basic types of problem situations in teaching mathematics.

6) Mathematical knowledge and skills. Scientific and educational knowledge. Transformation of scientific knowledge into educational (didactical transposition). Basic results of teaching mathematics: mathematical knowledge and mathematical development. Relations between mathematical knowledge and skills. The principles of the selection of the contents of school mathematical course. Psychology and logic of the process of learning the concepts, of proving propositions and solving problems in teaching mathematics. Psychology and logic of questions and answers. Algorithms and heuristics in teaching mathematics. The role of problems in teaching. Means of searching for a solution of a problem. The systemic and structural analysis of school mathematical problems. Complexity and difficulty of mathematical problems.

7) Mathematical development. Various treatments of the concept “mathematical abilities of the pupils”. Detection and development of mathematical abilities during the process of teaching. Means of reaching certain levels of the mathematical development. Investigational activities in teaching mathematics. Motivation of learning. The principle of the best stimulus (G. Polya). Independent work of pupils with the elements of creativity. The role of non-standard tasks in mathematical development of the pupils.

4. Further problems

The complex approach to the solution of the above-mentioned complicated problems, and also multidimensional character of the preparation of teachers compels us to combine the work of the lecturer and the student, all possible forms and variations of training in colleges and higher pedagogical educational institutions, to determine the work and responsibility of various subdivisions in the system of in-service teacher education. In this connection a global problem arises – a problem of the detection of the levels of professional readiness, of the evaluation of these levels, of the detection of mechanisms and technologies of the transition from one level to another etc. It is possible to formulate rather primitive, but useful initial statement: it is well known, that the professional skill comes with experience; at the same time it is clear, that the

teacher who comes to work in school, should have the skill in a certain initial level (so that below this level one does not have the right to teach).

The system of preparation of the mathematics teacher consists of a series of blocks, and now in conditions of the multilevel system of education these blocks are even more distinct, their structure and contents are subjects of thorough attention during the process of evaluation of curricula and of work of a faculty or an institute in general.

As already noted above, it is necessary to begin with the detection of interrelations (in actions and in effect) of psychological and pedagogical, on the one hand, and methodological, on the other hand, preparation of the teachers of mathematics. The transition to the multilevel system of preparation of the teachers demands elaborating levels of readiness to professional activity corresponding both to stages of education and to general fundamental conceptions of professional skills of teachers.