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Training future teachers of mathematics: a historical perspective

Oksana Zhernovnykova

Kharkiv National Pedagogical University named after G.S.Skovorody
Ukraine, Kharkiv

E-mail address: oazhernovnykova@gmail.com

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ABSTRACT. Training future teachers of mathematics differed in different years. Each stage of training had its own peculiarities and characteristics.
The article reviewed and analyzed on the basis of the scientific literature, how evolved mathematics education in schools and develop mathematical training of students of pedagogical universities in different periods, starting from the XII century. to the present.

1. INTRODUCTION

Pedagogical education is an important component of society culture development. The problem of adequate transfer of experience of previous generations concerned the mankind for centuries. The basis for pedagogical education has always been mathematical education, which determines not only the transfer of information from different areas of Mathematics, but also the formation of students` thinking skills as well as their scientific worldview. Today the trend of decline in the quality of knowledge of Mathematics of pupils of secondary schools and students of pedagogical universities is widely observed. However, history shows that not everything was so bad in teachers of Mathematics professional training. Thus, the **purpose of the article** is to follow the stages of students of pedagogical universities mathematical training and determine the contemporary stage of development of mathematical education, which is being currently implemented at pedagogical universities.

2. THE FIRST STAGE OF TRAINING FUTURE TEACHERS OF MATHEMATICS.

The process of establishment and development of a network of universities in Ukraine took place in close connection with economic, social, political and cultural life of the state, which included the Ukrainian land. Taking into account the above mentioned fact, it is useful to consider periods of mathematical education on the territory subordinated to the Russian Empire.

It is difficult to dwell on forms of mathematical education in the XVII century: mass schools almost didn`t exist and Mathematics was hardly taught at universities. Thus, Theophanes Prokopovych, a prominent religious leader and statesman, first introduced lectures in Geometry and Physics into the program of Kyiv-Mohyla Academy and later taught tham at the above mentioned educational establishment. Thus, *the first stage* of teachers of mathematics training (the XVII century) is chaotic and is characterized by absence of mass schools, poor government`s support, lack of information about forms, tools and methods of teaching Mathematics [1; 3; 6; 9; 12].

3. THE SECOND STAGE OF TRAINING FUTURE TEACHERS OF MATHEMATICS

The second stage begins with the establishment of Moscow School of Mathematical Sciences and Navigation in 1701 by Peter I, and later engineering and artillery schools, mining colleges in which mathematics was a major subject.

"Numerical" schools at episcopal buildings and large monasteries with compulsory study of Elementary Mathematics were founded in provincial towns in 1714 by a special ordinance. By 1722 their total number reached 42 schools and 2000 students. Numerical school existed until 1744 and,

despite their ineffectiveness, contributed to the dissemination of mathematical education. Teachers from specialized professional schools taught at numerical schools. Training was of a dogmatic nature: only memorization of the rules and the ability to apply them to solve relevant problems were demanded. They, in turn, continued instilling them in their students [2; 18; 19; 20; 21].

At the same time, Moscow University was entrusted supervision of all private pensions in Moscow and central provinces and examinations for foreigners claiming to receive a diploma tutor. In the last quarter of the XVIII century University actively participated in the preparatory work on opening schools in provincial towns.

Moscow University played a major role in the development of education in the country and was one of the country's major centers for training school teachers. Students of the University constituted a significant part of teachers of gymnasiums in the end of XVIII - beginning of XIX century.

The peculiar feature of the educational process at the university was that such methods of teaching as observation, experiment, experiment, visual aids were used there. All this contributed to a better learning and stimulation of individual research work [4; 14].

Advanced for their time pedagogical principles and instructional techniques found a vivid reflection in the «Ways of Teaching» – one of the first Russian books on teaching, composed by university professors.

Mathematics and Mechanics were only secondary items at the university of XVIIIth century. The task of teaching Mechanics and Mathematics were not set by the university, which affected both the nature of teaching and the quality of teaching mathematics. Thus, D. Anichkov, whose textbooks on all branches of mathematics were repeatedly published and republished until the end of the century, tried to fill them with materials necessary primarily for practitioners and scientists. Advances in engineering set tasks for the introduction of teaching elements of Higher Mathematics – Analytic Geometry, Differential and Integral Calculus at the university.

Thus, in the XVIII century purposeful mathematical training of future teachers of high and comprehensive schools was not carried out, methods of teaching Mathematics were not distinguished as a separate field, training was carried out mainly at universities and teacher training seminaries. According to the project by the academician Epinusa, General People's College and Teachers` Seminary under it, were opened in 1783 in St. Petersburg. They were devided into two separate educational establishments only in July 1786. From physical and mathematical subjects, Arithmetic, Geometry, Physics and Mechanics were included in the curriculum of the main colleges. No special pedagogical subjects were taught then.

4. THE THIRD STAGE OF TRAINING FUTURE TEACHERS OF MATHEMATICS

At the beginning of the XIX the government had to take certain measures in the field of education, as it could not provide for the growing needs of the developing industry, normal operation of the state apparatus. Thus, in 1802 the Ministry of Public Education was established, and in 1803 «The Preliminary Rules of National Education», which aimed at increasing the number of schools and organizing their work were published. It was the beginning of the *third stage* of didactics of mathematical education [13].

At the beginning of the XIX century Moscow University gained more importance. One of the main tasks of the university was teacher training. The whole country was divided into six school districts. Petersburg, Kazan and Kharkov Universities were to be created in addition to Moscow, Vilna and Dorpat Universities. School curricula at the time were large, encyclopedic: for example, three languages – Latin, German, French, Geography and Statistics – General and of the Russian State, the introductory course of Philosophy (Metaphysics, Logic, Ethics), Mathematics (Algebra, Geometry, Trigonometry), Physics, Natural Sciences (Mineralogy, Botany, Zoology), the Theory of Commerce, Technology, Drawing were then studied. Close contacts with the schools increased professors` interest in educational issues. However, the demand for teachers was growing, universities could not give the necessary number of specialists for the number of schools that had increased by that time. In 1828, a new regulation of high schools, providing for their establishment

not only in principal cities of provinces but also in provincial towns was approved. As a result, the Chief Pedagogical Institute, whose purpose was to train teachers and professors now only for colleges of national education, was founded in 1828. Mostly students of theological seminary who had to study for 6 years were accepted to this institute. Those 6 years were divided into three courses: praparatory course which lasted for 2 years, the main course – 3 years and course in Pedagogics – 1 year.

To improve pedagogical training of future school teachers the Department of Pedagogics was established and students` teaching practice was organized in the early 50s of the XIX. Practice had a peculiar character: high school students were taken to the university, where the latter give lessons in the presence of students, then followe the analysis of these lessons.

In 1804 the Pedagogical Institute was created on the basis of the St. Petersburg Seminary. Teacher training was carried out at pedagogical institutes (departments) at universities, seminaries and rural seminaries and schools, teaching courses and classes at girls' schools, that emerged after the abolition of serfdom in 1861. Pedagogical Institues trained specialists for district and local, and then - for higher and beginner colleges. In general there were 25 higher educational institutions whose graduates worked at schools in the tsarist Russia of the XIX century.

A huge contribution into the improvement of secondary pedagogical education was made by Russian pedagogs of XIXth and the beginning of the XXth centuries: K. Ushinsky, M. Korf, M. Bunakov who studied the problem of teachers` seminaries activity and for many years supervised teachers` congresses. Since 1911 the Physics and Mathematics Faculty of Moscow University introduced an elective course of Pedagogics. However, it was far from the science that was necessary for future teachers. History of teaching ideas was covered only as a history of Western European Education – domestic pedagogical thought was not studied at all. Subjects of pedagogical cycle, taught at the university, were not associated with school practice [10].

Tests for the right for teaching mathematics was conducted in the following subjects: Analytic Geometry, Introduction to Analysis, Higher Algebra, Differential and Integral Calculus, Number Theory, Probability Theory. Maths teachers were trained exclusively at universities.

With the rapid development of pedagogical science in the beginning of the XXth century teaching Mathematics attracted the attention of scientists and educators. The main pedagogical problem that worried the mathematical community – was an abstract mathematical content (both in secondary and high schools) and the lack of connection with life. V. Dyachenko believed that the biggest mistake in teaching is prevailing of abstraction over concrete material, and prevailing of logic over intuition. First general terms and definitions were offered in a purely abstract form, and only then specific examples that are often too abstract were provided [2].

This visual method of teaching is opposed to abstract – deductive, and forming of a logical thought and mental development of students is opposed to the liveliness of presentation of educational material and strength of retention of mathematical facts in one`s memory.

The second conclusion that it is impossible to form mental development of the student through the formation of mathematical thinking on highly specialized educational material was also generally accepted.

Contents of mathematical education in secondary schools almost didn`t coincide with mathematical training at universities, but a major role in establishing the continuity of education was played by the congress of teachers of Mathematics. The first congress was held in St. Petersburg in 1911, in particular, the decision regarding the introduction of elements of Higher Mathematics into the course of a secondary school – namely, the concept and definition of the function , its graph, and the foundations of Infinitesimal Analysis was made there. It was at this congress that first the question of differentiating of studying at senior classes of secondary schools was raised, which was highlighted in the reports by K.Posse and W. Struve.

A new wave of teacher training institutions organization occurred in 1908-1909. Temporary teaching courses were opened in St. Petersburg, Moscow, Kiev and Odessa. These institutions operated in the management of the respective school district and were short – they lasted only for a

year. The courses accepted people who had graduated from universities. Students had a scholarship of 600 rubles a year.

On March 10, 1910 Moscow Pedagogical Institute named after P.H.Shelaputin was founded. Students who successfully listened to the two-year course, received the title of a teacher of a gymnasium, then, when their service began, the time of studying at the university was considered (after 4 years) as the period of active service.

Thus, over the centuries dichotomy of the pedagogical process of teaching Mathematics is clearly seen: fundamental training (university education), which was completely independent on further professional activity and methodological training (pedagogical courses, instatute, gymnasium), which was underdeveloped in terms of methodological components of the pedagogical process.

The second problem that remained unsolved in the educational process was isolation of university teaching of Mathematics from a secondary school. The factor, that going from school to the university the student forgot everything that he had studied at the secondary school, and graduating from the university, he, first of all, forgot everything that he had studied there, did a lot of harm.

The third issue of mathematical education before the revolution in 1917 – is almost a complete lack of vocational and educational focus on teaching Mathematics at the universities (which provided the bulk of secondary school teachers) and lack of fundamental training in pedagogical institutes [5; 8].

The fourth period of training teachers for secondary schools Matematics begins in 1917 and continues up to now. This period is characterized by self-sufficiency of higher education (concerning the classical university education) to face social challenges of training teachers of mathematics.

5. THE TOURTH STAGE OF TRAINING FUTURE TEACHERS OF MATHEMATICS

The development of Teacher Training Institutions after the revolution of 1917 was determined by the economic situation of the country, political attitudes, increasing needs for public education. In 1918 the National Commission on Education approved the transformation of Teacher Institutes, seminars and courses into Pedagogical Institutes. The period of studies lasted 4 years. According to the Resolution of Commissariat 3d and 4^{th} year students had to work at the common labour school 2-3 hours a day. Teachers of secondary schools were also trained at pedagogical faculties of State Universities. During the first decade of the Soviet Pedagogical Institutes activity there existed neither national plans, nor common curriculum. Curricula were too various, encyclopedic, not subject to a single goal. Little time was allocated to teaching practice [16].

At the same time, during the reorganization of higher educational establishments serious mistakes were made. Thus, in 1930th academic groups were divided into brigades of 3-5 students who, without systematic guidance of qualified teachers, had to study, «do» educational tasks. This «active brigade-laboratory method» of studies almost completely eleminated lecture courses taught by outstanding scientists. Reading general and special courses was replaced by introductory lectures on independent work of students` brigades; exams and tests as an individual form of assessment were replaced by brigades` collective reports on «accomplishing» their educational tasks [7; 15].

In 1930-1931 all pedagogical faculties at universities were reorganized in Pedagogical Institutes. The number of general subjects at Pedagogical Institutes was reduced from 22 in 1927 to 9 or10 in 1931. Up to one-third of the planned hours was given to a subject block of a curriculum (including courses in Mathematics). Time on teaching practice has increased to 38-40 % of the total training time [17].

Despite the apparent success in the organization of Mathematics teachers training for secondary schools in the prewar period, the quality of training,the number of highly qualified scientists and pedagogs remained on a low level. Opening of a large number of teaching institutions resulted into 10 % of teachers having degrees and titles. The Pedagogical Institutes curriculum in

Mathematics was a «shortened version» of university curriculum, there was underestimation of private practices, poor development of vital issues Didactics, methods of teaching Mathematics, Pedagogics of Higher Education.

However, such prominent mathematicians and methodologists as W. Kagan, M. Chobotarov, S. Shatunovskyy worked for system of Ukrainian pedagogical education. In 1942 Arnold defended the first in the Soviet Union doctoral thesis in methodology of teaching Mathematics, and his textbook «Theoretical Arithmetic» (1938) made a significant impact on teaching of this discipline in Pedagogical Institutes [11; 15].

Also an invaluable contribution to the organization of mathematical education was done by G. Crow, A. Markushevich , D. Raikov, E. Shchegolkov, I. Andronov, G. Glaser etc.

Since 1952, teachers' institutes were reorganized in Pedagogical Institutes. Thus, a unified system of training teachers for classes V-X was created. Future government regulations sanctioned the development of faculties and departments for one-major specialities with a four-year period of studies. Training in two specialities for small schools (with a period of training – 5 years) was also preserved.

In the late 60s the Ministry of Education realized an extensive plan to bring educational process at the Pedagogical Institute in accordance with the requirements of scientific and technological progress and the secondary school reform. A new subject «Scientific Basis of School Mathematics» was introduced at mathematical departments. Its curriculum which was developed by the academician A.Kolmogorov, and combined courses of mathematical analysis and Theory of Functions, Algebra and Number Theory, Geometry. However, a large course of Elementary Mathematics was eliminated and replaced by the workshop on doing mathematical sums, that affected future teachers` of Mathematics training.

The situation between school and university Mathematics became worse. The main drawbacks: formalism of knowledge, lack of formation of integrity of mathematical objects, underdeveloped logical-model thinking, lack of strength of knowledge, skills and methods of school Mathematics, insufficient connection between school and university Mathematics. Students were bad at imagining the mechanism and peculiarities of mastering mathematical content as a professional basis for building of learning Maths at school.

Further development of mathematical education of future teachers of Mathematics made these difficulties and contradictions grew worse.

Despite the change in nomenclature of professions, the introduction of new subjects (e.g. Computer Science), the elimination of other subjects (e.g. courses in Mathematical Logic, Numerical Systems etc.), greater control over students` individual work, a significant improvement has not been achieved.

6. CONCLUSIONS

Mathematical education of students of higher pedagogical educational establishments is most vulnerable to technological innovation of a model nature, content and deep interdependencies of mathematical activity.

At the same time, bringing the curriculum to conformity with State educational standard experiences significant difficulties in realization. Curricula and plans, as well as their structure, for training a specialist teacher differ little from previously existing. The latest always brought fundamental training to the fore. Extensive courses of Algebra, Mathematical Analysis, Geometry are abstract in content and represent a great difficulty for most students of pedagogical universities majoring in Mathematics. At the same time, the quality and stability of mastering professionally-oriented learning material (school curriculum) was therefore secondary.

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