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TRANSFORMATION OF MATHEMATICAL EDUCATION IN RUSSIA AND MORAL EDUCATION

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Abstract

Various factors caused by globalization, the implementation of the market in all spheres of life have an impact on the modern mathematics education in Russia. Thus, certain trends in the Russian mathematical educational transformation have been outlined over the past decades. There has been a change in its content, the gap between the primary education, profile and specialized training levels of school mathematics has been increased. There were attempts to replace the traditional systematic course of mathematics by training oriented on practice, and to improve financial literacy instead of studying the fundamental mathematical facts. Abandoning the traditions, these trends can negatively affect the moral state of Russian society. The pedagogical nature of training, systematic courses (courses based on the axiomatic method and "Euclidean-style" proofs), oral examinations, permanent textbooks and curriculum should be included into Russian mathematical education traditions. In the teaching of mathematics, moral education in Russia is translated both through the content (by solving specially selected textual mathematical problems, the deductive nature of the presentation), and through the teaching forms and methods (the main principle for the teacher is the love for children). The moral criterion is the most important for the plot selection of such mathematical problems. These tasks should cultivate love of neighbor, mercy, diligence, respect for other people's work, careful attitude to nature, aesthetic taste, healthy lifestyle formation, etc. These qualities are necessary for a young person to maintain their identity in the global world.

Keywords: Mathematical education, moral education.

1. Introduction

It is known that ideology influenced mathematics to a lesser extent than humanitarian subjects (for example, history and literature). Inherently, mathematical facts and statements are apolitical. No decree or resolution can cast doubt on the Pythagorean Theorem. However, such nuances are possible in the history of the development of science itself, due to scientific concepts and facts revision and restructuring (for example, the rejection of Lobachevsky's geometry for a long time). But this does not mean that the teaching of mathematics is free from the spiritual and moral component. Scientists from different countries prove this statement (Bishop, 1999; Bishop, Seah, & Chin, 2003; Kwan, 2013; Watson, Beswick, & Brown, 2012; Falkenberg & Noyes, 2007; Voskoglou, 2009).

Various factors caused by globalization, the implementation of the market in all spheres of life have an impact on the modern mathematics education in Russia. Thus, certain trends in the Russian mathematical educational transformation have been outlined over the past decades. There has been a change in its content (elements of probability theory and combinatorics have been issued, less emphasis has been given to the trigonometric line, etc.), the gap between the primary education, profile and specialized training levels of school mathematics has been increased (growing proportion of elite mathematics education for the privileged few, decreasing proportion of the mass nature of mathematics education). There were attempts to replace the traditional systematic course of mathematics by training oriented on practice, and to improve financial literacy instead of studying the fundamental mathematical facts (Gerasimova, Savvina, Telkova, Melnikov, & Trofimova, 2015; Kozlova & Sakhieva, 2017). On the other hand, there had been a decrease in the level of mathematical education in modern Russia compared to Soviet period. Academician Arnold (2003) argues that the recent years innovations "eliminate the traditionally high-quality domestic mathematical education" (p. 34).

2. Problem Statement

The changing socio-economic situation turns us towards the search for the optimal dimension and content of mathematical education. However, at the theoretical level, the problem of the moral education role and place remains unsolved. Under the modern conditions, the Soviet concept of moral education based on communist morality has lost its relevance. The problem of the study is to show the correlation of mathematical education and moral education in a historical perspective. The underestimation of this correlation in education causes not only to the degradation of the individual moral qualities, but also to a decrease in the mathematical education level.

3. Research Questions

Mathematical education is considered as part of the holistic education of the individual. Moral education implies development of individual qualities based on love (vitality, diligence, philanthropy, frugality, responsibility, modesty, etc.). These qualities development appears to be traditional for mathematical education in Russia. So, at the beginning of the twentieth century, the Russian mathematician Egorov, Letters, & Egorov (1980) exhorted his disciple N.N. Luzin with these words: "As for the life guidance, mind is not the only gift given to a man; and a sensitive conscience will always tell you that the

purpose of life is doing good as the best as you can. In the end, the world holds on with love!" (p. 13). Later, N.N. Luzin became a famous scientist, the founder of a scientific school.

The pedagogical nature of training, systematic courses (courses based on the axiomatic method and "Euclidean-style" proofs), oral examinations, permanent textbooks and curriculum should be included into Russian mathematical education traditions. The school course of mathematics in Russia is constructed linearly-concentrically; the university course of higher mathematics is linear.

The absence of market relations and the Christian origins of the worldview determined the specifics of mathematical education in Russia. In contrast to the European tradition, at the center of Russian mathematics study was the attempt to answer the question "why?" and not the question "how?" The teacher is interested in the success of his student and does not consider him as a competitor. Studies of Kwan (2013), Watson, Beswick, and Brown (2012) indicate the emergence of similar trends in other countries.

Mathematical education is associated with the state ideology. The influence of the ideology on the mathematics teaching is manifested both through the scope and content of mathematics education in schools and universities, and through the teaching methods and forms (for example, the project method dissemination, distance training is actively promoted nowadays). Proponents of distance training invoke the arguments of affordability and cheapness, but they overlook the quality. Accessibility of information does not mean accessibility of education, since education implies "humanized", transferred from one person, who perceive the knowledge, rather than providing for information. In its turn, specially organized teaching of mathematics allows achieving the moral educational goals. The mathematics educational nature is particularly evident in the formulation of textual problems associated with a creative nature and historical events of different years real facts.

These problems received special attention in the pre-revolutionary and Soviet mathematics textbooks in Russia. Here are some examples so as to confirm this statement:

Problem 1. Someone wanted to give 8 rubles to a beggar; he wanted to give 20 kopecks to every man, and 25 kopecks to every woman. But there were three more men and two more women than he expected, and therefore he gave to everyone 20 kopecks. How many men and women had come?

Problem 2. There is a graph of grain crops growth in yield on the collective farm "Dawn". Schedule a table of the grain yield growth in centners per hectare from 1945 to 1954 (Larichev, 1958).

Obviously, the solution of such problems contributed to the formation of proper life orientations for the young man (the first task is to develop mercy; the second task is to develop a respectful attitude to work).

The analysis of Russian mathematics textbooks and tasks collections textual problems in recent decades indicates a clear bias towards economic and consumer issues. The algebra problem plots in the control and measuring materials of the unified state exam (compulsory for all Russian schools' graduates exam) orient the student towards consumption, the search for profit, and not the formation and development of moral qualities. Problems in the theory of probability are replete with plots promoting gambling (tasks for playing cards, dice, etc.).

In order to clarify and entertain the authors reach the point of absurdity. Here is the problem example placed in one of the problem books on discrete mathematics.

Problem 3. There are 49 students in the 11th grade. 29 of them drink alcohol, 37 of them smoke, and 3 of them do not drink alcohol and do not smoke. How many students do drink alcohol and smoke at the same time?

Of course, such problem can attract the students' attention, but precisely by its negative content, the promotion of unhealthy lifestyles and bad habits. In the course of the solution, the students' attention is drawn not to mathematics, but to the negative information that is contained in the problem's plot. As a result, the substitution takes place, instead of keeping students interested in mathematics as a science, the opposite result is achieved - doing mathematics is associated with carefree pastime.

The liberalization and commercialization of areas related to education resulted in, on the one hand, an overabundance of educational and methodical literature focused on preparing for the Unified State Exam, on the other hand, the popular science books on mathematics for schoolchildren lack and the absence of teaching aids for teachers of moral education in the process of teaching mathematics.

Those who compile educational-methodical literature on the preparation for the Unified State Exam in mathematics should understand their moral responsibility to the reader. The randomness of the material presentation, errors in solving typical tasks, answers inconsistency, typographical errors, will cause the reader the painful overcoming of a false self-accusation for misunderstanding something. Only a person, repeatedly faced such tasks in his practice, or someone who obtain alternative solutions (as a rule, these are methods from higher mathematics), can recognize a typographical error, the student, finding a typo, is in most cases unable to recognize it. His attempts to solve of the problem according to the answer indicated at the end of the book are sometimes leads to attempts to fit the result, or cause apathy and unwillingness to continue to deal with the solution. Both variants are detrimental to the emerging personality, therefore, it is necessary to tighten control over the quality of printed products.

4. Purpose of the Study

To show the pedagogical possibilities of teaching mathematics in modern conditions. To reach this goal the following problems should be overcome:

- a retrospective analysis of textbooks and problem books in mathematics;

- a formulation of textual problems in mathematics that promote moral education;

- an identification of requirements for the content and scope of mathematical education based on moral positions.

5. Research Methods

The study was conducted in accordance with the regularities of the pedagogical forecasting methodological problems, including the method of expert assessments and historical analysis. Using the method of expert assessments requirements for educational and methodical literature in mathematics, based on moral criteria, were established. Hermeneutic analysis of mathematics' textbooks and problem books texts was used as the main research method. This method helps to show the mathematical education transformation depending on the moral state of society level. The development of author's textual problems demonstrates the modeling method application.

6. Findings

The influence of morality on the mathematics teaching is manifested both through the scope and content of mathematics education in schools and universities, and through the teaching methods and forms (the project method dissemination, distance training). This is especially obvious in the formulations of textual problems. The first Russian textbook on mathematics "Arithmetic" by L.F. Magnitskii (1703) is an example of humanitarian and mathematical book's components combination. Throughout the book the author appeals to the reader with love, calling him "industrious and wise-loving". However, this textbook was practice-oriented and did not have strict definitions and proof.

Nowadays, the mathematician problems about workers fulfilling the plan; youths planting trees; farmers, gathering their harvest and etc., have sunk into oblivion because of the socioeconomic changes that have taken place in Russia. They were replaced by the problems about the yuan exchange rate, profitable purchase of motor cars or making deposits. During the Unified State Exam graduates are certainly invited to solve the problem of bank loans (Figure 01). It is clear that the earlier formulations of tasks from the pre-revolutionary and Soviet past are outdated, but the main thing in these tasks is the ideology aimed at developing the students' moral qualities, the creative meanings of their lives, respect for the workers, etc. Of course, there are no collective farms and pioneers nowadays, but if you look around you can find an adequate substitute. Schoolchildren can offer tasks about harvests collected in farms, tasks about the production of dairy products, about the activities of volunteers, about charity, about sports, etc. For example, children are happy to solve such problems.

Problem 4 (healthy lifestyle and benefit from sporting promotion). The diagram shows the distribution of the number of all goals scored at the 2014 World Hockey Championships for teams from 12 countries. Among the countries represented at the diagram the first place was taken by the Russian National Team, the twelfth place – by Italy. What place in the number of scored goals did the Finnish team take?
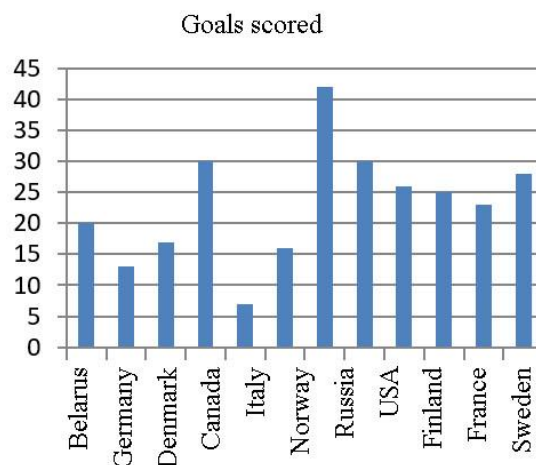

Figure 01. The diagram to the Problem 4

Problem 5 (*healthy lifestyle and benefit from sporting promotion*). The participant of the darts competition has 28 points left to complete the game. He can throw darts at the target three times. How many ways are there to complete the game?

Problem 6 (Inculcation of mercy). The school asset of the parents collected fund for drugs and treatment for a girl from a poor family. 15 parents donated for medicines, 10 parents donated for treatment, 7 parents donated both for treatment and medicines. How many parents are there in the school asset if all parents contributed to the fud for the sick girl?

Problem 7 (respect for nature). Over the summer ants of a large anthill destroy 100 thousand insect pests. How many harmful insects will ants of 4 anthills destroy in 5 years?

Apart from solving problems with an educational plot, the study of the axiomatic method has a powerful educational effect. Notoriously, the essence of the axiomatic method is that, firstly, the basic undefined concepts are given, and the statements taken without proof are postulated (axioms). Then, with the help of definitions, further notions are introduced and the subsequent assertions (theorems) are proved (derived by the laws of logic). It is important to mention that almost any mathematical fact (not necessarily geometric) is established in accordance with the law of a syllogism. So, before solving an equation (linear, quadratic, trigonometric, etc.), its type is determined (for example, the equation is quadratic) and a conclusion is made about the solution method (it can be solved using a discriminant). Hence it is clear that a person who has mastered such mathematics will have logical thinking and the ability to link judgments at a certain level.

7. Conclusion

Under the global market conditions, it is important to preserve the identity of the child, his uniqueness. The tasks for economic plots do not meet this goal but form an impersonal mass consumer. Therefore, it is necessary to draw the problem plots from other areas of human life as well - from industry, sports, culture, etc. Plots on the beauty of the world around us (geometric facts and objectives for the aesthetic taste development) or from ecology (raising a careful attitude to nature) have a nurturing effect on the student.

The moral criterion implies careful selection of the content, forms and methods of teaching mathematics, etc. The main principle in teaching mathematics should be the principle of love for children. In the selection of the material content the attention must be paid to the plot of textual problems, to what educational meaning it contains. Mastering mathematics is impossible without hard work, so lessons on mathematics should not be presented to students as a carefree pastime.

At the same time, the role of practical problems should not be exaggerated in teaching mathematics. It is important to keep the systematic and deductive nature of Russian mathematics education, which is responsible for the formation of such important personality traits as logic and critical thinking, love of truth.

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