Chapter 15
Math-Related Problems in Russian Engineering Education:
Possible Solutions Based on Best Practices in European and Russian Universities

Ilia Soldatenko
Tver State University, Russia

Irina Zakharova
Tver State University, Russia

Oleg Kuzenkov
Lobachevsky State University of Nizhniy Novgorod, Russia

Alexander Yazenin
Tver State University, Russia

ABSTRACT

Engineering education tends to be more and more attractive to Russian students in response to the growing demands of the labor market in this area. However, there is a serious problem of high percentage of drop-outs during first year of study in STEM courses (science, technology, engineering, mathematics) and mathematical disciplines are the most typical reason for that. This problem is addressed by international TEMPUS project MetaMath whose aim is modernization of the Russian education system in accordance with international trends and Russia's cultural and educational traditions as well as needs of business and industry. The purpose of this chapter is to describe research results and analysis of modernization experience of educational programs based on the produced methodology.

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INTRODUCTION

Engineering education tends to be more and more attractive to Russian students in response to the growing demands of the labor market in this area. However, nowadays there are several serious problems in this area.

These problems, firstly, include global changes in the world that certainly affect education. The speed with which engineering knowledge and competencies evolve has been steadily increasing; new skills required by engineers constantly emerge while some of the existing ones become obsolete. Sometimes it even happens that some technology becomes outdated before a student completes a four-year bachelor course of study.

This, in turn, complicates the process of learning. Modern student is obliged not only to master a certain amount of knowledge but also to learn how to use it to solve practical problems which were not dealt with explicitly during training and may lie on the intersection of different fields. This requires formation of respective competencies of the student.

Secondly, there is a very serious problem of high percentage of drop-outs during the first year of study in STEM courses. Mathematical disciplines are the most typical reason for that. According to current statistics, the average drop-out rate from engineering specialties because of mathematics in Russian universities is about 20%, for some curricula it reaches 40%.

School graduates, who choose these courses, usually underestimate the role and place of mathematics in their upcoming education. Often, prospective students have this false perception that mathematics is unimportant for a chemist, a physicist or a programmer. Everything is also aggravated by the difference in the level of mathematical training between universities and schools.

At the same time, numerous studies have shown that the level of mathematical knowledge is a major factor determining the success of engineering education. In Russia all university students pursuing this kind of curricula are obliged to take a lot of math-related courses at the beginning of their education. Disciplines of engineering profile for which the mathematical knowledge and skills are essential input requirement appear only during senior years.

Other reasons for the above-mentioned problems in Russian universities include reduction of teaching hours (credits) for math subjects in curricula of some Russian universities and the fact that new information technologies are not used to the full extent in education process. The European experiences and research results have proven that significant improvements in learning outcomes in mathematics can be achieved by applying new Technology-Enhanced Learning (TEL) tools and pedagogic approaches.

Because of these circumstances, much methodological work is required to modernize the system of mathematical education for engineers in Russian universities.

This problem is addressed by international TEMPUS project MetaMath (MetaMath, 2016) which involves five Russian universities (Tver State University, Lobachevsky State University of Nizhniy Novgorod, Kazan National Research Technical University named after A.N.Tupolev, Ogarev Mordovia State University, Saint-Petersburg Electrotechnical University (LETI)), Association for Engineering Education of Russia and four European universities (Tampere University of Technology, Claude Bernard University Lyon 1, Saarland University, Chemnitz University of Technology). This project's aim is modernization of the Russian education system in accordance with international trends, best practices of European universities and Russia's cultural and educational traditions as well as needs of business and industry.