

# Mathematical Higher Education in St. Petersburg: Challenges and Prospects

**Alexander Kulikov**

*St. Petersburg Department of Steklov Institute of  
Mathematics of the RAS, Russian Federation*  
[alexander.s.kulikov@gmail.com](mailto:alexander.s.kulikov@gmail.com)

**Nikolai Mnev**

*St. Petersburg Department of Steklov Institute of  
Mathematics of the RAS and St. Petersburg State  
University, Russian Federation*  
[nikolai.mnev@gmail.com](mailto:nikolai.mnev@gmail.com)

**Petr Zograf**

*St. Petersburg Department of Steklov Institute of  
Mathematics of the RAS and St. Petersburg State  
University, Russian Federation*  
[peter.zograf@gmail.com](mailto:peter.zograf@gmail.com)

St. Petersburg mathematical school has always been held in high esteem. Even though it has already been long since the center of mathematical life in the country relocated to Moscow, St. Petersburg remained the leader in many areas both within fundamental and applied mathematics. In the 1990s, however, the situation worsened: many mathematicians left the country, which affected the quality of mathematical education. Below we discuss the recent attempts to change the situation.

Mathematics students at St. Petersburg State University (SPbSU) are usually introduced to what it is like to do research at a relatively early stage. Students choose an advisor in their second or third year already and start attending seminars dedicated to a specific research area. Despite obvious benefits, such an early specialization might lead to “tunnel vision” and lack of familiarity with even the most basic of terms that are used in other fields. There are several factors that worsen the situation even further:

- SPbSU Department of Mathematics and Mechanics is situated far from the city’s other mathematical centers;
- mass brain drain of the 1990s (which affected St. Petersburg much more than Moscow) has led to lack of qualified faculty and, therefore, fewer available courses that would cover many aspects of modern mathematics;
- students are struggling financially and often have to work after classes, which impedes educational process.

The same could be said about graduate students too, who go even deeper down into their very narrow, very specific field of research (often imposed by their advisors). As a result, we get a pool of specialists who know little outside their own field and who aren’t integrated into the international mathematics community, which, in the end, brings them even further away from the world of modern science. Moreover, some mathematical disciplines that used to be well-represented in St. Petersburg too are on the brink of extinction.

We will discuss three projects, all of which have been implemented within the past decade. They were aimed at solving the above-mentioned problems and creating an interesting and stimulating environment that would let senior undergrads and graduate students learn more about modern mathematics by inviting the best international experts to give lectures and organize workshops.

The first such project was called the Physics & Mathematics Club (PMC) at the St. Petersburg branch of Steklov Institute of Mathematics of the Russian Academy of Sciences. The idea behind it belongs to A.S. Losev of the Institute for Theoretical and Experimental Physics, and it was brought to life by N.E. Mnev of Steklov Institute. PMC was launched in fall 2004. The quality of fundamental education the sphere of physics and mathematics was very much under scrutiny in St. Petersburg in the early 2000s. The problems were caused both by mass emigration of the 1990s and questionable organizational decisions (e.g., when SPbSU Departments of Physics and Mathematics were moved outside city center to the Peterhof campus). Nevertheless, thanks to the fact that there were still a few good schools in St. Petersburg and to the fact that many families were traditionally highly committed to giving their children a good education, there always were quite a lot of mathematically-gifted young people. By their third year at university, those of them who had chosen fundamental subjects would realize that they weren’t satisfied with the quality of teaching. Therefore, it was necessary to create an (informal) space where such students could learn more about modern science, namely mathematics and theoretical physics, and get to meet prominent academics.

Yet, even developing a local educational initiative requires new concepts and principles. PMC was guided by the idea of an informal approach to education (following the example of Le Collège de France). Its main principles are: the classes are free and open for everyone, there are no obligatory exams, the lecturers present broad material of a relatively high level. In the 1960s, there used to be a similar club at SPbSU Department of Mathematics and Mechanics, called “Advanced Studies Course for Engineers”. PMC was an informal organization too, where self-management was stimulated; students were encouraged to be independent and to organize workshops themselves. Such activities could be more or less successful, depending on the year,

but that is exactly how affinity groups develop. The most active students were rewarded financially: they were paid for organizing seminars and got funding to participate in international summer schools. They also organized their own summer schools together with the Institute for Theoretical and Experimental Physics, St. Petersburg Nuclear Physics Institute, and the International University of Moscow. There has been a number of joint summer schools together with Kiev Institute for Theoretical Physics, and several specialized summer schools held at Institut des Hautes Études Scientifiques in France (IHES coordinator: Nikita Nekrasov), Weizmann Institute of Science in Tel Aviv (WIS coordinator: Sergey Yakovenko), and the Chinese Institute for Advanced Studies in Shanghai. In 2006–2011, PMC enjoyed ample funding due to the help of the Russian Academy of Sciences and Dynasty Foundation, so a lot was going on: around 50 advanced courses per year and numerous seminars and colloquia were given by lecturers coming from Moscow or from abroad. The club's approximate attendance rate was between 200 and 300 people. On the whole, we can say that PMC was a success: it has helped a new generation of talented students to learn more and accomplish more in their chosen field. Nowadays PMC is only funded through moderate private donations, and is folding its operations, though it would've probably remained useful.

In 2010, Chebyshev Laboratory began to slowly take over the functions of PMC. It's an interdisciplinary research lab created at SPbSU in December 2010 by the Fields Medal winner Stanislav Smirnov within the "megagrant" framework of the Russian government. The lab conducts interdisciplinary research that covers mathematical analysis, algebra, probability theory, mathematical physics and other areas. One of its priorities is to engage undergraduate and graduate students into research. Besides that, the lab also organizes:

- workshops and seminars on a wide number of topics within modern mathematics (about 100 a year);
- presentations by leading international scholars (over 50 visitors a year);
- conferences and schools for students (about 10 a year).

The lab also supports young scholars (including senior students) financially, which allows them to participate in conferences and summer schools both in Russia and abroad.

The lab's staff are relatively young and very active: the number changed between 40 and 50, with the average age below 30; they publish more than 100 articles and working papers per year. In 2013, JSC Gazprom Neft started to support Chebyshev Lab as part of its social investment program. Students and young PhDs with outstanding performance receive Gazprom Neft scholarships. In 2014, the lab also received a grant from the Russian Science Foundation, and its members regularly win personal research grants and prizes.

In 2007, a club similar to PMC was founded, called Computer Science Club (CSC). Its aim is to introduce students to different aspects of computer science. CSC organizes lectures that cover both fundamental topics (often related to the computational complexity theory) and applications domain. The lectures usually take place during weekends and are free for everyone, no sign-up required. The club is funded by Anton Likhodedov of Deutsche Bank and Yuri Bogdanov of Rigmora Holdings. So far, over 100 courses (consisting of least 10 lectures each) have been read at CSC. They were taught, among others, by leading scientists from Russian universities and research centers, as well as by colleagues from the University of Oxford, University of Warwick, European Bioinformatics Institute, and University of Bergen, and by the representatives of Microsoft Research, Yahoo Research, etc.

In 2011, Computer Science Club became part of Computer Science Center, which was organized together with the School of Data Analysis and the Academy for Modern Programming. The center offers 2- or 3-year-long on-site courses; the classes usually take place in the evenings. The students can get a diploma in one of the three areas: Computer Science, Data Mining or Software Engineering. Core courses include: discrete mathematics, asymptotic analysis, algorithms and data structures, C++, Java, computational complexity theory, databases, computer architecture, concurrent programming, compilers, game theory, image analysis, machine learning, etc. Besides that, the students have to complete experimental projects and to do research. There is no tuition fee but the admissions process is very selective. The call for applications is announced once a year. The center is funded by JetBrains and Yandex, as well as Anton Likhodedov and Yuri Bogdanov.

All the three projects have been very successful in supporting mathematics in St. Petersburg and have helped downplay the negative developments discussed at the beginning of this paper.

## References

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