

ETH Math Youth Academy invites high school students

(an informal and unofficial translation of the original article, available at

<http://nashgazeta.ch/news/education-et-science/matematicheskiy-kruzhok-dlya-shkolnikov-v-eth>)

Why is the Swiss Federal Institute of Technology in Zurich, the best university in Switzerland, trying to attract teenagers? Here is the answer.

According to the 2012 study by the Programme for International Student Assessment (PISA), performed in the countries that are part of the Organisation for Economic Co-operation and Development (OECD), the general level of mathematical education in Switzerland (along with Liechtenstein) is best in Europe and 9-th in the whole world. The overall level of the school students is very high; however, opportunities for them to go beyond the standard high school program have not been created to a sufficient extend, at least in comparison to countries in Eastern Europe or the US.

Supported by the Swiss National Science Foundation, a massive long-term research project SwissMAP <http://www.nccr-swissmap.ch/> was launched in 2012, aimed towards interdisciplinary research in mathematics and theoretical physics. The main responsibility for its realization was assigned to Geneva University, known with its strong mathematics department, which has brought to the Swiss Confederation already two Fields medals (Stanislav Smirnov, <http://nashgazeta.ch/news/10552> in 2010 and Martin Hairer in 2014), and ETH Zürich. One of the many concrete tasks of the project is attracting school students into studying these subjects. For that purpose, a postdoc position at ETH has been created, part of which involves creating and implementing programs for students in school. Kaloyan Slavov is holding this position since September 2015; he is a Bulgarian, a graduate of Harvard and the Massachusetts Institute of Technology (MIT), and an author of a number of mathematical publications, whose titles are capable of driving off our fellow readers, so we do not include them. With his light hand, the Math Youth Academy, or, as we say, a math circle, came about at ETH. Its purpose is to give opportunities for the interested and creatively thinking high school students to get deeper into the wonderful world of the neat formulas. We are going to have a discussion with Kaloyan about how he is doing this, who he has managed (or wishes) to attract, and what the first results are. (We were discussing in English, but Kaloyan reads Russian freely and understands absolutely everything.)

nashgazeta.ch Kaloyan, you come from Eastern Europe; we are used to being criticized by everyone (and by ourselves to begin with) that everything we have is bad, that we are not capable of anything. This is why it is especially pleasing when some of our experiences are replicated in the West, especially in such a prestigious educational institution as ETH. Still, I am ready to argue that when you were founding the math circle and calling it an Academy, you were inspired by your memories from your Bulgarian childhood.

Kaloyan Slavov: You are completely right! In the school were I was studying, there were such math circles for every grade, this is part of the Eastern European tradition. Such a tradition does not exist in Switzerland, but we are working on creating one.

Switzerland is a country of pragmatics, not in any criticizing sense. If the government decided to invest in mathematics, then it sees a reason behind that. What is it, in your opinion?

Professors from ETH Zürich and Geneva University applied for a government grant for the program that materialized itself as SwissMAP. (This is why these two universities assume responsibility for its realization; as we know, no initiative goes unpunished.) The government responded with understanding and accepted the arguments of the scientists that the whole society benefits from the delving deeper into mathematical knowledge. The Swiss are indeed pragmatic. I think that SwissMAP is considered as a government investment in the scientific potential of the country.

The math circle at ETH Zürich is not the first and not the only one; something similar exists in Geneva University and is involved with mathematical olympiads every year, as well in EPF Lausanne (the Euler Course). (Full information about all courses can be found here <http://www.nccr-swissmap.ch/education/school>). Do you communicate among yourselves? What is common and what is different?

Of course, we all communicate, ask each other for help and advice, and share experiences — our goal, after all, is the same. There are some differences. For instance, the math circle at the University of Geneva mathematics department is oriented more towards preparation for mathematical olympiads — by the way, I strongly encourage all students to participate in these. The Euler course at EPFL covers several years of the high school curriculum along with the first year of the university. They are all great and I wholeheartedly recommend everyone to participate in the programs available at their locations!

Many Russian moms often complain about the low level of mathematical education in Swiss schools <http://nashagazeta.ch/news/education-et-science/8294>. Do you agree with this evaluation? Is there really a fundamental difference in the methods of teaching?

In my opinion, the educational system in Switzerland is designed and works very well — if you send your child to any school, even the most ordinary one, right next to where you live, you can be assured that they will get a quality education. What is missing here — and this is the fundamental difference with Russia, Bulgaria, USA — is the special attention to students who demonstrate outstanding ability and the creation of special environment for their further development. That is to say, homogenization vs. selection. I think that in Switzerland, one should not change anything, but just add that missing element, which is actually what we are doing.

About the methods of teaching, the difference is that in Russian schools, students study fewer topics but in more depth, while in Switzerland it is the other way around. But is it necessary that everyone at school level delve into mathematical jungles, given that the majority will not become mathematicians? Probably not, and it would not be fair to make them go into that. Just as it is unfair to deprive of such opportunities those, for whom school mathematics is going very well and who want to reach more depth. In this way, we can say that our math circle is for those who do not want to be bored in their mathematics lessons. Everyone is welcome; there is no fee.

I noticed that among the materials that you use, one finds the famous “Leningrad math circles” by Genkin, Itenberg, Fomin. At the time, Soviet books were cited very often. How is it today?

There exists rich, fabulous mathematical literature in Russian. In fact, I chose to study Russian at school as my second foreign language specifically in order to read it in the original (there are, unfortunately, few translations). In general, Russian is very useful for mathematicians. There is an old mathematical tradition in your country, and by giving problems to the students from books written in the 1980’s or 1990’s, I figure out that these books have not become old at all, just as symphonies written several centuries ago have not.

How does the selection for the Academy take place? Does a student have to have outstanding mathematical abilities, or is it enough just to like mathematics?

The course is intended for all *interested* students, age 14 or above. I intentionally do not use such adjectives as “talented” or “gifted,” since, on the one hand, this may drive away some of the more modest students, and, on the other hand, one cannot determine the ability level of students at such a young age. This is why every student willing to spend two hours a week in extracurricular mathematics in a welcome guest in our math circle.

How are the classes organized and can you give specific examples of what you do?

We have two groups, “main” and “advanced,” according to age and experience of the students. The classes are in the form of mini–courses, each takes 3 to 6 weeks and is devoted to a specific topic or method. The main accent is on high school–level, and yet nontrivial mathematics. In other words, all the topics belong to the high school domain, without entrance into the university curriculum. Students who later choose mathematics as their main subject will learn these anyways, while the development of creative, non–standard thinking is beneficial for absolutely everyone, regardless of the career they choose. In addition, the students learn how to give careful argumentation in concrete given tasks — we pay special attention to rigorous proofs. Finally, at least for students at this age, it is easiest to display the beauty and aesthetics of mathematics precisely in such “fundamental” contexts.

How do you attract students to the math circle?

This is a completely new project, this is why so far the information is conveyed by word of mouth, so to speak, through our ETH webpage. In addition, besides the weekly classes, I have launched a series of public talks in various high schools. So far, there have been only two such — about “Mathematical induction” and about “Mathematical games,” both available from our website <https://www.math.ethz.ch/eth-math-youth-academy>. I hope that I will receive further invitations from other schools, which would allow me to popularize mathematics among a wider student audience.

The classes take place in English. Isn’t this an obstacle?

No, the majority of Swiss students are comfortable enough with English. Currently, there are about 15 students attending regularly, boys and girls, mainly from Zürich. One of them comes from Solothurn every week, spending an hour in the train in each direction. The first two classes were attended by 40 students each, who later decided that this is not quite for

them. Such a natural selection does not discourage me, although I would like, of course, the project to develop. For this, we encounter two difficulties. First, mathematical circles are a new phenomenon in Switzerland, and the tradition is yet to be established. Secondly, many students are very busy with their regular school curriculum, which does not give enough time for extracurricular endeavors. However, those who currently attend, I would say, truly like mathematics and are enjoying the classes. I hope that they will be joined, in particular, by a number of young readers of `nashgazeta.ch`.