

PHYSICS AND MATHEMATICS SCHOOL BY CORRESPONDENCE
AT THE NOVOSIBIRSK STATE UNIVERSITY

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1. *Background*

First a few words about Novosibirsk University. It was founded in 1959, shortly after the famous Akademgorodok was created near Novosibirsk in Siberia. Several research institutes of the Russian (then Soviet Union) Academy of Sciences were built there “from scratch”, with most of research staff initially coming from European parts of USSR, mostly from Moscow and Leningrad. Most of the research institutes were in Sciences: mathematics, computing, physics, chemistry, genetics. The new university was a necessity for bringing up a new generation of researchers, finding new talent in nearby Siberian population, giving researchers in the institutes the opportunity to have under- and post-graduate students, PhDs, postdocs, who would later become new members of staff at the institutes. Novosibirsk University became one of the best universities in USSR, and now in Russia, under the exceptional arrangements that most of its teaching staff are on 0.5 positions while having their main positions at the research institutes of the Academy of Sciences.

Soon after the foundation of Akademgorodok and Novosibirsk University, a specialized Physics and Mathematics School (“FMSH”) was also established. This is a boarding school, where children of 15–17 years of age (in their last two years at school) study advanced curriculum in mathematics, physics, and chemistry. Classes in these subjects are organized in university style, with lectures by professors and with tutorials in small groups, many teachers also being researchers. The aim is to attract school children to Sciences, to prepare them for entering Novosibirsk University. There is also an element of a kind of “social engineering”—to give gifted school children a better chance when in many cases their talents could not be adequately nurtured at their local schools in various cities, little towns and villages in Siberia. Pupils in FMSH are selected at mathematical olympiads which are conducted

in every school, then winners take part in district olympiads, then winners go to regional olympiads. This olympiads system has of course a “sports” component—further winners are selected to go to All-Russia olympiads, where the Russian team at International Olympiad is selected. But for the purposes of selection to FMSH, it is the regional (oblast’) level where representatives of Akademgorodok conduct interviews. On the basis of these interviews some 500 children are invited to Akademgorodok to the Summer School in August. It is mainly from participants of this Summer School that about half of them are selected to one- or two-year course in FMSH boarding school.

But being a pupil in FMSH is by no means a necessary condition for becoming a student at Novosibirsk University—only about 20% come from FMSH. Given a certain competition among universities for better students, it is important that Summer School participants, even if they did not enter FMSH, were exposed to the impressive environment of Akademgorodok, could have a taste of being in a truly world-class research centre, see real scientists at work. Summer School participants go to excursions to the research institutes, for example, to see a computer-guided work of electron-positron colliders at Institute for Nuclear Physics, or to hear and see effects of welding by explosion at Institute of Hydrodynamics.

Another aspect is of psychological nature. It is not unusual for school children that are into mathematics, say, or other sciences, to feel like a black sheep among their classmates in ordinary schools, being perceived as “nerds”, etc. It is therefore important that participants of Summer School find themselves among like-minded pupils, also interested in science, mathematics, cosmos, research, etc. This experience can already make a difference in a young person’s perceptions, provide additional motivation for further life choices. This is true even if a participant of Summer School would not enter FMSH for whatever reasons (say, not willing to go to a boarding school hundreds of miles from home, or already studying in a good school in their home town).

2. *ZFMSH—Physics and Mathematics School by Correspondence*

ZFMSH is another part of this system of attracting and preparing school children to Novosibirsk University. The selection process is somewhat less demanding: usually anybody doing reasonably well at school would be able to join, although there are some entrance tests. Nowadays about 200 best pupils of ZFMSH are selected to be invited to the aforementioned Summer School, as a supplement to the

Olympiads selection process; this practice began on a smaller scale back in 1980s. From these figures and other information on the web-site of ZFMSH, it is clear that the importance of ZFMSH has increased, and its organization became better.

I worked at this school by correspondence in 1973–78 when I was a student at Novosibirsk University, and later in 1984–86 as Head of its Mathematics Department, which was a part of my additional 0.5 position at the university (while having my main employment as a research fellow at Novosibirsk Institute of Mathematics). So I worked in ZFMSH long ago and may not be in the best position to describe the current situation. But as far as one can judge by the aforementioned web-site, the structure remains the same. Even if nowadays assignments may be sent or/and submitted by e-mail, it is the same basic learning of mathematics: understanding theory, examples, solving problems, no matter which medium is used. ZFMSH also had physics and chemistry departments, and later more departments were added, like biology and economics. But I will focus mainly on its Mathematics Department.

The actual work of ZFMSH consists in sending to pupils about 4–5 assignments per year with test questions. The assignments are so-called “metodichki”—booklets of about 10–20 pages each, on a particular topic, with theoretical material, with plenty of examples, and with about 15–20 problems for the pupil to solve, which constitute an assignment. These booklets are sometimes original, sometimes compilations and extracts from popular-mathematical books for school children. In USSR and in Russia there were and still are a number of excellent publications like the monthly *Kvant* magazine, or a series of *Library of Physics-Mathematics School*, including such books as, for example, *Functions and Graphs*, *Straight Lines and Curves*, *Method of Coordinates*. The pupil would spend about a month studying the booklet and solving the problems of the assignment and then send their solutions by mail (nowadays e-mail submissions are also possible). This work is then marked by the “teachers”, or tutors. In my time these tutors were mostly under- and post-graduate students, at some point they were paid small fees for their work, which disappeared at some point, but I do not know how this works nowadays. Anyway, when I worked, it was important that the markings were not merely grades for each problem–solution but contained relevant advice. Efforts had to be made that all “teachers” adhered to this rule. Some of these undergraduate “teachers” (just one–two years ago themselves school children) had to be corrected, prevented from showing contempt towards “stupidity” of pupils, from supplementing grading marks with

ironic or sarcastic remarks, from asserting their egos at the expense of the pupils . . . There were also four permanent members of staff who would keep all the correspondence, order printing of the booklets, solutions, entrance tests, keep records of ZFMSH pupils.

The programme is quite close to the school curriculum. But it is meant to be more than routine exercises in algebra and geometry. In ordinary schools, in classes of 25–30, teachers usually did not have time (probably still do not have), and sometimes do not have ability or motivation, to engage more able pupils. Even if most of the topics were present in ordinary school textbooks, the booklets and problems in them were not merely repeating school curriculum but were aiming at developing understanding of mathematical ideas, proofs, methods. For school children in their final year there were also assignments helping to prepare for entrance examinations to universities.

Here are some examples of topics of those booklets, which I remember from 1980s:

- *Geometric Loci*
- *Sets and operations with them*
- *Mathematical Induction*
- *Vectors*
- *Symmetry*
- *Method of Coordinates*
- *Similarity in Geometry*
- *Divisibility*
- *Elements of Combinatorics*
- *Parallel Projections*
- *Equations and Inequalities*
- *Sequences and Limits*
- *Functions and their Graphs*

3. *Some personal remarks*

My first close encounter with ZFMSH happened when I was a first-year student of Mathematics and Mechanics Faculty of Novosibirsk University. It became known that this school was in trouble, needed help, had to be rescued. The fact was that before that moment there were some, albeit quite limited, funds that were used to pay for marking the “scripts”, the assignments sent by the pupils. These markers—essentially “teachers” in this school—were mainly undergraduate students, who had some very modest income from this marking. When, for reasons unknown to me, these funds disappeared, some of these

“teachers” quit (but remarkably not all of them, some continued regardless!). As a result a huge backlog of unmarked scripts/assignments accumulated.

So there was a call for volunteers, and I was among those who volunteered, with clear sense of purpose of doing something really useful, helping school children who were interested in mathematics. Quite often these school children would not have opportunities to develop their interest and ability in the subject, sometimes living in small villages in Siberia, sometimes with inadequate teachers, etc. We were quite enthusiastic, proud to be useful in this unpaid work. One can, however, also argue that this was a kind of exploitation of our enthusiasm, using it to plug certain shortcomings of the education system. Actually, this work in ZFMSH also “counted” towards more or less compulsory “voluntary social work” for members of Komsomol (Young Communists League, which included 99% of young people in USSR). For many of us this type of “social work” was much more satisfying and meaningful than many other official activities within Komsomol.

Anyway, I have fond memories of doing this work in ZFMSH during student years. With my friends, we became quite active in this work, and recruited many of our fellow students both in my year and younger. Some of us became “team leaders”—heads of teams of about 5–7 “teachers”; then some members of these teams became team leaders themselves, and so on.

Later, after graduation from Novosibirsk University, I became for some time Head of Mathematics Department of ZFMSH, being responsible for the programme (syllabus), and to some extent for the recruitment of markers, “teachers”. The latter was at that time a weak link in the operation of ZFMSH, with students-teachers sometimes neglecting their duties, with dozens of scripts being again left unmarked for weeks. It is hard to blame the students-teachers, though,—they could be busy with their own studies. In my opinion, a better approach is regarding this work as real work, which should be paid for if higher responsibility is expected. Recall, I am writing here about the situation in the 1970s-90s; I do not know how ZFMSH functions today. Actually, after checking the on-line information at <http://zfmsch.nsecc.ru/>, I could see that nowadays the organization seems to be much better: many more mathematicians, physicists, chemists, etc., most of them university graduates, are now involved in this demanding work, which requires dedication and understanding of the advanced programme.

About the author

Evgeny Khukhro (born 1956) is a Russian mathematician. He made contributions to the areas of group theory and theory of Lie rings. He also taught various under- and post-graduate courses in Novosibirsk, Cardiff and Manchester. In regard to school mathematical education, he taught at Novosibirsk Physic and Mathematics School, participated in organization of mathematical olympiads in Novosibirsk and at all-USSR level.