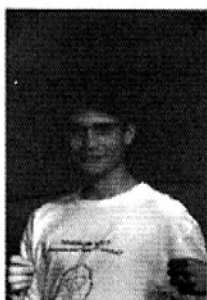


Six Years of Scientific Research Training in Hungary

Progress, Plans, Problems

Péter CSERMELY, Zoltán BORSODI, Tamás KORCSMÁROS, Bálint PATÓ
Hungarian Student Research Foundation
H-1149 Budapest, Dongó str. 8, Hungary



Abstract. The first six years of a new program to organize high-level scientific research training for gifted high school students in Hungary are described. Besides giving top-level research opportunities for talented students in their most receptive age, the program already helped the establishment of almost two hundred scientific research clubs in high schools of Hungary, Romania, Slovakia and Serbia, providing a focal point for science training of high school teachers and helping regional cooperation in Central-Eastern Europe.

1. Introduction

Six years ago a new program has been established in Hungary helping gifted high school students (in the age between 14 and 20) to find mentors who introduce them to scientific research in Hungarian universities or research institutes. The program gained an overwhelmingly positive response from the Hungarian scientific community. Mentors are of highest scientific merit: among them 78 are members of the Hungarian Academy of Sciences (*George Olah* is a Nobel Laureate), and most are respected professors of their research field. The patrons of the program are *Ferenc Mádl*, the President of Hungary and *József Pálkás*, Minister of Education (both are well-known scientists themselves, members of the Hungarian Academy of Sciences).

Whenever this program was introduced to new areas, first we always had questions: are not these guys simply too young for this? Science is something "serious". Are not you making fun of it? We believe that high school students are in an excellent age to start scientific research. Excellent, because this age is the first period in life, when someone wants to explore himself and the surrounding nature with the systematic, logical way of understanding, science uses. Excellent, because science is an area of exploration, which is – by nature – infinite. Excellent, because science can be perceived only as an international endeavor. And finally excellent, because good science does not know hierarchy. Bright high school students are equal with the Nobel Laureate whenever, they have a new question rising from a fresh mind. Science can break the petrified borders of society, and give a chance for self-expression at a different scale. This unusually wide channel of "status-jump" is especially important in many of the Central-Eastern European countries, where more than ten years after the regime-change social differences broadened, and social mobility was rather diminished. In these countries talent support became an even more central issue now than it was in the past.

Why does a student start scientific research? A general answer is not easily found: many students realize their talent, their need to change their life and find a way for self-development, independence, and social endeavor in form of scientific research. However, the most important motivation is always a part of the "personal history": without a devoted teacher, a deep-thinking relative, or someone else in the close neighborhood students seldom have or trust the examples around them. Therefore instead of a – probably false – rank-list of motivations let us give a concrete example from our recent questionnaire⁹:

"When I was starting to explore my family traits, I was shocked to find that many members of my family were participating in important events of recent history. History became personal, and I began to like it. Now I pursue studies of local history." (Livia Kovács, born 1984)

2. How do we work?

We provide a link between high school students, who wish to participate in research and devoted scientists who are willing to teach them without any payment or other direct benefit. Many times this collaboration results in scientific research papers in various journals. Much more importantly, the research experience leaves a mark in the student, who will keep this throughout the whole life. János Balogh, a respected Hungarian scientist told once: "You guys teach not only science here, but give moral standards, life itself." Indeed, many students find a second home in the laboratory, team they work. Their habits, aims, perspectives, whole life has changed.

At first we were rather frightened. We have a few hundred mentors and more than 100,000 students in high school. How are we going to select them? Realizing that scientific merit may come from a thousand sources, we instantly discarded any types of test, being it any IQ-test or questionnaire of the respective field. "Science is one of the most frustrating

⁹The questionnaire was distributed to all current and former high school students in late 2001. We received back 96 questionnaire from current, and 45 from past student researchers. If not otherwise stated all data in the current summary are coming from the evaluation of these answers.

professions.” (Csaba Pléh, a member of the Hungarian Academy of Science in the field of cognitive psychology). The only general advice for success is motivation and endurance. Science also needs a lot of independence. How can we test these? During the years we found two screens, which may sound simple, but work remarkably well. The essence of the formula sounds rather lazy and selfish: we give no help.

53 % of participating students find us *via* their teachers, 15 % are persuaded by their student fellows already knowing the initiative, 12 % read or hear about us from the media, and 5 % accidentally finds our home-page during web-surfing. There is only one potential source we intentionally disqualified: parents. Each kid is a genius for the father or mother. However, if the motivation is not internal, but comes mostly from family-pressure, the cooperation between the student and the teacher will not be long-lasting, joyful and creative.

When a student finds us, he has to answer to two simple questions:

1. Why do you want to pursue research?
2. Why do you feel yourself better than average?

These seem to be rather simple questions. However, our experience shows that to find an answer to them in this age is by itself a rather good screen for maturity and motivation. To be honest, we accept almost all answers. (Please do not tell this in the Hungarian schools...☺) We would like to give the chance to almost all students to pass the second screen.

The second screen is also very practical, simple and a good “mimic” (actually a part) of real life. The student has to find the mentor alone. All the courage has to be collected before that first letter, email, or phone call to address a professor, or – for God’s sake – a Nobel Laureate. All our researchers are waiting for these letters and calls. Students know this. Still. That very first step makes a good second screen.

This initial “cruelty” is not a general philosophy. We do not leave our students in the desert. If the student does not get an answer from the mentor, he finds a mentor who is not helpful enough, or he does not find a mentor of his interest at all: he is fully entitled to our help. Mentors are called sorted, listed, re-listed and enlisted all the time.

3. Mentors and students

In 1996 we started with approximately 300 mentors. The number of scientists devoted to the program doubled in the last six years. So far six editions of the list of mentors were published in 4000 copies each, and have been sent to each Hungarian high school, to 500 high school teachers who regularly recruit new students and to almost 1000 gifted students personally. Winners of various student competitions, student members of MENSA HungarIQa, or student authors of scientific papers in the Hungarian Journal “World of Nature” were all personally addressed each year.

At start we had a hundred students only (1). Currently we have 800 and an additional 3200 working in student research clubs. The ratio of boys and girls was always close to fifty-fifty (currently we have 55 % boys). This shows that the interest for science is

independent of gender at this age. Therefore the rather significant "male-dominance" of science is mostly derived from conflicts between the "publish or perish" principle and child-birth, which often results in a several-year gap for women in science.

Four years ago¹⁰ 50 % of students worked in life science laboratories, 30 % attended to Faculties of Arts, 19 % to Faculties of Natural Sciences (life sciences excluded) and there was 1 % in economy and law. Currently the ratio of life science and economy/law researchers are unchanged, however, natural sciences and arts drew 27 % and 16 %, respectively. The life-science dominance (which has a very significant share of environment protection) shows the student's continuing interest for the living nature around them. On the other hand, the highly competitive crowd for the entrance exams to faculties of economy and law seems not to be driven primarily for scientific interest...

Our students reached an average mark, which is 90 % of the best. Their 84 % participated in one or another scientific competition besides their research. 97 % planned to go to universities and after a very strict entrance exam 93 % of them was actually accepted. Many of our students started their university studies abroad in Europe, in the USA or in Japan.

If we examine all the 800 currently listed students 25 % of them were from the capital of Hungary, Budapest; 32 % from Hungarian towns with a population larger than 100,000; 25 % from smaller towns of Hungary and 21 % from villages. Students from Romania, Slovakia and Serbia are 23 % of all¹¹. Three years before 28 % of our students came from Budapest, 18 % from big, 31 % from small towns and 23 % from villages. Data show that students from Budapest (an oversized capital of Hungary having more than 20 % of total population and an even much greater share of scientific and cultural life) are not dominating the initiative. The most important part is the unchanged quarter of students coming from small villages. These are the researchers who probably would have never found a similar possibility without our help. Not surprisingly, many of our students are coming from families of low income. We set up a special "quick-aid-fund" to cover their expenses for travel, books or other small items. Even more importantly, *all of our programs are free of charge* to give an equal chance to participate.

4. Organizations

In 1998 a Research Student Foundation was established to channel the financial help for the program. The annual budget of the Foundation grew to approximately 100,000 euros by 2002. Sponsors of the action include: the Béres Foundation, EGIS Ltd., Gedeon Richter Ltd., Hungarian Patent Office, Ministry of Education, Ministry of Environmental Protection, "Műszaki" Publishers Budapest, NATO, Program for Children and Youth and UNESCO.

¹⁰Our former questionnaire was from 1998 having a sample of 76 students.

¹¹If we restrict this statistics to the questionnaires we recently received, 20 % of the students are coming from Budapest and 24 % are from Romania, Slovakia and Serbia. The remarkable similarity between the ratios of the two data sets suggests that the sample we had with the "responders" to our questionnaire may be a rather good representation of the total population.

In 1999 participating students, mentors, high school teachers and scientific research clubs formed a Research Student Association, which currently has approximately 500 members. The issues of the movement (including all finances) are decided by the student president (currently Mr. Bálint Pató) and by the two deputy presidents (currently Mr. Zoltán Borsodi and Tamás Korcsmáros). The president and the deputies are elected each year by the participants of the National Conference. Students are eligible to be a member between age 14 and 20. After passing the age limit, or grade I. at a university they continue their research in the undergraduate research student associations and can apply for being a "student-mentor" of the movement.

5. Annual Conference – Summer camp



From 1997 six national student conferences were organized. In each of these conferences 40 to 80 students participated, and 20 to 30 scientific presentations were made. From the second conference these meetings were organized as a summer camp in July near the Lake Balaton (1). Besides the short presentations of students on their own research, successful scientists talked about their approach of science and about their devotion. Psychologists and social-psychologists discussed the possible dangers of being outstanding in a field, and showed how to solve the conflicts, which might arise from this situation. The camps were all free for the

participants. The major language of the camp is Hungarian. However, almost all participants speak a rather good English, and in case of a significant participation from abroad, we will organize an English program as well. As the size of the movement grew, more than twice as many students wanted to come than the size of the camp: the selection of "campers" became increasingly difficult. We did not want to make "clones" of the camp, since the invitation of top-level scientists would not be possible to all of them. Therefore, from 2001 only the winners of the national conference of high school science clubs can participate in the research camp.

6. Science clubs in Hungarian high schools

The Research Student Foundation announced a competition for 2500 USD in the fall of 1999 to help the establishment of science clubs in Hungarian high schools (2). Since then the call for application was repeated each year offering a steadily increasing financial support. Members of these clubs may be involved in a research project requiring a team-work, or may perform individual studies and inform each other regularly about their progress. Most of the research clubs also invite established scientists to speak about their own experiences in research, or to summarize recent advances in their field. The Foundation receives approximately a hundred applications each year from Hungary, Romania and Slovakia. In these science clubs more than 3000 students are being introduced to scientific research.

From 2000 a special annual meeting of these research clubs has been organized. In these meetings almost 200 students gave an account on their research. From 2002 our movement grew to the point where a single annual meeting would be too large to accommodate. Therefore we organize regional student conferences (this year we had four: in Budapest, Győr, Szeged and in Romania) and the winners of these conferences can participate on the annual meeting on the national (actually: multi-national) level.

From the beginning we had an ongoing discussion around the question: to what extent should we exploit the natural drive of this age for competition? True science is not a race. Science is joy, hard work, exploration, meditation, and the unprecedented feeling of the birth of a novel thought. True science is a touch of God. Still. High school students have such a great tendency to compete that we simply could not leave this element out of our movement. We do have prizes. However, our prizes are not oversized. Therefore – despite of their merit – we avoided to grant a free entrance to the universities even to our best students. We want students who join us not because of any prize, but because of the joy of science itself. Besides this the most what we can offer to our students are themselves. To many of them our conferences and camps give the first opportunity in their life to find not only nice chaps, pals but true friends.

7. Organization of high school teachers

During the last six years we established a network of 500 high school teachers who regularly recruit students to work in research laboratories and/or lead science clubs in their own school. In 1999 the first national conference of these teachers was organized. The successful event was a forum to exchange various methods on the establishment of science clubs, local competitions, fundraising, recognizing talented students, etc. The conference also made a possibility for a discussion with government officials on several general issues, such as governmental help to enhance research activities in high schools, and to increase the number of Ph.D. studies among high school teachers. Recently, due to the increasing financial support an expansion of this programme became possible by opening an office of the movement. We plan to offer scholarships/awards for the best teachers in scientific research training, organize student/teacher research pairs, form virtual teams by the help of the Internet, explore international collaborative teacher/student research by Internet connections, help the development of novel Science Education curricula (e.g. that of molecular biology, genomics, nanotechnology, etc.), develop a special web-site offering extra materials for current topics in science education, promote the formation of the Hungarian Association of Science Educators, etc.

8. Contacts

8.1. Most Important Hungarian Contacts

In the last six years we have established a good contact with almost all official members, bodies of the scientific life in Hungary as well as related government institutions and NGO-s. Among this long-long list we would like to mention only the two most important points, the “input” and the “output”. Our initiative can help gifted children

between the age of 14 and 20. Seldom we have an exceptionally independent and capable student in the age of 12, or 13, who is able to participate in scientific research in some special fields. Usually these children are recommended to us by the Hungarian Talent Support Association, where the vice-president, *Dr. Maria Herskovits* is a long-time supporter and friend of our initiative. *Vice versa*, if we are approached by a talented student (or – usually – by the parents), who is below our usual age limit, we direct the student to Dr. Herskovits. A research student, who becomes “too old” for our movement, enters the Hungarian Association of Research Undergraduates, which is the same movement at the university level having more than 30000 members and enjoying rich traditions of its fifty years of existence.

8.2. International Contacts

The program has several hundred Hungarian speaking students, high school teachers and science clubs from the neighboring countries of Romania, Slovakia and Serbia. Our primary goal in the international scene is to enhance the regional cooperation in this segment of Central-Eastern Europe. Our goal is to form an international network for student/teacher exchange as well as to exchange and propagating existing “know how”-s of scientific research training. We have mentors from Australia, Austria, Canada, Italy, Romania, Slovakia, Serbia and the USA.

As another type of activity, the program already established several contacts with other organizations helping gifted children abroad. The sponsorship of the Deutsche Schülerakademie, Bildung und Begabung made possible to one of our members the participation in their summer camp from 1998, two of our students are invited to the SciTech camp in the Weizman Institute in Israel from 1999. We sent two students to Dublin, to the camps of the Irish Center for Talented Youth, and will send our first student to the National Institutes of Health (NIH, Bethesda, USA) for a two-month research practice in 2002. We also accepted a Belgian and an American student in our summer camps. It is our goal to extend these contacts in the future possibly in the form of mutual exchanges of talented young students.

As a recent development, our best student was invited to the Nobel Ceremonies each year in Stockholm. The selection of the student will be arranged by a special competition together with the Hungarian Association for Innovation (<http://www.innovacio.hu>).

Finally let us close with three quotations from our recent students:

“I became to know many interesting people: I became to know the world better. I have already received a great help to develop my endurance from your organization. The lists of the mentors gave me a chance to crystallize my widespread interest, and to focus to that what I need most.” (Brigitta Sipőcz, born 1984)

“It is always a fantastic feeling to ask nature! – Especially when one does receive an answer.” (Tamás Visnovitz, born 1983)

“It is a great fortune for a student to have an opportunity like this. Therefore Your work is highly important, noble, and honorable.” (Tünde Gál-Berey, born 1982)

References:

- [1] P. Csermely. Scientific research training for gifted children in Hungary. *The Biochemist* 21 (June 1999) 28-30. (more information can be found on the web site <http://kutdiak.hu>)
- [2] Csermely, P., Halász, G., Jenei, G., Máthé, J., Mikló, L., Solymári, D., Szekeres, Á., and Tamás, G. (2000) Research training between 14 and 18 in Hungary. *Biochem. Education*, 28, 132-133 The ratio of boys and girls was always close to fifty-fifty (currently we have 55 % boys).