

# Non-formal activities as scaffolding to informatics achievements

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**Abstract.** We will discuss our more than 20 years of experience in non-formal activities concerning informatics/computer science at secondary school and university level in Slovakia. We claim that the non-formal activities such as Programming Olympiad, correspondence programming competitions, IPSC, and ACM ICPC provide the background for further achievements in informatics. In Slovakia there is a strong correlation between students who are successful in most of the above mentioned activities and those who later organized them for the next generation of talented students. We argue that this community-building process is one of the most important factors behind the contest results of our students.

## Introduction

Immediately with the first wide-spread personal computers, like Commodore 64, Sinclair ZX, followed by PMD-85 (Czechoslovakia-made i8080 microcomputer) first programming competitions were started in Slovakia, which was a part of Czechoslovakia at that time. The emphasis in these contests was on designing effective algorithms and data structures. The oldest competition in Slovakia is the Correspondence seminar in programming (KSP) organized at the Comenius University in Bratislava and still in operation since 1983.

We will have a brief look at various competition-like activities in Slovakia. We will try to find what they all have in common besides the fact that they are all programming, algorithms or in general problem solving competitions.

For an overview of various aspects of programming contests worldwide, consult (Dagiene 2004), (Cormack 2006), (Pohl 2006), and (Verhoeff 1997).

### ***KSP***

The Correspondence seminar in programming (KSP) is a correspondence competition in programming for secondary school students (with occasional participants from primary schools). It is organized by Faculty of Mathematics, Physics and Informatics at Comenius University, Bratislava since 1983. During each school year there are four problems sets sent by mail to schools and students. Written solutions are sent back, corrected by the organizers and then returned back to the students with comments and printed model solutions. The emphasis in this contest is not only in algorithm design but at the same time in its implementation and in the ability to write a clear concise explanation of used ideas and at least some thoughts about the complexity of the solution. For about last ten years it turned out useful to have two categories with different tasks: one category for the beginners and one for students that already have experience in programming and algorithm design.

Usually twice a year there is a week-long camp for the best roughly 30 students. The camps play an important role in building the community of students who are interested in the same professional area. The camps provide a place for rich social and professional life at the same time. Details about KSP, including rules, tasks, and information (activities, photographs, etc.) about camps can be found at <http://www.ksp.sk>.

It can be of interest that from the very beginning (as soon as we were able to transport some computers to the camp place) at the camps team programming competitions (called ProBoj - Programming Fight) took place. In these contests teams wrote the algorithm for one player in a mathematical or a strategy game. Usually the contestants only wrote one procedure which was called from the main program with restricted resources (e.g., time) and performed some simple task, for example one move in the game. Then there was a real time contest between procedures of different teams incorporating various strategies. The camp organizers programmed a framework that allowed to execute this contest, and to visualize the strategies of contestants.

### ***MO-P, IOI***

IOI is organized since 1989. At the Slovak national level it is (since 1985) organized as a part of the Olympiad in Mathematics (MO-P). Both MO-P and KSP were founded by the same group of people. The national contest has three rounds – a home round, a regional round, and a national round. The regional level is without computers, it has only a written part. The national level has two days, the first day is dedicated to theory (solving tasks with pen and paper only, same form as the regional round), the second day has the same form as a contest day at the IOI.

The students who placed at the top places in the national round are invited to a week-long selection camp, from which the best four form the Slovak team for the IOI. Usually the students that are selected to form the IOI team have several years of experience in programming competitions (mostly KSP). Further details can be found at <http://www.ksp.sk/mop/>

IOI	rank*	gold	silver	bronze
2005 Poland	1.-3.	4	0	0
<a href="#">2004 Greece</a>	14.-19.	0	2	2
<a href="#">2003 USA</a>	<a href="#">12.</a>	1	1	1
<a href="#">2002 Korean republic</a>	<a href="#">6.</a>	1	2	1
<a href="#">2001 Finland</a>	<a href="#">1.</a>	2	2	0
<a href="#">2000 China</a>	<a href="#">16.</a>	0	2	2
<a href="#">1999 Turkey</a>	<a href="#">7.</a>	2	0	1
<a href="#">1998 Portugal</a>	<a href="#">1.</a>	4	0	0
<a href="#">1997 South Africa</a>	<a href="#">3.</a>	1	3	0
<a href="#">1996 Hungary</a>	<a href="#">3.</a>	2	2	0
<a href="#">1995 Netherlands</a>	<a href="#">12.</a>	0	2	2
<a href="#">1994 Sweden</a>	<a href="#">7.</a>	1	2	1
<a href="#">1993 Argentina</a>	<a href="#">1.</a>	2	1	1

**Table 1.** Number of medals of Slovak participants at the IOI. \* The rank is the position in an unofficial ranklist of countries based on the medals gained.

#### *ACM ICPC (International Collegiate Programming Contest)*

This contest had 30<sup>th</sup> anniversary in 2006. At the beginning it was founded as a programming competition among universities and colleges in the USA. During the years it evolved into an international contest. The contest is organized at regional level and the best teams from each region compete in the world finals. Last year more than 5600 teams from more than 1700 universities took part in the contest. ICPC is a team competition – each team has up to three members, five hours of time, one computer and usually 6-10 problems. The goal is to write programs which solve the given problems as quickly as possible. The solutions are checked in a black box-like way. The testing data are not known and contestants only receive short message with the status of testing for their submitted solutions. Exact rules, past problems and more can be found at <http://icpc.baylor.edu/icpc/>

ICPC finals	place	from Europe
2003	4	4
1999	18	8
1998	29	9
1997	7	2
1996	12	3
1995	8	3
1994	7	2
1993	20	1

From Slovak Universities, only teams from Comenius University, Bratislava, made it to the World Finals on several occasions. The above table summarizes their

placement in the finals. Our successful contestants had prior experience from secondary school contests (KSP, IOI, etc.) and many of them were organizing KSP during the years when they competed in the ICPC.

It is of interest that Slovak students were in the contest finals several more times as members of teams from Caltech (9<sup>th</sup> place), MIT (15<sup>th</sup> place) and University of Chicago (27<sup>th</sup> place) and they were coaches of Princeton and Caltech teams, and helping in preparation of the Cornell team, too.

### ***IPSC (Internet Problem Solving Contest)***

Founded and organized since 1999 by former participants and organizers of KSP and successful participants at IOI and ICPC. The main goal was to create a competition where one should use computer as a tool in problem solving, not only as a device to implement given programs. The problems are given in an open-data form, i.e., the contestants are given a problem description and a set of input data, and they can use any means necessary to compute the correct output data. Of course the problem instances given as the input data are selected in such a way that to solve the problem one has to prove that one has (nontrivial) insight into the problem.

The contest is organized once a year as an on-line contest. Each year between 500 and 1000 teams participate in this contest. One should note that the open-data format became so popular that in recent years the IOI used several such problems. Detailed rules, results, and problem sets with solutions are at <http://ipsc.ksp.sk/>

### ***Programming Hatchery***

In recent years, the level of international programming competitions keeps rising. As a consequence, the difficulty of national contests has to increase as well. And thus for students that just start programming it is more and more difficult to take part in contests. To cope with this difficulty, in 2005 we started an e-learning portal that helps to introduce young students to the area of programming competitions. The portal contains graded series of programming tasks, and quite a large amount of introductory study materials, all in Slovak language. All of these materials were authored by organizers of KSP. To date the portal has roughly 400 registered users. (For comparison, roughly 150 students take part in the first round of our national olympiad. Thus we consider the portal to be a major success.)

The portal can be found at <http://liahen.ksp.sk/>.

The USA Computing Olympiad has a similar portal (the USACO Training Gate) running for several years.

### ***TopCoder***

Since roughly 2000 the TopCoder competitions became one of the world's largest programming contests. One and a half year ago there were only two active members from Slovakia registered at TopCoder. Not long after this contest became popular in the already existing community of Slovak contestants, this number grew rapidly. To date, there are 161 registered contestants from Slovakia, and Slovakia is currently on the 7<sup>th</sup> place in overall country rankings. It's not surprising at all that all high-ranked contestants from Slovakia are also former contestants in KSP and MO-P, and their current organizers. For such a small country (5 millions inhabitants) this is a substantial achievement.

The TopCoder competitions can be found at <http://www.topcoder.com/tc> .

### **Common ground**

We perceive *community building* as the major step towards the successes of Slovak contestants in programming competitions. The contests bring together a group of young people with similar interests. In addition to the actual contest, the organizers prepare lots of adjunct activities dedicated to support interaction in this community and bring in new members.

The most important activity from this point of view is the week-long camps for roughly the best 30 participants in the correspondence contest KSP organized twice a year. The camps offer a mixture of programming, sports and teambuilding activities (e.g., an outdoor game in the night). In the past years, these camps started to be the greatest motivation factor for contestants in KSP.

Other activities organized for the community of young programmers include hiking trips, canoeing, but also a set of special lectures about popular topics from mathematics, physics and informatics. Thanks to all these activities, the contestants from all around the country can stay in touch throughout the whole year. In recent years, the spreading of internet access to homes and schools made it possible to start discussion boards and forums where the active members of the community meet and communicate.

The main result of having an involved community is *continuity*. The creative spirit of this community has been the moving force that in turn attracts further students to become part of this community and help to continue with the various activities. Former participants continuously become the new organizers of some or all of the activities mentioned above. Usually they are involved in organization of these activities during their university studies, i.e., for four to five years. One important corollary of this fact is the absence of an age boundary between the contestants and the organizers. The contestants often view the organizers as older friends and at the same time they look up to them as to role models.

What seems even more important is that the years of experience that were accumulated in the community often lead to new, interesting ideas. One such example is the Internet Problem Solving Contest (IPSC) that started in 1999. This contest made the "open data tasks" principle so famous, that it has been used in several recent IOI problem sets.

One other point worth mentioning is that the contests also serve as a form of self-promotion of the organizing university. This becomes more and more important as more and more of young students tend to leave Slovakia to study abroad. With this problem are faced various countries. This phenomenon is, however, far more important for smaller countries. We feel that we certainly miss the students in the field of informatics/computer science. There is a large number of Slovak students studying computer science in Czech republic, mainly at Charles University and Czech Technical University in Prague and at Masaryk University in Brno. What it means in the terms of above mentioned competitions? As an example, there were many students of Slovak nationality competing in ACM ICPC teams of Charles University or Czech Technical University. Also, in the recent years a substantial (but lower) number of Slovak students starts their university study in United Kingdom or USA, but on the other hand those are usually very good students. As we already mentioned above, Slovaks competed in ACM ICPC finals for many foreign universities. We understand this slowly growing trend in a positive way that it will help to build the broader computer science community and future collaboration.

A similar community around programming contests has formed in other countries as well, Poland being a prime example. The results can be easily seen in almost all international programming contests – the countries with an involved community tend to have much more successful participants than their population size would predict.

## Literature

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