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Young Talent in Informatics

Preliminary Findings of an IOI Survey Launched by AICA in Cooperation with IT STAR

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Abstract. The paper presents some preliminary results of the IOI-related Survey intended to examine the experience of several Central, Eastern and Southern European countries whose participation in competitions of the International Olympiad in Informatics is truly remarkable. It identifies several common features, which have contributed to this success. These include tradition in organizing and participating in informatics-related competitions, strong emphasis on mathematics in national education, further extra-curricular activities and individual training, early start in training and competing, dedicated and motivated individuals and organizations.

Key words: informatics olympiads, competitions, education, motivation.

1. Introduction

The International Olympiad in Informatics (IOI) is widely recognized as a leading international competition of algorithmic nature, in which national teams composed of secondary school pupils show such basic IT skills as problem analysis, design of algorithms and data structures, programming and testing.

On the occasion of the International conference on Young Talent in Informatics, organized in conjunction with the 24th IOI in Italy, and the 25th Anniversary of UNESCO's endorsement of IOI, AICA – the leading Italian Informatics Association in cooperation with IT STAR – the regional ICT Association in Central, Eastern and Southern Europe, launched a survey with the objective to examine and promote the experience of countries in Central, Eastern and Southern Europe whose IOI teams have shown remarkable results in IOI competitions. The findings, based on consultations, interviews and Internet research, are intended as contribution to the conference and will be further disseminated.

2. Approach

Competitions are embedded in the process of education. Whether in the classroom, or on a local, regional, national/international level, the constant monitoring of teaching and learning results is a useful practice to assess performance, gain new experience, introduce measures to improve the process and reward the best performers. In this regard, the

performance of national teams at IOI competitions could be viewed as indicative of ongoing processes in the broad fundament of the national education systems and the national network of mathematics and informatics related institutions.

In considering our project approach, we kept in mind that exact sciences are "difficult". There is a decline of ICT students in many European countries (Schagen, 2011). On the other hand, ICT competences are strategic assets for the development of Europe as a real knowledge society, and any broadening of the gap between the scarcity of ICT-Skills and the needs of informatics professionals and users by the economy might have serious consequences (Occhini and Nedkov, 2009). Policy-makers in Europe should take urgent notice of this fact and ensure the necessary measures and investments in education. We hope the findings of the project will be useful to this end.

This paper (and, indeed, the survey) is based on a questionnaire related to the selection, preparation and participation of national IOI teams of Bulgaria, Croatia, Latvia, Poland and Slovakia. These countries were chosen in order to have a representative sample of the whole of Eastern Europe – Latvia for the Baltics, Poland and Slovakia for Central Europe and Bulgaria and Croatia for South-Eastern Europe. With the exception of Poland, these countries are rather small in all counts but deliver remarkable results at international informatics competitions.

Their overall ranking, on the basis of IOI medals, is presented in Table 1.

Their IOI achievement is striking and they were our start-up point, however, the project is open to the experience of other countries in the region, which have done remarkably well in IOI. We hope to have on board in the near future material concerning Romania, 6th in the overall IOI ranking, the Czech rep. – 12th, Hungary – 15th, and other.

Chairpersons/leaders of the national bodies and IOI teams were invited to complete a questionnaire and to comment on such issues as the national team selection, coaching, communication and promotion, motivation and background for success. A section of the questionnaire was on informatics curricula in schools. In addition, personal interviews were organized in some of the countries. This was carried-out so as to gain a deeper understanding of the following:

Table 1

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#	Country	Gold	Silver	Bronze	Total
1	China	57	22	12	**91**
2	Russia	40	28	12	**80**
3	**Poland**	**31**	**27**	**23**	**81**
4	United States of America	30	30	14	**74**
7	**Slovakia**	**20**	**32**	**18**	**70**
8	**Bulgaria**	**18**	**32**	**30**	**80**
17	**Croatia**	**10**	**23**	**29**	**62**
23	**Latvia**	**5**	**19**	**33**	**57**

Source: `http://www.eduardische.com/ioi/`.

- How could countries of this region with small economies and tight budgets for education show consistently, within the IOI format, significantly higher results than the larger and richer economies of Western Europe?
- What are the driving forces of this achievement?
- What are the motivation factors?

A separate set of contacts was made with youngsters who are/were national team-members and have won medals in IOI competitions. The perspective of school teachers and trainers was sought to expand our knowledge of the successful organization and experience of these countries and the issues involved and we are of the opinion that the project could lead to further work with wider implications in education and beyond.

3. Findings

On the basis of our work so far we can identify the following groupings of factors contributing to the successful participation of the national teams of these countries in IOI competitions:

- *Tradition.*
- *Strong emphasis on mathematics in national education.*
- *Targeted extra-curricular activities.*
- *Early start and gaining experience by participating in competitions.*
- *Systematic management, dedicated people.*
- *Motivation and reward.*

3.1. *Tradition*

Math competitions were organized in the region as early as the end of the 19th century: a primary-school math competition was reportedly held in Bucharest, Romania in 1885 and in 1894 the Eotvos competition in Hungary set the model for math competitions of secondary school pupils. Mathematics journals were launched in both countries in the 90's of the 19th century. In 1934 a Mathematical Olympiad was organized in Leningrad, now St. Petersburg, Russia. The 1st International Mathematical Olympiad (IMO) was organized by Romania in 1959 with seven countries from Eastern Europe participating – the idea to organize such a competition matured during the 4th Congress of the Romanian Mathematicians in 1956 and provided a model for the organization of other competitions, including in the field of informatics. Today, IMO brings together competitors from over 90 countries (Kenderov, 2006).

The proposal for an International Olympiad in Informatics (IOI) was made by Blagovest Sendov[1] on behalf of Bulgaria, and endorsed by UNESCO's General Conference in 1987. The 1st IOI was held in Pravetz, Bulgaria in 1989 with the participation of teams from 13 countries (Kenderov, 2007).

[1] Mathematician, was rector of Sofia University and president of the Bulgarian Academy of Sciences

The respondents from the countries involved in our survey point out that they possess tradition and culture in organizing programming competitions – an important factor for the success of their teams, and an inspiration for further work.

3.2. *Emphasis on Mathematics in Schools*

The regular school curricula in mathematics and informatics are not sufficient to form good competitors in IOI related competitions, however, a solid mathematical knowledge base is certainly a tipping success asset – as a matter of fact, some of the competitors and winners of medals in past IOI competitions have done similarly well in IMO competitions.

The Eastern European model of secondary education during the 60s, 70s and 80s of last century has had a strong emphasis on the study of exact sciences. In addition, a network of gymnasiums specializing in mathematical education (similar to the model of foreign language schools in these countries) was established in the late 60s – early 70s. Such specialized math-oriented schools continue to function today, though, in some of our interviews it was made clear that the ongoing reorganizations of the educational field might negatively influence math education in secondary education in general, which might also reflect on the performance in math and informatics-related education and competitions. In the case of Slovakia, the reorganization of school education has led to a reduction of the weekly number of math teaching in basic and secondary school. On that backdrop, the results of the Slovak IOI teams suggest a decline with no gold medals won during the last 6 years.

3.3. *Extra-Curricular Activities*

There are some informatics related courses in the curricula of lower secondary (10–14 years) and upper secondary schools. This as mentioned above is not sufficient for the preparation of highly competitive participants in informatics related competitions. Several of the IOI competitors we interviewed said that on-line competitions, training, solving tasks from previous competitions, participation in correspondence seminars in programming, participation in special courses for math and informatics competitions, summer camps and other forms of preparation have contributed to their success.

There are many paths and activities to ensure a solid preparation for IOI-related competitions. We give the following for illustration:

In the case of Bulgaria and Latvia, private educational institutions are involved in preparing all who wish to compete: in Bulgaria, the A&B private school in Shumen was established with the objective to prepare pupils for national and international informatics related competitions (Mollov *et al.*, 2009), in Latvia, Progmeistars private school[2] has similar objectives. Both institutions have developed and introduced methodologies in delivering results and a confirmation of this is that pupils who have attended their courses have won gold medals during the last IOI-2011 in Thailand. A gold medallist who had

[2] `www.progmeistars.lv`

taken part in such courses said that this has helped him think as a programmer – an important detail related to the performance of these private schools.

One successful training activity in Slovakia is the Correspondence seminar in programming (CSP; Andrejkova, 2005). On the seminar's website one can find the problem sets and other information. The competition is of theoretical nature and is organized in rounds. Another form of training/competition for students from secondary schools is "PALMA" – Programming, algorithms, and mathematics. This is an on-line competition involving real programming and automatic evaluation. There is also PALMA Junior organized for pupils at basic school and prepared for one- or two-member teams.

The Polish Children's fund has an important function to work with talented children in various fields, including IT. Similarly, in Bulgaria the High School Student Institute (HSSI) was established by the Institute of Mathematics and Informatics, the Union of Bulgarian Mathematicians, Foundation "Eureka" and the International "St. St. Cyril and Methodius" Foundation with the objective to identify, develop and manifest the talent of pupils in mathematics and informatics. In Croatia, the programs of the Croatian Computer Science Association (CCSA), the main organizer of the selection and preparation of the national IOI teams, fully cover the IOI syllabus.

In most of these countries, the olympiad itself is an educational activity: materials are published after the events and contain detailed analysis, Internet portals are maintained and summer camps are organized.

3.4. *Early Start, Gaining Experience by Participating*

Most of the respondents to our questionnaire said there is no minimal age for participating in regional and national competitions, but in practice the youngest participants are from 10 to 14 years old. In our further interviews, opinions were expressed that, to be successful in IOI competitions, contestants should start at least at the age of 12–13 as at 15 it is already late.

Another aspect of this is that many contestants experience an initial "stage fright" related to their participation in international competitions. Gaining experience by participating is an important success factor and this is reflected in the record of top performers during the course of several consecutive years of participation in IOI competitions.

3.5. *Systematic Management, Dedicated People*

Formally IOI related matters are under the broad umbrella of the national ministries of education, yet in all countries there are specialized professional institutions, which have responsibilities to prepare and oversee the process of selection through internal competitions of the national teams, their additional coaching and participation in IOI competitions.

This is a tested process of meticulous organization based on several tiers of selection – school/local, regional and national competitions, summer schools, training camps and international competitions (Manev *et al.*, 2007; Diks and Madey, 2008). Teams from all

the countries involved in this survey take part in interregional competitions such as the Balkan Olympiad in Informatics, the Baltic Olympiad in Informatics and the Central European Olympiad in Informatics. For some countries (i.e., the Baltic OI for Latvia) these interregional competitions are an element in the selection process, for others (i.e., Poland in the case of the Baltic OI) they present opportunities for "younger" participants to gain experience.

In the core of this process are dedicated individuals – university professors and students, teachers, tutors, ex-competitors. Many of them have started their involvement as early as the first participation of their country in the IOI process. Some fears were expressed that it is hard to find "new recruitments" for this activity. At the same time, it was a pleasure to meet with the Latvian organizers during the recent 18th Baltic OI, 3–7 May 2012 in Ventspils, Latvia[3] and to observe that many ex-members of the Latvian IOI teams (currently students or young professionals) continue to be involved as organizers, deputy team leaders for recent IOIs, and as authors of tasks and other activities related to IOI.

The ministries for education provide some funds for the organization of competitions, training camps and international travel and associated activities, though these are reportedly far from sufficient. Additional funds are sought and sponsors attracted, very often on the basis of personal connections, in some cases also related to ex-competitors that have consequently done well professionally. Sponsorship from the IT Industry, foundations and other sources is an important aspect of the funding of IOI related activities in Bulgaria, Latvia and Poland.

3.6. *Motivation and Reward*

Motivation is in the core of success and all stakeholders in the process are motivated to take part and see opportunities in doing so. There are two types of participants – the pupils that go through the process and compete at IOIs, and their teachers, instructors, methodological leaders and organizers.

The competitors we interviewed are bright young men, yet no one of them considers himself as exceptional in any respect. After one session of interviews in Latvia I was asked jokingly by one of them whether this would make him famous. This reminded me of a reaction from Genadii Karatzkevitch (Belarus)[4], then 14 years old. Asked whether he has his own strategy of problem-solving his response was that he tries various ways and one works . . . followed by "I am no genius. I am simply good at it".

Yes, they are good at it and this is achieved with a lot of practice and exercises and the motivation comes from various sources including family and friends, teachers and tutors, computers and ICT, challenging problem-solving, learning from mistakes and improving, competing and winning, . . . One should also not forget the fun part of it – summer camps, meeting friends, local and international travel.

[3] `http://www.boi2012.lv/`
[4] `http://www.ioi2009.org/downloads/br8-3str-en.pdf`

When entering the path of international competitions, the link between success in IOI's and its impact on future professional development is hardly a fixation for anyone. But the possibilities are there and these competitors are gradually exposed to them – top performers are "noticed" and become heroes of sorts in their communities, travel more, have possibilities for internships in leading IT companies, receive awards and scholarships, gain easier access to top universities in their countries and internationally.

For the other type of participants – teachers, researchers, instructors, team-leaders – there are some financial awards, according to some of the respondents, though the highest reward for a good performance in our mind is professional satisfaction, accomplishment and recognition. Clearly, most of the persons involved in IOIs are professional academics and educators and their experience with IOI is directly reflected in their academic output.

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