Is there an impact of mathematical competitions on the development of mathematical research? The Romanian experience

VASILE BERINDE, RADU GOLOGAN
Societatea de Ştiinţe Matematice din România, str. Academiei 14, 010014, Bucureşti

We give some arguments in favor of the important impact given by the Romanian Mathematical Competitions during the more than 110 years of existence, to the Romanian mathematical research. A particular attention is given to the International Mathematical Olympiads invented by the Romanian Mathematical Society in 1959. The present paper is a written version of the talk given by the second author at the 7th Congress of the World Federation for International Mathematical Competitions held in Barranquilla, Colombia, in July 2014.

Keywords: Mathematical competitions, High school students, IMO, Research in mathematics, Romanian Mathematical Olympiads

The last decades gave an impressive growth in competitions for school students, especially in the domains of mathematics, physics and computer science. More and more scientists in all domains started their careers in school competitions where they proved talent and ambition.

All these imply a great debate all over the world on the impact of such competitions: which is the proportion they contribute to the growth of the quality of science.

In the present paper we shall discuss on the particular case of Romania in the domain of mathematical science. It seems that our case is strongly different form many Western countries but similar to the other countries in Eastern Europe.

The difference consists in the fact that the percentage of important mathematicians of Romanian origin that have an Olympiad history is significantly greater than the same for countries with strong mathematical history: France, Germany, Great Britain, USA etc.

The paper is divided in three parts: the first consists on a brief history of Romanian mathematics and mathematical competitions. The second discusses some examples. The final part is devoted to conclusions.

1. A brief history of Romanian mathematical competitions and Romanian mathematics

Neighbors:
Bulgaria (South)
Serbia (South-West)
Hungary (North-West)
Ukraine (North)
Moldavia (East)
The Black Sea (East)
Area: 237,500 sq. km
Population: 19,697,103 (July 2013)

The creation of the Romanian modern state started in 1859 with the union of the two Romanian language speaking small states. The first doctorates in mathematics were obtained at universities in France and Germany starting with 1872. In Iasi, Cernauti and Bucharest were established the first Romanian Universities of Western type in 1860 and 1864. Starting with 1866 and ending in 1898 a new education system was legally adopted.

Under these circumstances, the first ideas that mathematics is strongly important in education appeared. As a consequences some math competitions were held. It seems that the first was in 1885 May 21: for primary-school students in Bucharest, with 70 participants; 11 prizes were awarded (9 boys and 2 girls). In **1883 the** first issue of Recreaţii Ştiinţifice is published in Iaşi by a group of ten teachers of mathematics and other subjects. Although the journal also published articles and notes in physics, chemistry, natural sciences, etc., the part devoted to mathematics was predominant and it contained: articles, problems solved, problems proposed and a few notes.

In 1894, when discovering bad results in papers on mathematics at the admission tests at the Engineering School in Bucharest, a group of young engineers had the idea to edit a journal whose main aim was "to improve the knowledge of mathematics of high-school students" – Gazeta Matematică. The first issue of *Gazeta Matematică* was published on September 15th, 1895 (and it has still being published ever since).

Gazeta Matematica had since a great impact on the development of Romanian mathematics during more than a century: most of the Romanian mathematicians having, as school or university students, an important history of collaborating with the journal. Problems in elementary and projective geometry were in the first decades of the twentieth century extremely nice and difficult, being thus the starting point of the Romanian geometry school.

It was also Gazeta Matematica that organized the first national mathematical competitions starting in 1905. One of the first winners was Dan Barbilian, who become a great mathematician and poet (nowadays Barbilian spaces is an important domain of research in metrical geometry).

In 1910 the group of engineers that founded the journal was joined by some young mathematicians to form the Gazeta Matematica Society, the nowadays Romanian Mathematical Society. The main goals of the Society status were to continue publishing the monthly **Gazeta Matematică***,* which has been appearing continuously since September 15, 1895, to publish theoretical books on mathematics or its applications, to organize mathematics competitions, to award prizes and encourage those who distinguished themselves in the competitions organized. All these had a great impact on the development of mathematics in Romania, starting with the school of mathematics. The number of students in mathematics increased continuously and as a result many good teachers taught all over the country.

The communist period that started in 1946 brought a lot of changes in the educational system. Mathematics was not touched in great manner. So, in **1949** the Romanian Mathematical Society was founded as the continuation of the Gazeta Matematica Society and instead of the "Annual Contest *Gazeta Matematică"*, the New Society become the main organizer, but in a different manner, of the **National Mathematical Olympiad (NMO)**. The competition was initially intended for high-schools students and consisted of two rounds. In each round two written tests and an oral examination were given. The best pupils were awarded prizes by the Ministry of Education. A number of 3,500 students participated in the local round (both mathematics and physics) and 336 qualified for the final round of the first edition of **NMO**. A number of 86 students were awarded.

The competition became very popular and extended to junior high students also with three rounds. In 1970 more than 200.000 students participated in the first round.

An important moment was in 1959 when Tiberiu Roman, then the secretary General of the Mathematical Society with good connections in the Ministry of Education put in life an idea discussed in 1956 at the 4th International Congress of Romanian Mathematicians, to organize an international mathematical competition. The name Olympiad came from the word used for competitions in the former USSR but the official translator from Romanian to English used the same word instead of the correct one Olympics. The first IMO was held in Brasov and the second in Sinaia, Romania. Only few socialist countries participated then. The first Western country that joined the IMO was Finland in 1965 followed by France, Italy and Great Britain in 67. As it will be shown the IMO's had a remarkably impact on Romanian Mathematics: most of the Romanian Mathematical scientists had an early experience in the HMO's, as it will be shown in the next chapter.

Although during the communist regime it was practically impossible to travel or to study abroad, the existence of the Institute of Mathematics and after 1975 the Department of Mathematics of INCREST made it possible to do good research in

modern mathematics. It was the goal of many IMO students to study mathematics and continue to do research at the Institute. Even today 80% of the members of the Institute are former IMO students.

The period 1946-1989 was also when important mathematicians for the first time in some western country decided for political and scientific reasons not to return in the country. This represented the first important group of Romanian mathematicians with remarkable results in important centers of research in American and European countries.

After 1990 things changed dramatically in the sense that most of the OIM medalist choose to study in Western universities, mainly in the USA. The effect was double: on one side the gifted young students worked hard to achieve the best results that gave them a good resume for entering famous universities and, on the other side, the Mathematical Faculties in Romania had no more a significant number of excellent students. On the other side the impressive number of Romanian mathematicians getting PhD's abroad and thus positions in important universities made it possible, for Romanian mathematicians working in Romania to have strong collaborations abroad and thus better mathematical results.

Moreover, the percentage of those IMO participants remaining in the field of mathematics sensible changed from 80% before to 50% nowadays.

2. Examples. Romanian Mathematicians being IMO medalists

Simple statistics shows the impact of IMO's and the Romanian Mathematical Olympiad on the Romanian Mathematical History. Romania participated in all IMOs. Romania obtained 73 gold medals, 124 silver medals, 96 bronze medals and with Ciprian Manolescu has the record of three consecutive perfect scores. In a list containing 36 former IMO medalists that gained important mathematical prizes (Fields medal, Wolf Prize, EMS Prize, AMS Prizes, Clay Award) Romanian mathematicians appear 4 times (former USSR 5 times, Great Britain 5 times, Hungary 3 times, USA 2 times). This is also a proof on how different the popularities of the IMO is in different countries with a pole in Eastern Europe.

Let me list some important Romanian mathematicians that started mathematics by good results in math competitions and medals in the IMOs.

The first Romanian gold medalist was Basarab Nicolescu in 1959, now at Laboratoire de Physique Nucléaire et de Hautes Énergies, Université Paris VI.

He is also a well-known philosopher and writer. He is a honorary member of the Romanian Academy (see also:

http://www.hotnews.ro/stiri-aniversare_ olimpiada_matematica-17488698-video-interviu-document-basarab-nicolescu-romanul-care-luat-aur-prima-olimpiada-internationala-matematica.htm).

The second gold was obtained by Cezar Gheorghe, now a nuclear physicist at the National Laboratory of Nuclear Phiysics.

Viorel Barbu, took a honorary mention in 1960. He is now a world known specialist in differential equations at the University "Al. I. Cuza" Iaşi. Viorel Barbu is a full Professor, former rector of University of Iassy, member of Romanian Academy, former Vice-President of the Romanian Academy, member editorial boards of Numerical Functional Analysis and Optimization, Marcell Dekker, New York, Differential and Integral Equations, Communications in Applied Analysis, Advances in Differential Equations.

Silver and bronze medals took in 1960 Nicolae Popa and Serban Stratila. They are senior researchers at the Institute of Mathematics in Bucharest and full professors at the University of Bucharest.

Constantin Nastasescu got the silver medal in 1961. He is now a member of the Romanian Academy and a well-known specialist in algebra.

In 1962 and 1963 **George Lusztig** obtained silver medals. Presently he is a Norbert Wiener Professor of Mathematics at MIT. He got the Cole Prize in 1985.

In 1964 Laszlo Zsido obtained a gold medal. *He is now a* Full Professor at the University of Rome "Tor Vergata", specialist in operator algebras.

Dan Voiculescu was the first Romanian having more gold medals: silver medal1i 1965; gold medal 1966; gold medal 1967. Presently he is Full Professor, University of California at Berkeley. Voiculescu is a specialist in C*-Algebras , von Neumann Algebras, Free Probability Theory , Free entropy, the latest domains being introduced by himself. Voiculescu is a member of the Editorial Boards of Advances in Mathematics, Annals of Mathematics (1993–99), Integral Equations and Operator Theory, Journal of Operator Theory, International Mathematics Research Notices, Pacific Journal of Mathematics, Infinite Dimensional Analysis, Quantum Probability and Related Topics, Journal of Functional Analysis.

Eugen Popa took bronze in 1965 and silver in 1966 and 1967. Presently he is a specialist in mathematical Analysis, full professor at the University in Iaşi.

Vlad Sergiescu – obtained bronze medals in

1967, 1968 and 1969. He is professor at the Institut Fourier, Université de Grenoble, specialized in topology

Dan Ralescu got a bronze medal in 1966. He is now professor at Columbus, Ohio.

Barbu Berceanu obtained a gold medal, with a perfect score, in 1968 and two more silver medals in 1969 and 1970. He is presently senior researcher at Institute of Mathematics of the Romanian Academy, director of the PhD program at Lahore University, Pakistan.

After 1970 the list of former IMO medalists with a great career in mathematics is much more impressive. Alexandra Dimca (University Nice),, Rad Logan (IMAR and University Politehnica), Dragos Popescu (Bucharest), Mircea Martin (perfect score in 1971 now art Baker University, USA), Dan Timotin (IMAR), Stefan Ralescu (Queen's College), Mihai Pimsner (University of Pennsilvania), Alexandru Buium, Adrian Ocneanu (gold in 1974, now at Pennsylvania State), Mihnea Coltoiu (member of the Romanian Academy), Bogdan Enescu (gold in 1978, deputy leader of the IMO Romanian team), Victor Nistor (gold medalist, Pennsylvania State University), Gabriel Nagy (Kansas University), Alexandru Zaharescu (University of Illinois Urbana-Chamaign), Luis Funar (gold in 1985, now at the University Grenoble I), Daniel Tataru Gold medalist in 1984, 1985, now at University of California, Berkeley, Bochner Prize in 2002), Razvan Gelca (gold in 1985, now at Texas Tech and deputy leader of the IMO USA team), Nicusor Dan (gold with perfect score in 1987, and gold in 1988, now at IMAR), Andrei Moroianu (two golds, one silver, presently at Ecole Polytechnique), Teodor Banica (three golds in 1989-91, now at CNRS), Sergiu Moroianu (gold in 1991, presently at IMAR).

The following mathematicians got medals in the last 25 years: Gabriel Mititica, Ion Bejenaru, Dragos Oprea, Radu Saghin, Dragos Ghioca, Adrian Corduneanu, Constantin Chiscanu, Ovidiu Savin (invited speker at the ICM 2006), Ciprian Manolescu (three perfect scores in 1995-97, professor at UCLA and EMS Prize in 2013).

In the last years some former IMO medalists have become young and very promising scientists. We can cite Adrian Ioana (at San Diego, EMS prize in 2013), Ana Caraiani (Putnam fellow and gold medalist, now professor at Princeton), Andrei Negut (gold medalist now at Columbia University), Claudiu Raicu (Princeton), and the list can continue.

Our list did not discuss tens of examples of Romanian Mathematicians, winners of the National Mathematical Competitions before the IMO was firstly held. Maybe the most celebrated is that of

Ciprian Foias, winner of the Romanian Olympiad in 1949.

3. Final remarks

In what was said, it seems that tradition in competitions for school students represents the main explanation for the great number of Romanian mathematicians in worldwide Universities. On the other side the fact that important mathematicians have no Olympiad history, proves that competitions during school is not the single way to become fond of math.

In the end let us remark that during years the Romanian professors taking part at the IMO's as leaders, contributed to the popularity of mathematics in the Romanian media. Ion Cuculescu, Ioan Tomescu and Mircea Becheanu were the most active during their mandate.

References

[1] M. Becheanu, *IMO 1959-2000,* senbid.com, ebook.

[2] V. Berinde, E. Paltanea, *Gazeta Matematica-A Bridge over three centuries,* Societatea de Stiinte Matematice din Romania, 2004 (in Romanian).

[3] I. Cuculescu, *The International Mathemacal Olympiad for school students,* Ed. Tehnica, Bucuresti, 1984 (in Romanian).

[4] H.-D. Gronau, H.-H. Langmann, D. Schleicher, 50th *IMO-50 Years of International Mathematical Olympiad,* Springer, 2011.

[5] M. Saul, *More than a System: What Can Learn from the International Mathematical Olympiad,* Notices of the AMS, volume 58, Number 3.

[6] The History of Mathematical Education in Romania, Gazeta Matematica, collection 1995-2013 (availabe in electronic format at www.ssmr.unibuc.ro) https://www.imo-official.org/ www.hotnews.ro/aniversare_olimpiada_ matematica m.youtube.com/watch?feature= youtu.be&v=jMEKIYshZyk

[7] V. Berinde, Professor at the University in Baia Mare, vberinde@ubm.ro.

[8] R. Gologan, Professor at the University Politehnica, Bucharest, president of the Romanian Mathematical Society.

_____

Corresponding author: radu.gologan@imar.ro