

DG 16: The role of mathematical competitions in mathematics education

Team Chairs: *Peter Taylor*, University of Canberra, Australia
Frédéric Gourdeau, Laval University, Québec, Canada
Team Member: *Petar Kenderov*, Bulgarian Academy of Science, Sofia, Bulgaria

Aims and focus

This discussion group was organized by the two chairs, Peter Taylor and Frédéric Gourdeau with the collaboration of Petar Kenderov making up the third member of the team. André Deledicq (France) had originally been appointed chair with Peter Taylor, and helped design the program, but he had to give up his role before the congress and his place was taken by Frédéric Gourdeau.

The program had two two-hour and a single one-hour sessions. The first session, with invited introductions by Andrejs Cibulis and Dace Bonka (Latvia) and Peter Crippin (University of Waterloo), focused on the range of competitions and related activities which are available. The second session, with an invited introduction from Andy Liu (University of Alberta) discussed the relation between competitions (and related activities) and the teaching and learning process. The last session summarized the previous proceedings with a view to writing a final report.

The discussion group was well-attended, not only by regular participants in World Federation of National Mathematics Competitions activities but also by many different people, mainly teachers and educators from countries in Europe. About 40 people attended each of the first two sessions and about 12 attended the last session. It is estimated that between 60 and 70 people attended at least one of the sessions. The following report has been prepared by the organizing team based on the discussions and after all participants who left their email address had had a chance to comment.

What are competitions?

In recent years the meaning of the word “competition” has become much more general than the traditional meaning of either a national olympiad, or more broadly based multiple choice question exams which have become popular in a number of countries. The World Federation of National Mathematics Competitions, the principal international body comprising mathematics academics and teachers who administer competitions, has formally defined competitions as including enrichment courses and activities in mathematics, mathematics clubs or “circles”, mathematics days, mathematics camps, including live-in programs in which students solve open-ended or research-style problems over a period of days, and other similar activities.

In addition there are publications of journals for students and teachers containing problem sections, book reviews, review articles on historic and contemporary issues in mathematics in addition to support for teachers who desire and/or require extra resources in dealing with talented students, were also important activities related to competitions.

Competitions come in a number of categories, the elite national and international olympiads, the broader and popular inclusive competitions usually involving (regretfully) multiple choice questions, and special themed competitions, which sometimes



I C M E
1 0
2 0 0 4

DG

Discussion
Group 16



I C M E
1 0
2 0 0 4

DG

Discussion
Group 16

involve teams rather than individuals. In some cases, these teams are composed of whole classes, giving a very different feel to the competition. Special note was made of project, or research based activities, in which students have a longer time frame to solve problems than normally permitted in an exam-based environment. In addition to purely mathematical competitions there also exist competitions focusing on mathematical modelling.

These activities all have in common the values of creativity, enrichment beyond the normal syllabus, opportunities for students to experience problem solving situations and provision of challenge for the student. Competitions give students the opportunity to be drawn by their own interest to experience some mathematics beyond their normal classroom experience.

Competitions are usually administered by teachers on a voluntary basis beyond their required duties. Administering bodies are usually independent of the standard curriculum and assessment bodies.

How competitions contribute positively to the teaching and learning process

There are many ways for this. Competitions provide, for example, a focus on problem solving, sometimes giving students an opportunity to be associated with a cutting edge area of mathematics in which new methods may evolve and old methods be revived.

Competitions provide opportunity for creativity and independent thinking, as students often solve problems in unexpected and innovative ways. The success of competitions over the years, particularly the resurgence in the last 50 years, indicates that these are events in which students enjoy mathematics. Different students derive different experiences, and it is exciting for students when they see how a problem can reach the same solution by two quite different techniques. Because competitions give students an opportunity to discover a latent talent, they provide a stimulus for improving learning.

Paul Erdős was reported to have said about competitions that the most important thing about them was the enthusiasm they generated. For many participants in popular contests, the aim is not to win, but to take part, thus taking up the challenges provided. Olympiads provide higher mountains for the more able students to climb.

Discussants had various attitudes towards competitions. Some preferred individual competitions, others felt it was positive for students to develop a competitive attitude. Many strongly supported team competitions and competitions involving inter-activity.

Some time was spent discussing the creation of problems and the importance of creating problems with good structure that can capture the imagination.

Assessing negative images of competitions

A number of criticisms are often made of competitions. These include claims that competitions are only for the elite, they involve pressure and stress, widen the knowledge gap between students, are a negative experience for many students, and display a bias towards boys.

The discussion group did not engage in a detailed discussion of these criticisms as competitions vary and have different objectives and formats. Some participants argued that for competitions to have a positive impact, teachers must see the progress made by their students. In this view, the role of competitions is to develop a critical body of kids



I C M E
1 0
2 0 0 4

DG

Discussion
Group 16

who can do problem solving; in a sense, this role is to get people interested. This suggests that a different view of competitions may be needed. For some, the suggestion that doing mathematical competitions had a negative impact on many students was not borne out at all by their experience of broad-based mathematical competitions. However, the International Mathematical Olympiad teams do contain predominantly more boys than girls. (Apparently, evidence shows that average scores of boys and girls are similar and that boys show a greater standard deviation.) In contrast, evidence from large, broad-based competitions indicates at least equal participation by girls, at least up to the age of about 15. This differing participation of male and female needs more research and better understanding.

Entry in competitions is usually voluntary; students' performance does not usually affect their regular school assessment, and, if anything, gives the student an opportunity to discover talent (as argued in the previous section). One teacher noted that elite students in mathematics often do not act elitely with respect to their peers and that there is much less social pressure in mathematics than for instance in sport.

Collaboration and support for teachers

Finally there was much discussion about this theme. In particular Peter Crippin in his invited introduction mentioned that competition organizers are now focusing increased attention on various forms of support for teachers.

The competitions themselves, often available with solutions and grading advice, provide vast resources for class room discussion. Material available to teachers should not just include problems and solutions, but should be well structured, with good advice on practical use. Some competitions even provide didactical notes so that teachers can know what type of solutions to expect and how to use these in their teaching. Many organizations which run competitions also now run seminars and workshops for teachers.

This report was written by Peter Taylor, Frédéric Gourdeau, and Petar Kenderov. They are happy to be contacted at pjt@olympiad.org, fredg@mat.ulaval.ca, kenderovp@cc.bas.bg for further information on the work of this DG.