

Gifted Students and the ROLE OF MATHEMATICS COMPETITIONS



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looks at the role of mathematics competitions and how they can be used to extend and motivate gifted students.

Introduction

It is highly likely that you have a mathematically gifted student in your regular class or you may have responsibility for teaching a group or class of gifted students. So who are the mathematically gifted? There is no single definition of mathematical giftedness but the literature suggests that mathematically gifted students could be thought of as those who have special mathematical abilities or those who engage in qualitatively different mathematical thinking.

There are many published lists of characteristics of mathematical giftedness. House (1987, p. 9) suggests the following characteristics as indicators of mathematical giftedness:

- early curiosity and understanding about the quantitative aspects of things;
- ability to think logically and symbolically about qualitative and spatial relationships;
- ability to perceive and generalise about mathematical patterns, structures, relations, and operations;
- ability to reason analytically, deductively, and inductively;
- ability to abbreviate mathematical reasoning and to find rational, economical solutions;
- flexibility and reversibility of mental processes in mathematical activity;
- ability to remember mathematical symbols,

- relationships, proofs, methods of solution, etc.;
- ability to transfer learning to novel situations;
- energy and persistence in solving mathematics problems; and
- mathematical perception of the world.

Catering for the mathematically gifted

There are a wide range of provisions to be considered when catering for the mathematically gifted student(s) in your classroom. These include acceleration, enrichment, differentiation, curriculum compacting, mentorships, and competitions.

The focus for this article is specifically on the use of competitions as one provision for the education of mathematically gifted students. Reference is made to perspectives of teachers, students, and parents who were involved in the author's study involving fifteen 10 to 13 year-olds who had been identified by their teachers as gifted and talented in mathematics. Ten of the students were in Year 6 (2 girls, 8 boys) at the start of the study and five were in Year 8 (2 girls, 3 boys). The Year 6 students were from either a regular class, or a cross-class ability group, and the Year 8 students were from a full-time gifted class. The students' teachers (n=13), during this two-year period, and the students' parents (n=15) were also involved. Data were collected from questionnaires, documents, interviews, and classroom observations.

The role of competitions

Competitions are recognised as part of the continuum of provisions for gifted and talented students (Ministry of Education, 2000). This continuum includes enrichment and acceleration. Competitions can also be used as part of a multi-method identification that is recommended in gifted education (see, for example, Callahan, Hunsaker, Adams, Moore & Bland, 1995). These identification methods include tests, teacher observation

and nomination, classroom activities such as problem solving, parent, peer, and self nomination, and competitions. Competitions also offer students the opportunity to strive for personal achievement and to compare themselves with others. They can enhance students' self-directed learning skills and sense of autonomy (Karnes & Riley, 1996). Students mostly compete independently in competitions that require rapid and accurate answers under pressure. More recently, some competitions in mathematics have included group problem solving activities where team work and collaboration are important.

Motivation from competitions can be extrinsic, resulting in certificates and awards, selection for other competitions, recognition, and prestige. It is also believed that "learning to deal with competition in a constructive manner is essential for gifted children, especially given the competitive nature of Western culture and the central role of competition in high-level achievement" (Udvari, 2000, p. 215). The opportunities to showcase talent should outweigh any negative elements associated with competitions. Stress and feelings of failure from excessive competitiveness are cited as negative elements (Davis & Rimm, 1997). However, according to Cropper (1998), these negative effects are usually because of poorly planned competitive goals.

What competitions are available?

In Australasian primary schools, students should have the opportunity to participate in a variety of different types of competitions or challenges. Some of these are offered within a school, in clusters of schools, regionally, nationally, or internationally. In many schools, the most favoured mathematics competitions, available to the more able mathematics students, are those organised by regional Mathematics Teachers' Associations. Others are organised by universities such as The Australasian Schools Competitions

conducted by the University of New South Wales. This is established internationally as a suite of assessments for primary and secondary students to provide diagnostic information about students' abilities in core skills in areas such as Science, Mathematics, and English. It is expected that the assessments will help identify students with particular talents. There is also the Australian Mathematics Competition (AMC) (www.amt.canberra.edu.au/eventsamc.html) run by the Australian Mathematics Trust, and bank-sponsored mathematics competitions. An example of a question from the AMC middle-primary warm-up paper is provided in Figure 1.

In New Zealand, the Otago University Problem Challenge Competition (www.maths.otago.ac.nz/pc) is designed for 10 to 12 year-olds. In this competition, students attempt a set of five problems in 30



5. Some friends cut up 15 apples. They cut 7 into halves and the rest into quarters. How many pieces of apple were there?

(A) 28
(B) 46
(C) 30
(D) 44
(E) 64

Figure 1. Example question from AMC.

minutes in their own class on five occasions throughout the year. Certificates are awarded for performance and the top students are invited to take the Final Challenge at the end of the year. Past competition questions and solutions are available for a fee.

Multiple views on the use of competitions

School policy

It is useful for schools to document competitions as one of their provisions for gifted and talented students in their policy statements. If it is stated in policy, then it is more likely that schools and/or teachers will commit to subscribing students so that they have the opportunity to participate. Opportunity, in practice, usually relies not only on policy but other factors such as school and teacher organisation. In some schools the policy restricts the opportunity to only those in a designated 'gifted' class. This means that potentially some undiagnosed gifted students may miss out on the opportunity to participate.

Teachers' views

The teachers in this study felt that gifted students thrive on mathematics competitions. Two teachers explained that they would not, however, use them for a student who found them threatening. The team problem solving competitions were favoured by the teachers especially where the school held their own competition as part of the selection process. Some schools ran special training classes in preparation for these competitions. One teacher (Miss S) commented, "It's good because they have to work within a team and quite often they might be gifted mathematicians who just like to focus on their own and not to problem solve in a group. I think it's good for them as they may not be used to problem solving in a group."

Some of the teachers felt that boys, in particular, thrive on competitions as part of their programme. Comments included:

Boys don't want to do it just for the sake of a competition. They want to do it if there's an outside chance of winning. There's competition out there and that in turn goes from the sports field to in here. (Mr M)

Boys, they thrive on competition. They have

to have competition ... People have this horror and shock about competitiveness because they think that if you are being competitive you are putting other people down or you are not allowing everyone to have a good slice of the pie but it doesn't need to be that way if you are having educated competitiveness and it's done in the right way. (Mr H)

One teacher recommended that you do not use competitions at the start of the year but should wait until the students feel safe and comfortable in class. They may be sorting themselves out in relation to others and may also be afraid to make mistakes and to not do well. The teachers and schools also used competitions results as a way of tracking students' achievements and monitoring any slippage that might occur.

Students' views

Most of the mathematically gifted students involved in this study were in favour of participating in competitions. If a school failed to send in entries or did not participate in competitions (in which they had previously competed) the students were not impressed.

The students liked the team competitions. They enjoyed the preparation and working together. They also liked doing the same competition in following years as they knew what to expect. Figure 2 shows a team of students engaged in solving a problem as part of the Mathematical Association of Tasmania's annual Relay Competition. Further information about this competition is available at <http://mat.aamt.edu.au/Activities/Student-Activities>.

It is likely that students will soon let you know if they do not view a competition favourably. Nina, a mathematically gifted 12-year-old, gave her view on one such experience:

We did do this other one which I didn't like, the questioning was so different, it asked pointless questions which didn't test your true academic ability in maths, it asked



Figure 2. A mathematics relay team working together to solve a problem.

you strange things. I didn't like it; I'm not doing it again. They were just pointless questions like how many acute angles can you have in a polygon with 2001 sides, it was harsh... I prefer the New South Wales one, it actually asks what you know and what you should know rather than random ones.

Parents' views

The parents in the study felt that their children enjoyed the mathematics competitions because they gave them a chance to compare themselves not only with others in their group at school but also with a wider group of students. They favoured the independent competitions and, like the teachers and students, recognised the benefits of team competitions. They found that their children would often talk at home about preparation for competitions and proudly share achievements. The parents also explained that when the results are supported by reasonably detailed information, competitions can provide a way of tracking levels of achievement over time.

Parents may play an advocacy role in encouraging schools to become involved in mathematics competitions (Assouline & Lupkowski-Shoplik, 2003). For example, they may intervene when the school fails to register their children in competitions in which they have participated in previous years. One parent in the author's study demonstrated

that they will also question a child's right to participate if they are prepared to pay the fee. From my experience, many parents of mathematically gifted children have access to Internet sites and are aware of the various mathematics competitions. However, in some instances students can only be entered through a school registration and parents may ask questions about a school's lack of participation in such competitions.

Some questions to ponder

Think about the following questions as you consider how you might use competitions as part of your school's mathematics program.

- Why are competitions being offered as part of our mathematics program?
- Are they part of a planned program of provision?
- Who decides which students are given the opportunity to participate?
- Are there equitable opportunities? (Consider the gifted underachiever, the twice exceptional¹ student, and under-represented ethnic minorities.)
- Are there any barriers to participation, such as the cost?
- What do the results indicate and what are the results to be used for?

Conclusion

There are many advantages to be gained from the use of competitions in a mathematics program such as student satisfaction, the enhancement of students' self-directed learning skills and, co-operative team skills, and the opportunity to celebrate the gifts and talents of your students. There are also potential weaknesses such as costs, sponsorship, and negative consequences of

competition. However, if competitions are incorporated into a well-planned mathematics program and the special abilities of individual students are given due consideration, then they should provide occasions for both enrichment and acceleration.

Resources

For information on some books, websites and other material, see http://www.maths.otago.ac.nz/home/schools/gifted_children/gifted_children.php.

References

- Assouline, S. & Lupkowski-Shoplik, A. (2003). *Developing mathematical talent: A guide for challenging and educating gifted students*. Waco, TX: Prufrock Press.
- Callahan, C. M., Hunsaker, S. L., Adams, C. M., Moore, S. D. & Bland, L. C. (1995). *Instruments used in the identification of gifted and talented students*. Storrs, CT: National Research Center on the Gifted and Talented.
- Cropper, C. (1998). Is competition an effective classroom tool for the gifted student? *Gifted Child Today*, 21(3), 28–30.
- Davis, G. A. & Rimm, S. B. (1997). *Education of the gifted and talented* (4th ed.). Boston: Allyn and Bacon.
- House, P. A. (1987). *Providing opportunities for the mathematically gifted*. Reston, VA: National Council of Teachers of Mathematics.
- Karnes, F. A. & Riley, T. L. (1996). Competitions: Developing and nurturing talents. *Gifted Child Today*, 19(1), 14–16.
- Ministry of Education. (2000). *Gifted and talented students: Meeting their needs in New Zealand schools*. Wellington: Learning Media.
- Udvari, S. J. (2000). Competition and the adjustment of gifted children: A matter of motivation. *Roeper Review*, 22(4), 212–216.

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¹ Gifted but also has learning disability or other special need.