

ICMI Study 16: Challenging mathematics in and beyond the classroom

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Readers of the Gazette may well be interested in participating in the coming ICMI Study on Challenge. In 2002 ICMI announced Study 16 and appointed an International Program Committee (IPC) of 13 mathematics educators to administer the Study. ICMI Studies take a number of years.

The IPC defines the Study by writing a discussion document, which not only outlines the timetable but also airs the relevant educational aspects which should be addressed by the Study. The highlight of the Study is a Study Conference, generally held about 2 years after initial circulation of the Discussion Document. The culmination of the Study is the Study Book, which sometimes comprises the papers presented at the Study Conference but can contain rewritten material as commissioned by the Conference.

Attendance at the Study Conference is by invitation. Anyone wishing to attend must show the IPC how they would contribute to the Study, and the IPC invites those who establish an ability to meet the Study's requirements. One of the Co-Chairs for this Study is an Australian, Peter Taylor, Executive Director of the Australian Mathematics Trust based in Canberra. The other Co-Chair is Ed Barbeau, of the University of Toronto.

The Study IPC approved the Discussion Document at a meeting recently at

ICME-10 and this can be found at the Study's web site <http://www.amt.edu.au/icmis16.html>. The Study Conference will be held in Trondheim, Norway, from 27 June to 3 July 2006. Proposals to attend must be received by the Co-Chairs by 31 August 2005. The IPC has also authorised the following abbreviated Discussion Document.

This Study is regarded as addressing a crucial contemporary aspect of mathematics teaching. There are some people, for example, who view the syllabus as having become particularly routine, with assessment testing short recall of routine skills. Certainly there is an increasing call for the introduction of greater challenge in the classroom. This can be done in a number of ways as discussed in the Document. One way is via competitions and Olympiads, and competitions now cater for students of all standards. Other methods involve hand-on demonstrations and a greater accent on problem solving in the classroom. Various methods of defining Challenge can vary from solving a completely unforeseen problem to the process of lifting oneself from one knowledge state to a higher one. In any case the Study will address the educational issues as to how challenge can contribute to the learning process, and the final Study Volume will become a definitive source on the topic for decades to come.

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Discussion Document, Short Version

From time to time ICMI (International Commission of Mathematical Instruction) mounts studies to investigate in depth and detail particular fields of interest in mathematics education. This paper is an abbreviated version of the Discussion Document of the forthcoming ICMI Study 16 *Challenging Mathematics in and beyond the Classroom*.

1 Introduction

In the Discussion Document we provide background to the study, the identification of challenge in its various forms, a need to understand how these challenges interact with the learning process, and a short description of the processes of the Study.

2 Description

Challenge

What is a mathematical challenge? This question is regarded as fundamental to the Study. The International Programme Committee (IPC), which has authored the Discussion Document, offers a number of definitions, but one answer is that a challenge occurs when people are faced with a problem whose resolution is not apparent and for which there seems to be no standard method of solution. So people are required to engage in some kind of reflection and analysis of the situation, possibly putting together diverse factors. Those meeting challenges have to take initiative and respond to unforeseen eventualities with flexibility and imagination.

How do we provide challenges?

In this section are described the roles of various people, particularly the teacher, in providing the challenge or otherwise enabling the student to access challenge as a means of motivating their interest in and improving their skill in mathematics.

Where are challenges found?

In the main version of this document a wide number of instances where challenge is used in the learning of mathematics are listed.

3 Current context

Practices and examples

In this section deeper contextual discussion of various instances of challenge are discussed. First are listed the examples of the large inclusive competitions such as the *Kangourou* in Europe and others in North America and Asia. There is also a discussion of the exclusive elite competitions such as the International and various national and regional Mathematical Olympiads. A variety of other types of competitions, sometimes of interactive nature, usually in a pleasant environment, are also described.

The Discussion Document then describes some contexts in which challenge is provided in the classroom. This can involve traditional or innovative methods, including problem solving situations, and sometimes methods which are easily transported to different classes.

Mathematical exhibitions are next described, some of on-going nature, some of an occasional nature, some of general nature, others quite specific. Large visitor numbers are reported for many of these, indicating a special role.

Resources of printed and electronic type are cited as further means of providing challenge. Also described are various types of mathematical “assemblies”, where students learn and practice mathematics together, in clubs, circles, houses.

Trends

Trends are discussed, and it is particularly noted that the number of avenues for providing challenge in its various forms have increased significantly over recent years.

Problems identified

The difficulties that these contexts produce are identified as falling into two categories: development and applications. In the former category most new initiatives depend on a small number of people for their success. This makes them fragile in some sense. It also seems that it is often easier to find money to begin new projects than it is to find continuing support for them.

By applications we mean applications in schools. It is not clear that much of the new material available is being used successfully by great numbers of teachers in the regular classroom.

4 Questions arising

In this section, possible issues are identified and examples of questions that may be considered within this Study are presented. These fall under a number of categories:

- Impact of teaching and learning in the classroom.
- Beyond classroom activities
- More general questions

These questions try to ask how challenge improves the learning process and identify difficulties and issues in the provision of challenge.

5 Call for Contributions

Members of the mathematics education and mathematics communities are invited to contribute to this Study by offering submissions, to be reviewed by the IPC, an international committee of 13 educators appointed by ICMI. Participation to the Study Conference, to be held in Trondheim, Norway, from 27 June to 03 July, 2006, is by invitation only, on the basis of the submitted contributions. The Study Volume, based on selected contributions as well as on the outcomes of the Conference, will constitute the final stage of the Study and is expected to be an important reference on this subject for decades to come.

Inquiries on all aspects of the Study, suggestions concerning the content of the Study Conference and submission of contributions should be sent to both co-chairs:

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The official website for the Study is <http://www.amt.edu.au/icmis16.html>