

## INSTEAD OF AN INTRODUCTION ...

*Some mathematics becomes more important because technology requires it.  
Some mathematics becomes less important because technology replaces it.  
Some mathematics becomes possible because technology allows it.  
(Bert Waits)*

Technology in general and Computer Algebra Systems (CAS) in particular require us to refocus the teaching and learning of mathematics. Technology brings in new dimensions in both the teaching and the learning process and this makes it necessary to reformulate what we want to achieve and demand in form of basic skills and abilities. We also need to rethink all aspects of assessment, i.e. both the organization/administration and the contents.

The 6<sup>th</sup> ACDCA Summer Academy »*Exam Questions and Basic Skills in Technology Supported Mathematics Teaching*« aimed at bringing together mathematics education researchers and teachers – i.e. experts who develop and implement the teaching of mathematics with technology in both theory and practice – and to stimulate discussions and the exchange of ideas, experiences, and research results regarding two main topics: how to design exams (*exam questions*) and how to define the *basic skills* which are required in school mathematics in the future.

Two important goals of mathematics teaching are:

- the development of understanding the theoretical meanings of mathematical concepts and
- the development of abilities and competencies for their application.

The theoretical meaning of mathematical concepts is the basis for determining what elementary theoretical competencies (here named **basic skills**) are needed for understanding the mathematical concepts.

In mathematics teaching, the application of mathematical concepts is done through solving mathematical problems. Mathematical problems play an important role as a tool of generalization within the process of developing mathematical concepts through exercises and homework. In form of **exam questions** they are also a key for both the teacher and the student for getting feedback about their efficiency during the learning process. Therefore exams, and in particularly exam questions, are an indispensable part of mathematics teaching – also when using technology.

The use of technology in mathematics teaching effectively supports the developing of mathematical abilities and competencies. According to this, the four keynote presentations published in this book take a look at this topic from four different points of view:

- Providing concrete suggestions and giving impulses for a discussion about what basic skills are required in a technology-supported mathematics teaching (Herget et al),
- giving, from the point of view of educational philosophy, several perspectives of mathematics, of the teaching of mathematics, and of (general) mathematics education which are well suited to contemplate and to evaluate the use of CAS as well as giving suggestions for basic knowledge and basic skills in a modern, technology supported mathematics classroom (Peschek et al),
- providing a list of basic competencies required in a technology-supported mathematics teaching and giving suggestions for testing them (Heugl), and
- giving examples for teaching (Laughbaum).

The use of technology inevitably influences the teaching and learning of mathematics. Teaching and learning mathematics using CAS or Dynamical

Geometry Software (DGS) causes us to make technical changes, i.e. changes in the **teaching methods**. Today more and more teachers are in a state of transition from traditional to “modern” (in the sense of “technology-supported” or “CAS-supported”) teaching of mathematics. For many teachers a first step is the changing of teaching methods. During the conference many different approaches to teaching with technology were presented. Teaching examples for various topics (functions, equations, geometry) using different technologies (TI-83/89/92, Derive, Cabri, Maple, Mathematica, CBL) were presented and analyzed – all centered around exams (exam questions) and the question of defining what basic knowledge we aim at. Both individual ideas and implemented curricula were presented covering a wide range of countries.

On the other side, technology requires us to make fundamental **changes in contents**. Technology opens up new dimensions of teaching and will cause teachers to change topics and/or to shift the focus within existing topics. Teaching and learning must no longer be “centered around algorithms” as it is the case in most traditional lessons. The goals of mathematics lessons are going to be changed. Now, the understanding of mathematics can – more than ever – become the central goal. The refocusing on basic knowledge (basic skills) is the base for the “new way of teaching”. The presentations include reports of empirical research, theoretical analyses related to conceptual versus procedural mathematical knowledge, and discussions of concepts such as “multiple linked representation” and the “window-shuttle-principle” (Schneider).

New teaching methods bring new assessment forms. “Two-tier exams” are presented as a well-balanced compromise meeting both the desires of technology supporters and the reservations of those who are concerned about the use of technology in the classroom (Kutzler).

CAS provides us with ready-made mathematical tools with which we now can pursue our initial goal, namely teaching the understanding of mathematical concepts and the application of mathematical concepts. The routine work can be done with computers and calculators. In this sense technology enables the “avoidance of over-specialization” while it represents the “outsourcing of skills”.

Technology (in particular CAS) is here – we use it, also for teaching. We also need to ask: “Do we really need technology in the teaching of mathematics?” Also this question was discussed at the conference.

The 6<sup>th</sup> ACDCA Summer Academy »Exam Questions and Basic Skills in Technology Supported Mathematics Teachingy gave a wide spectrum of approaches to teaching with technology. In this proceedings you will find stimulation and ideas for your own teaching as well as impulses for discussions.

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In the name of the conference chairs,

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