

DG 14: Focus on the development and research of mathematics textbooks

Team Chairs: *Lianghuo Fan*, Nanyang Technological University, Singapore
Stefan Turnau, University of Rzeszów, Poland
Team Members: *Shelley Dole*, University of Queensland, Australia
Emanuila Gelfman, Tomsk State Pedagogical University, Russia
Yeping Li, Texas A & M University, USA

Aims and focus

DG 14 was prepared by the entire organising team. As Emanuila Gelfman was unable to attend the congress, the DG organisation at the congress was taken care of by the two chairs and the two team members present. The DG 14 was well-attended over all three sessions which indicate the interest in mathematics textbooks by congress delegates. This report provides an overview of the aim and focus of DG 14 and a summary of the discussion that occurred throughout the sessions.

As set by the organization team, the general aim of DG 14 was, in the international mathematics education community, to increase awareness of the importance of textbooks in the process of teaching and learning of mathematics, to promote exchanges and collaborations in the area of mathematics textbooks, and hence to raise the level of research, development, and evaluation of mathematics textbooks. More specifically, through its official program during the congress and other activities (including those before and after the congress), DG 14 was intended to provide an international forum for all interested parties (e.g., mathematics education researchers, curriculum specialists, textbook developers, and school teachers, etc) to:

- Share experiences in developing, using and evaluating mathematics textbooks;
- Disseminate findings from research about mathematics textbooks;
- Exchange ideas about mathematics textbook research, development, and evaluation, and
- Identify various issues concerning research in mathematics textbooks.

The focus of DG 14 was mathematics textbooks, which according to the organization team included mainly the core teaching and learning materials (both the printed textbooks in the traditional sense and hypertexts in electronic devices that can be read as texts), but also other teaching and learning materials (such as resources books, problem booklets, workbooks, etc.).

Five specific aspects along with a series of questions were identified and recommended for contributions and discussions. They are as follows:

1. *The development of mathematics textbooks*

How are textbooks developed in different countries and how should they be developed? Who are the authors of mathematics textbooks and who should be the authors? Should textbook development be experience-driven, research-driven, or market-driven, and what are the realities and restrictions in different countries? What role does technology play in the development of mathematics textbooks, and how does it affect the development of textbooks? What are the peculiarities of an electronic textbook?



I C M E
1 0
2 0 0 4

DG

Discussion
Group 14



I C M E
1 0
2 0 0 4

DG

Discussion
Group 14

What role do the government, mathematicians, mathematics education researchers, curriculum specialists, and classroom teachers play in textbook development? What are the interests and forces that drive the development of textbooks in different countries and how should different interests and forces be viewed and dealt with for improvement? How do different socio-cultural values influence the development of mathematics textbooks in different education systems? What lessons can we learn from the history of mathematics textbook development in different countries?

2. *The relationship between mathematics curriculum standards/syllabi and textbooks*

How should mathematics textbooks follow and reflect the intended curriculum standards/syllabi, if there are such standards or syllabi? To what extent are mathematics textbooks in different countries aligned with curriculum standards/syllabi? How can the gaps between mathematics textbooks and curriculum standards/syllabi be filled? How do textbooks serve as a means to transmit socio-cultural norms and values embedded in different education systems or national curriculum standards/syllabi?

3. *The role of textbooks in the teaching and learning of mathematics*

Are textbooks essential in the teaching and learning of mathematics, and under what circumstances? Should mathematics textbooks be written for teachers or students or both? Should textbooks be treated only as an information source or should they be regarded as an instrument of organizing student's educational cognitive activity? How do textbooks shape the teaching and learning of mathematics within and outside schools and classrooms, for worse or for better, and to what extent? How do teachers and students use mathematics textbooks (e.g., do they follow textbooks closely or just use them as one kind of information source among others)? And why do they use textbooks in a particular way? How can teachers and students benefit from having/using a textbook, and to what extent? What are the influences of textbooks on students' achievement in mathematics, and how can this be measured?

4. *The evaluation of mathematics textbooks*

How can judgments about the quality of mathematics textbooks be made, for research and for practical purposes? What criteria and constructs should we use in making such evaluations? What textbooks may be called "good" for students, or teachers, or even parents? How can the evaluation of textbooks be related to the adoption of textbooks? What are the current processes of decision-making for textbook adoption in different countries, and how can such processes be improved? Who (e.g., educational administrators, school principals, heads of mathematics departments, classroom teachers, students and parents) should be involved in the decision-making process, and how?

5. *The research in the area of mathematics textbooks*

What is the status of mathematics textbooks as a subject for disciplined inquiry in the international mathematics education community? How can awareness of the importance of textbooks in mathematics education research be increased? What are the important issues in this area? What methods should be used to conduct research centering on mathematics textbooks, in addition to the commonly used ones such as comparative study and document analysis? What can we do to raise the level of research in mathematics textbooks?



I	C	M	E
	1	0	
2	0	0	4

DG

Discussion
Group 14

Nine papers were accepted for this DG, after being reviewed by at least two reviewers of the organising team and/or an external reviewer, and were made available on the DG's official website before the congress. They focused mainly on (theme 2) The relationship between mathematics curriculum standards/syllabi and textbooks ("An analysis of the representation of problem types in Chinese and US mathematics textbooks", by Zhu, Yan and Fan, Lianghuo, Singapore; "Differentiation in mathematics textbooks", by Anna Brändström, Sweden; "Fractions and ... fractions again?! A comparative analysis of the presentation of common fractions in the textbooks belonging to different didactical fractions", by Viktor Freiman, Canada and Alexei Volkov, France), (theme 3) The role of textbooks in the teaching and learning of mathematics ("A text-book as means for organizing students' cognitive activity", by Emanuila Gelfman, L. Demidova, and V. Panchischina, Russia; "Mathematics textbooks, opportunity to learn, and achievement", by Jukka Törnroos, Finland; "On the problem of typology and functions of school texts", by Emanuila Gelfman, A. Podstrigich, and R. Losinskaya, Russia; "Reading mathematical texts: Cognitive processes and mental representations", by Magnus Österholm, Sweden; and (theme 4) The evaluation of mathematics textbooks ("Characteristics and issues of China's primary mathematics textbooks based on the current curriculum standards", by Li, Zhongru, China; "The new edition of Chinese mathematics textbooks for primary schools," by Lu, Jiang and Wang, Yongchun, China). The organising team was encouraged by the good attendance of the participants during the congress, but a bit disappointed by the lower-than-expected contributions that were received, which suggests that mathematics textbooks are still under-researched and that more attention is needed to this important area.

Session 1

Focus: Development of textbooks in different countries

The first session was chaired by Lianghuo Fan and Stefan Turnau. After introducing the team members and providing an overview of the aim of DG 14, participants were invited to give an overview of textbook development in mathematics in their own countries. From this discussion, it was found that there are very different ways in which textbooks are developed in various countries. Summarised below:

Singapore – The National Institute of Education is the only teacher education university in the country, and textbook writers from this institution are approached by commercial publishers. All textbooks must be approved by the Ministry of Education before they can be published and used in schools.

France – A variety of textbooks are available to schools, but there is a central committee which determines whether a particular textbook is acceptable for use in schools. The committee then make a list of accepted texts available to schools.

Germany – 16 committees look into textbooks. They play a similar role as in France.

USA – Any author is free to seek publication of his/her textbook. The publisher's role is to market the text.

China – Textbook development was originally only done by the People's Education Press. The situation has changed. Textbook authors now need to apply and be approved by the Ministry of Education to write their proposed textbook, and then the textbook must be reviewed and accepted by a committee set up by the Ministry of Education for reviewing textbooks before they can be published and used in schools.



I C M E
1 0
2 0 0 4

DG

Discussion
Group 14

Poland – During communism, there was only one text approved by the government. Now, any person is free to write a textbook, but the book must be approved by government “experts”. There is a perception that the market has been flooded with textbooks of varying quality as the guidelines appear to be very loose.

Finland – There are three publishers and a de-centralised curriculum. There is a lot of variation between books in terms of organisation, appearance and price.

Denmark – Most of the authors of textbooks are teachers, but this has progressively changed to include authors who are involved in teacher education and/or mathematics education research. Publishers pressure teachers to make their schools buy particular texts.

Through this discussion, the issue of pressure from publishers arose. There was general discussion around this. One participant from Sweden voiced the concern that teachers are too dependent upon textbooks and that students spend too much time doing textbook exercises rather than discussing mathematical concepts and issues. It was further noted that the most popular texts selected by schools were those that were the easiest for teachers to use.

One participant from the Netherlands stated that there seemed to be a big difference between primary and secondary school textbooks. This issue was marked for further discussion, but did not occur at this time.

A participant from Romania stated that there was tension between what teachers wanted and which texts contained tasks and activities that children could understand. Teachers preferred texts that provided challenging problems for the students, but sometimes students could not understand what was required by such problems.

Yeping Li asked the question: What should be placed in a textbook? What kinds of pedagogical features are used by textbook writers?

Stefan Turnau raised the issue of teacher reliance on textbooks. He posed the following question: Could we foster innovation in the classroom through textbooks?

During this first session, two people provided an overview of their research into mathematics textbooks. Yan Zhu spoke on “An analysis of the representation of problem types of Chinese and US mathematics textbooks” (co-author: Lianghuo Fan). Anna Brändström spoke on “Differentiation in mathematics textbooks” (content and use of textbooks with students of varying ability). The two papers were pre-reviewed and chosen by the organisers to stimulate discussion.

Session 2

Focus: The role of textbooks in teaching and learning

Shelley Dole introduced this session by outlining the use of textbooks in Australia (where any person is free to write a textbook, and the publishers market the books to schools), and also overviewed her research on comparison of two popular Australian textbooks and their presentation of a particular mathematics topics (ratio and proportion). From her research, Dole concluded that both texts provided a rather confused presentation which had few connecting elements to students’ prior knowledge. Dole posed the following questions to the group:

- Are textbooks essential in the teaching and learning of mathematics?
- Should texts be written for teachers or students or both? (or parents?)
- Should texts be treated only as an information source or should they be treated only as an instrument for organising students’ educational cognitive activity?



I C M E
1 0
2 0 0 4

DG

Discussion
Group 14

- Would reform in mathematics education proceed much quicker if textbooks were banned?

Prior to discussion of these questions, three participants from China Zhongru Li, Yongchun Wang, and Zaijin Tian outlined some of the features of the new editions of Chinese mathematics textbooks, and discussed some relevant issues. Then Jukka Törnroos presented an overview of his doctoral study into mathematics textbooks, opportunity to learn, and achievement. These overviews were all based on the papers submitted by the speakers. At the end of this session, there was some input from the participants as to the focus for the final session.

Session 3

Focus: Research in the area of mathematics textbooks

Lianghuo Fan lead this panel-discussion session with panel members Stefan Turnau, Shelley Dole, and Yeping Li. Turnau first provided an overview of the research focus of papers that had been presented to the DG 14 group for review:

- Literary-type research (analysing text-books)
- Direct-impact type research (impact of text on students)
- Clinical (or classroom-based) experiment
- Project type research on construction of textbooks.

He suggested that there were three other fields of research required:

- Project type research – verification of the effectiveness of textbooks on students' learning (school-based)
- Ethnographic – observations were carried out in classrooms of how texts were used
- Hands-on developmental research.

Discussion was then opened up to consider the impact of textbooks upon teaching and learning. It was generally agreed that mathematics textbooks had a role to play and that they were a valuable resource, though it was also noted that this was not always true and there were cases that students, especially in the primary level, in some countries (e.g., Australia) did not have textbooks in learning mathematics due to different reasons. There was general consensus that more research should be conducted on mathematics textbooks to inform both textbook writers and textbook users on how to make the most use of this resource for teaching and learning.

Concluding comments

Due to the good attendance of participants at DG 14 over the three days, there appeared to be a strong interest in this topic. As a new Discussion Group, attendance and interest warrants the continuation of DG 14 in future ICMEs. The organising team also feels there is a need to conduct an ICMI study in the future in order to promote the level of the development and research of mathematics textbooks.

The chairs will be happy to be contacted at lianghuo.fan@nie.edu.sg and sturnau@atena.univ.rzeszow.pl for further information on the work of this DG.