WHAT CAN TEXTBOOK RESEARCH TELL US ABOUT NATIONAL MATHEMATICS EDUCATION?

Experiences from Croatia

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Research on mathematics education

• In Croatia, *Mathematikdidaktik* is still not fully recognized as a scientific discipline

• This means that there is relatively little research on mathematics education and that such research is at the beginning of its scientific development (Čižmešija, Milin Šipuš, & Glasnović Gracin, 2013)

• PISA, TIMSS, national exam results
Where should we start?

• In such an environment it is natural to pose questions such as:

  • *Where should we start?*
  • *How should the first steps be taken and what should they be?*
  • *How can mathematics education in Croatia be improved?*

• This paper is concerned with why exactly textbook research is a good first step towards understanding and improving national mathematics education.
THE TEXTBOOK AS AN OBJECT OF RESEARCH

- The textbook as an intermediate variable in the context of education (Fan, 2013)

Why are textbooks suitable for research?

A thorough reading the available literature highlights the reasons why textbooks are suitable objects of research:

a) Textbooks are artefacts and tangible media
   (Rezat 2006; Usiskin, 2013)

b) Textbooks contain text to a significant extent
   (Van Dormolen, 1986; Pepin & Haggarty, 2001)

c) Textbooks are widely used by students and teachers
   (e.g. Robitaille & Garden, 1989)

d) Textbooks are deeply embedded into the curriculum
   (Valverde, Bianchi, Wolfe, Schmidt, & Houang, 2002)

e) Textbooks reflect cultural and educational traditions
   (Pepin & Haggarty, 2001)
RESEARCH OF MATHEMATICS TEXTBOOKS IN CROATIA

• The Croatian educational system and mathematics textbooks
• Compulsory education: 8 years (primary education) / age 6
  • grades 1 to 4 (lower primary education) and grades 5 to 8 (upper primary education) / 4 times per week

• Curriculum and textbooks: Centralized process
• All pupils from grades 1 to 8 follow the same educational program according to the national curriculum outlines
• All textbooks used in schools are authorized by the state board / list
• Teachers jointly select authorized textbooks for their school for the period of 4 years

• Textbooks are traditionally bought by parents.
• They are brought to every mathematics lesson and used at home for homework.
The study on mathematics textbooks in Croatia encompassed various research approaches:

a) a review of educational traditions in Croatia and of foreign research on mathematics textbooks;
b) conducting a survey, interviews and classroom observations on the role of mathematics textbooks;
c) analysis of textbook content;
d) a comparison of textbook content and curricular requirements;
e) analysis of the PISA 2009 mathematics items and their comparison with textbook and curriculum requirements;
f) reflection on results and discussion on further research.

- PhD Thesis (University of Klagenfurt, Austria)
- colleagues (V. Domović, L. Jurčec, Lj. Jukić Matić)
Textbooks and educational traditions

- Textbooks reflect the goals of the national curriculum and the cultural and educational traditions of a particular country (Apple, 1986; Love & Pimm, 1996; Pepin & Haggarty, 2001)

- Two strong influences: Austrian Empire and former Yugoslavia (Cuvaj, 1910; Ljubunčić, 1929; Dadić, 1982; 2004; 2007)

- Austrian Empire: classroom practice / learning new content, use of textbooks

- Yugoslavia: content

- After the break up of Yugoslavia in 1991, the content and structure of mathematics textbooks in the Republic of Croatia did not change much from the textbooks of the 1980s

- This interesting aspect needs to be further analyzed and researched
The role of mathematics textbooks – survey, interviews, observations

- What is the role of mathematics textbooks in Croatia?

- A comprehensive survey on this issue was conducted (Domović, Glasnović Gracin, & Jurčec, 2012a, 2012b; Glasnović Gracin, & Domović, 2009)
- Involved nearly one thousand mathematics teachers / about 50%

- The findings show that mathematics textbooks play an important role in mathematics education in grades 5 to 8 in Croatia
- Teachers: teachers’ preparation
- Students: practice exercises and in their homework
- New content is mainly presented by the teacher at the front of the class followed by students working individually on textbook exercises
- Educ. traditions (Pepin & Haggarty, 2001)
The role of mathematics textbooks – survey, interviews, observations

• Survey / quantitative / socially desirable answers

• Interviews, observations / qualitative
• A qualitative view on the use and role of mathematics textbooks (Glasnović Gracin & Jukić Matić, 2014)

• 12 experienced mathematics teachers / 45 lessons
• Survey results were confirmed through classroom observations and interviews

• The research showed that the content and structure of the textbook have a great influence on mathematics teaching
• Other materials are also used, but not to such a large extent
Textbook analysis

• Since textbooks greatly influence mathematics teaching, it is reasonable to research the content within the textbook.

• The survey, observations and interviews showed that textbooks are used in particular for practising.

• All the worked examples and exercises from the three most frequently used mathematics textbook series for grades 6, 7 and 8.

• The analysis of more than 38,000 textbook items (Glasnović Gracin, 2011).

<table>
<thead>
<tr>
<th>Content</th>
<th>Context types</th>
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<tr>
<td>Complexity levels</td>
<td>Answer forms</td>
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<td>Activities</td>
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Textbook analysis

• Operation and calculation activities on the levels of reproduction or simpler connections

• The geometrical content predominantly requires the ability to deal with numbers, formulas and terms rather than mastering geometric concepts

• More than 96 % of the exercises analyzed are given in closed answer form requiring short (numerical) answers.

• Intra-mathematical and symbolic items (mostly more than 90 %)

• Argument and reasoning skills, open answer forms and reflective thinking are not represented

• The results showed a picture of traditional mathematics education in Croatia with an emphasis on algorithms and “mathematics as a tool” (Heymann, 1996)

• Many interesting textbook exercises / Why? Can you explain it?
Textbook and curriculum requirements

- Examination of mathematics syllabi shows a predominance of procedural tasks with an emphasis on calculating and operating activities (MZOS, 2006)

- It is only in relation to context that the textbook results do not meet the curriculum requirements:
  - Context / everyday situations

- Curriculum requirements
- Textbook requirements
- Classroom practice
Textbook content, national curriculum requirements and PISA requirements

• Generation of students / PISA 2009

• *Not usual* for Croatian mathematics education (Glasnović Gracin, 2011)

• Activities, answer form

• Rich text (PISA cca 80 words in Croatian translation)

• Although the PISA content requirements are all mainly included in the Croatian curriculum, a lot of text with context, interpretation activities and reflection requirements make the PISA items significantly different from the textbook exercises.

• These differences surely affected performance of Croatian students in the PISA assessment
Conclusions

• These findings are considered to be a good starting point
• We gained a clearer picture and a broader and deeper understanding of mathematics education from textbook research

• The findings not only generated new information, but also raised new questions on ways of understanding and improving the teaching of mathematics

• This could be applied not only to Croatia but also to other countries with limited experience in research in mathematics education

• In such environments the textbook may be an appropriate first step for research because it is a tangible artefact with text, it is part of the curriculum and it reflects national or regional traditions
Thank you for your attention!
References