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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



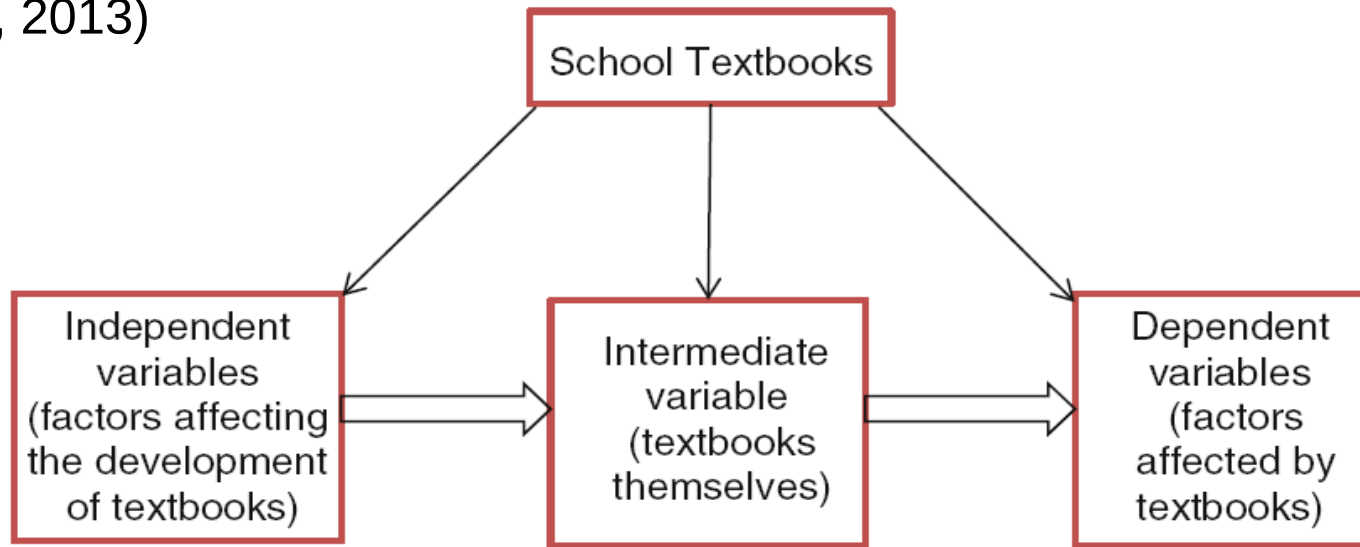
Where should we start?

- 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)



Source: Fan, L. (2013). Textbook research as scientific research: Towards a common ground on issues and methods of research on mathematics textbooks. *ZDM Mathematics Education*, 45(5), 765-777.

Why are textbooks suitable for research?

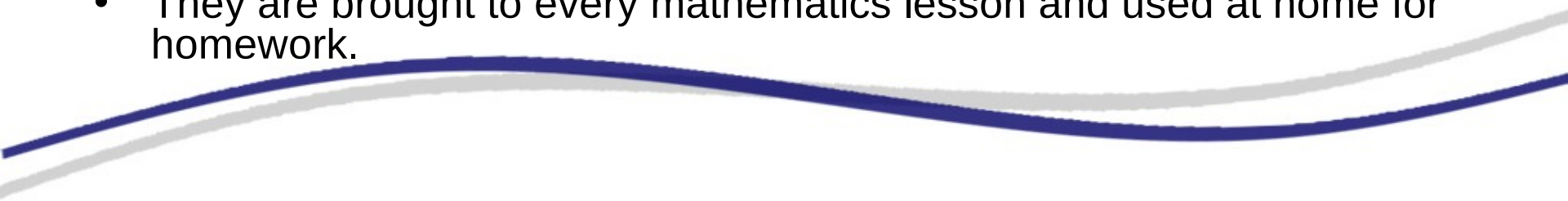
A thorough reading of the available literature highlights the reasons why textbooks are suitable objects of research:

- 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)
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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.
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RESEARCH OF MATHEMATICS TEXTBOOKS IN CROATIA

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)
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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
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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)
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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
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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)

Content

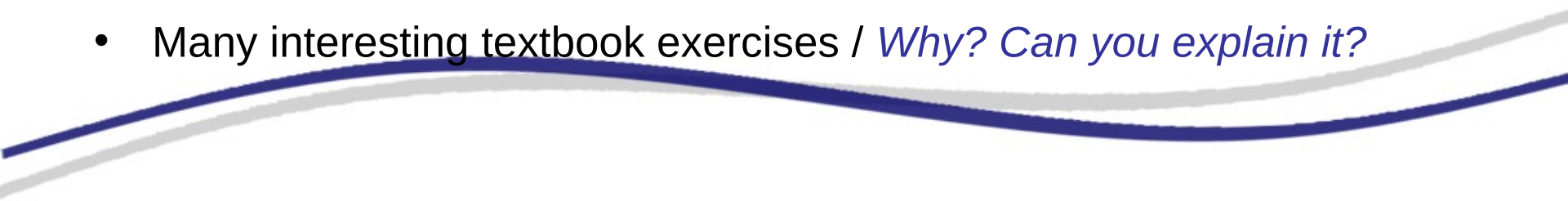
Context types

Complexity levels


Activities

Answer forms


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?*
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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
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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
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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
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Thank you for your attention!



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