

# Textbooks and the nature of maths and science

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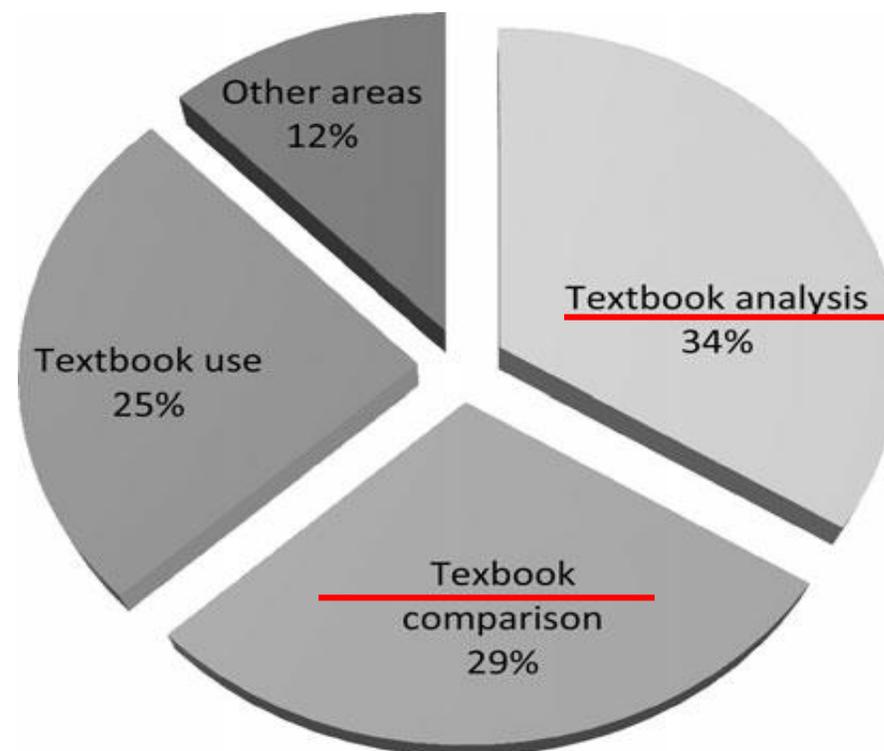
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## Important parallels in maths and science

- **Key curricular resources** for teachers and learners
- Aligned to curriculum: **AFFORDANCES**
- Teachers as **MEDIATORS** of classroom **ACTIVITY**
- Learners seeing maths or science as
  - **a fixed body of knowledge that has to be acquired,**  
versus
  - **As an activity** (maths) or **a way of thinking** (science)

# Textbooks research in Mathematics



Distribution of empirical studies on mathematics textbooks  
( Fan et al., 2013, p.635)

**Content matters**

## In South Africa: Geometry in textbooks

(Bowie, L., 2013)

- comparison of how geometry is constituted in the national curriculum statement and in two popular textbook series
- incorporating 'socially relevant contexts' into the school curriculum creates tensions in the geometry produced in the textbooks
- a particular tension around inductive pedagogies, and the deductive nature of much of mathematics

One of the key problems this study highlights is that, in an attempt to open up access to mathematics, learners have in fact been denied access to some of the crucial aspects of mathematics. This dilemma is at the heart of some of the issues surrounding recent reforms in mathematics education (p. 314)

## In South Africa: Linear Algebra in textbooks

(Mellor, K. et. al., 2015)

“It was found that the German textbook included a **higher percentage of content that promoted the development of conceptual knowledge**. This was especially due to the **level of cognitive demand** of tasks included in the analysed textbook chapters. Also, while the South African textbook presented a **wider range of opportunities to interact with the different representations of functions**, the German textbook, on the other hand, included **more links to the real world**. Both textbooks linked ‘functions’ to other mathematical content areas, although the German textbook included a wider range of linked topics. It was concluded that **learners from the two streams are thus exposed to different affordances to learn mathematics by their textbooks**” (p.1)

## Textbooks for developing countries

“Textbooks are especially important in developing country contexts because **many schools lack material resources** (such as age-appropriate and culture-appropriate reading materials for children) and **human resources** (with some teachers having obtained only a limited amount of academic and professional training). In these schools textbooks can play a central role in **defining a more structured approach to what subject matter is taught and how it is taught**”(p.1)  
(SACMEQ, 2010)

Availability does not necessarily imply use

“the functioning of a resource in and for school mathematics lies in **its use in context**, and **not in the mere presence** of the resource”  
(Adler, 2000, p.17)



Nobel Prize in economics won by trio for work on poverty

Michael Kremer, Abhijit Banerjee and Esther Duflo praised for experimental fieldwork

“an example cited by the committee was their work on the “learning crisis”, which found that **providing textbooks would not by itself help children learn more in school, without better and more tailored teaching**” (Financial Times, October 2019)

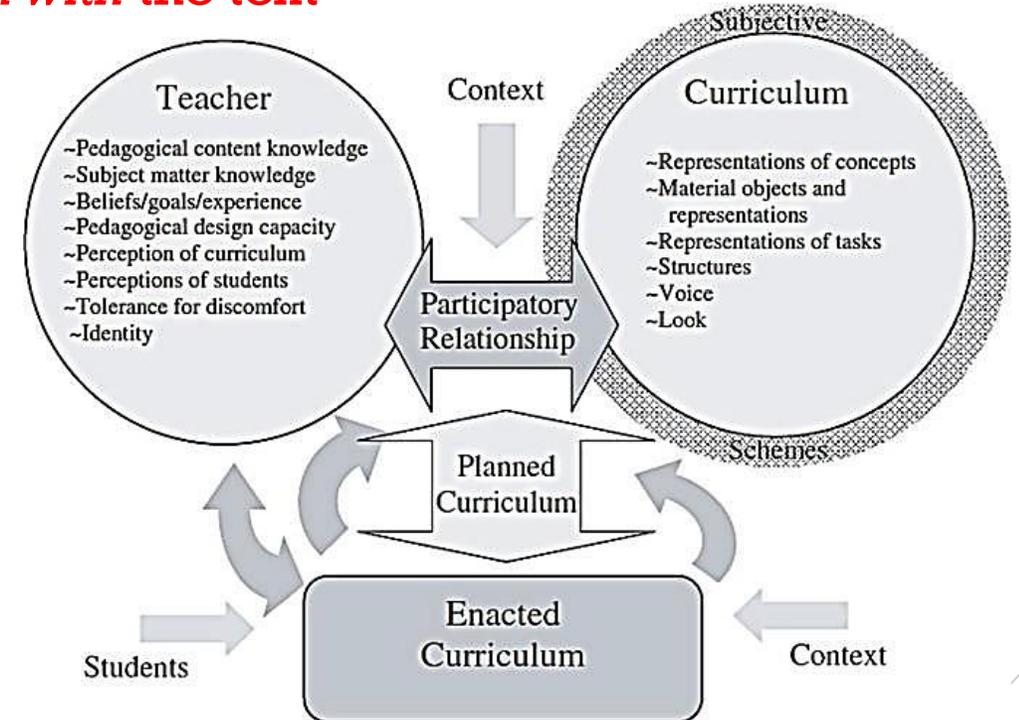
## Four conceptualisations of USE

- as *following or subverting* the text
- as *drawing on* the text
- as *interpretation* of the text
- as *participation with the text*

(Remillard, 2005)

# Research on Textbook Use

- Textbook use a **dual interrelationship** between **teacher** and **textbook features**
- **Each shapes the other** and together they **shape enacted curriculum**



Framework of components of teacher-curriculum relationship  
(Remillard, 2005, p.235)

## Research on Textbook Use:

7 teachers/3 schools  
(Leshota, 2015)

**Scripted Lesson Plans?**

## AFFORDANCES OF TEXTBOOKS

- Mathematical **content** (aligned to curriculum)
- Embedded pedagogical **approach**
- **Framework (1) for determining the approach** of a textbook (Leshota, 2019)
- **Quasi-inductive** vs **quasi-deductive** approaches

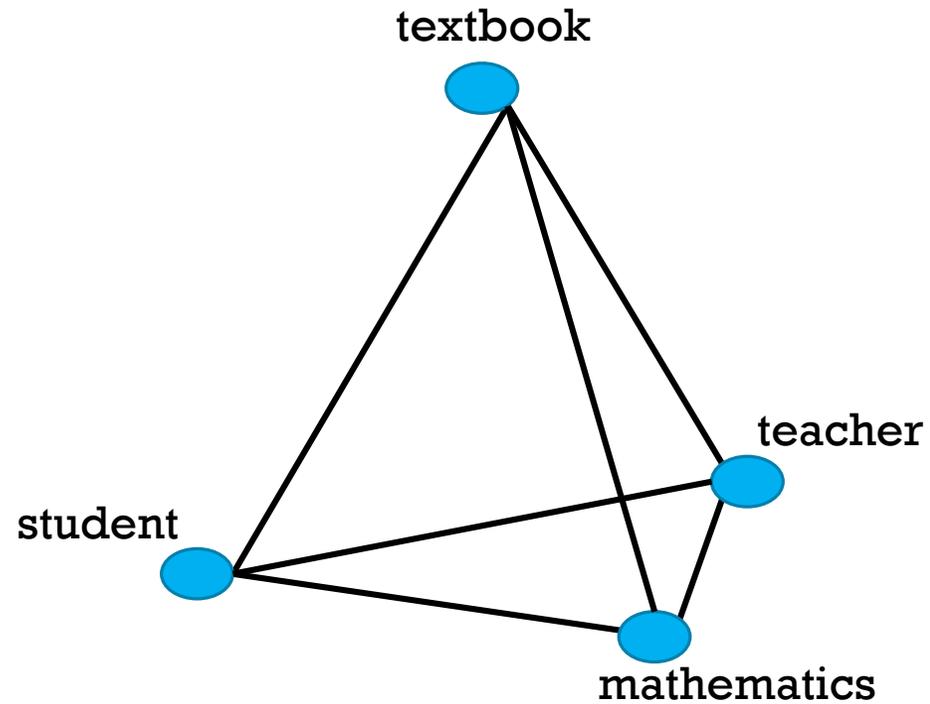
## TEACHER-TEXTBOOK RELATIONSHIPS

- **Framework (2) delineates injections and omissions** of textbook content (Leshota & Adler, 2018)
- **Generally not intimate**

## PEDAGOGICAL DESIGN CAPACITY (PDC)

- Capacity to **perceive and mobilise** existing resources for a **productive mediation** in the classroom (Brown, 2009)
- **Tacit** versus **deliberate & participatory** use of textbook
- **Generally low**

Research on  
textbook use  
(Rezat, 2012)



- There is always mediation between mathematics and the learner
- Any encounter with mathematics is mediated through artifacts/tools (Vygotsky, 1978)

*student – artefact (textbook) – mathematics*

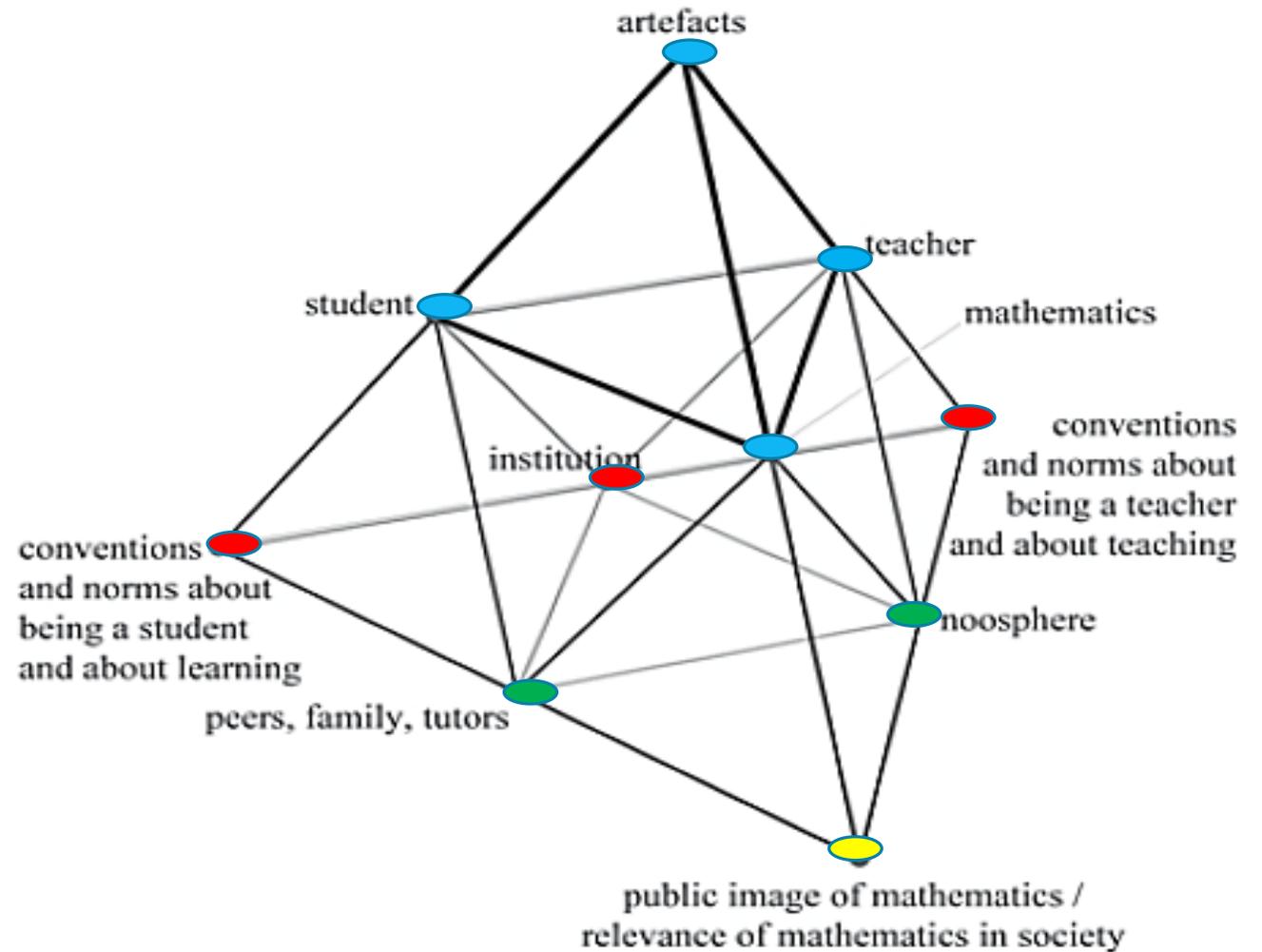
*teacher – artefact (textbook) – student*

*teacher – artefact (textbook) – mathematics*

# Research on textbook use

(social and cultural  
dimension)

**Social and institutional aspects  
affect classroom interaction**



Socio-didactical tetrahedron (Rezat & Straßer, 2012, p.648)  
(Based on Engestrom, 1998 model of activity system)

## CAPS:

To develop problem-solving and cognitive skills. Teaching should not be limited to “**how**” but should **rather** feature the “**when**” and “**why**” of problem types. Learning procedures and proofs without a good understanding of why they are important will leave learners ill-equipped to use their knowledge in later life.

- **Teachers are central** to the productive mobilisation of textbooks
- More research in South Africa needed into the
  - a) **Use** of textbooks by both teachers and learners
  - b) Affordances of textbooks to teachers (**design**)
  - c) **Educative materials** that support and guide teachers (Davis & Krajcik, 2005)