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Preparation of teaching materials

Example of a **textbook**

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My experience with textbooks

student



author



reviewer



decision maker



Example 1: [P.E. Textbook, grade 3](#)

“Keep the language in the vernacular. Students fail in writing about mathematics because their textbooks are written in language that they cannot understand. As a result, they resort to rote memorization because much of what they read and hear means little to their intellects. Paul Halmos even went so far as to say that **the job of the mathematics teacher is to translate the textbook into the vernacular**. It does not have to be this way.”

Phillip J. Davis (1995)

What is a textbook?

"A textbook is a book used in the study of a particular subject." (Merriam-Webster dictionary)

"A textbook is a book that contains detailed information about a subject for people studying that subject." (Cambridge Dictionary)

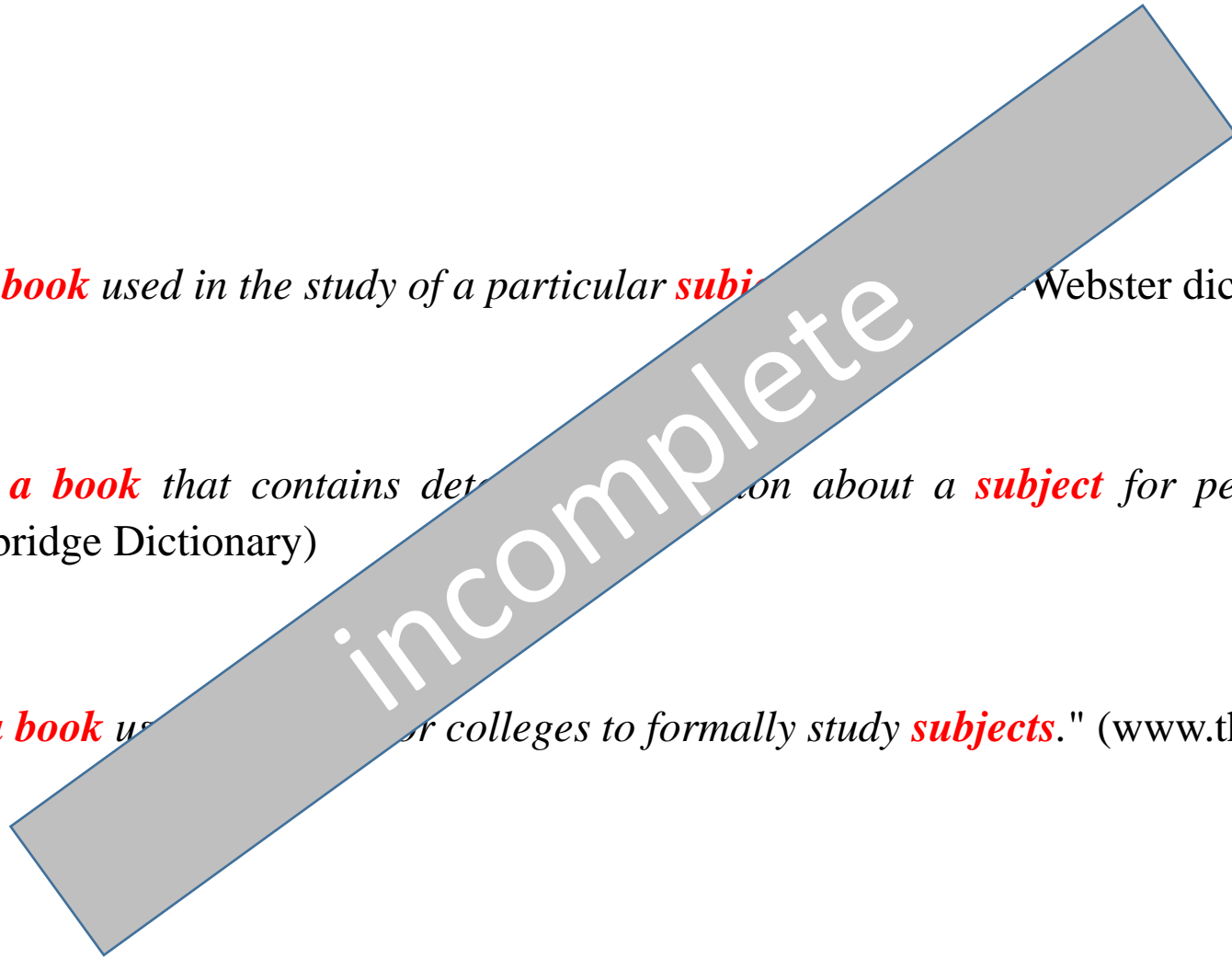
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"A textbook is a book that contains a comprehensive compilation of content from one branch of study with the intention of explaining it." (<https://en.wikipedia.org/wiki/Textbook>)

"A textbook is an organized material useful for the formal study of a subject area." (https://en.wikibooks.org/wiki/Wikibooks:Textbook_considerations)

"A textbook is a basic didactically shaped teaching tool, in any form or medium, which is used in educational work in school to acquire knowledge, skills, form attitudes, encourage critical thinking, improve functional knowledge and develop intellectual and emotional characteristics of students and learners, the contents of which are determined by the curriculum and which is approved in accordance with this law. " (Article 2, Law on Textbooks, "Official Gazette of RS", No. 27/2018)

Rezat, S. (2006). [A Model of Textbook Use](#). In J. Novotná, H. Moraová, M. Krátká & N. a. Stehlíková (Eds.), Proceedings of the 30th Conference of the International Group for the Psychology of Mathematics Education (Vol. 4, pp. 409-416). Prague: Charles University, Faculty of Education

Is the textbook a pedagogical means or a marketed product?

Is the textbook an instrument for learning or the object of learning?

Is the textbook addressing the teacher or the student?

Is the textbook supposed to be mediated by the teacher or is its intention to substitute the teacher?

Is the textbook a pedagogical means or a marketed product?

Textbooks are developed to serve a pedagogical purpose. Nevertheless, publishing is a business and must please its primary customers to remain viable.

Therefore the textbook is not only a pedagogical means but also a marketed product.

The economics of publishing also imposes constraints on the development of textbooks as a pedagogical means.

Is the textbook an instrument for learning or the object of learning?

The textbook mediates knowledge. In this respect, it is designed to be an instrument for teaching and learning. However, the group of authors argues, that the main aim of teaching has been to reproduce the text in the textbook. Therefore they conclude that the text must be regarded as the object of learning.

Is the textbook addressing the teacher or the student?

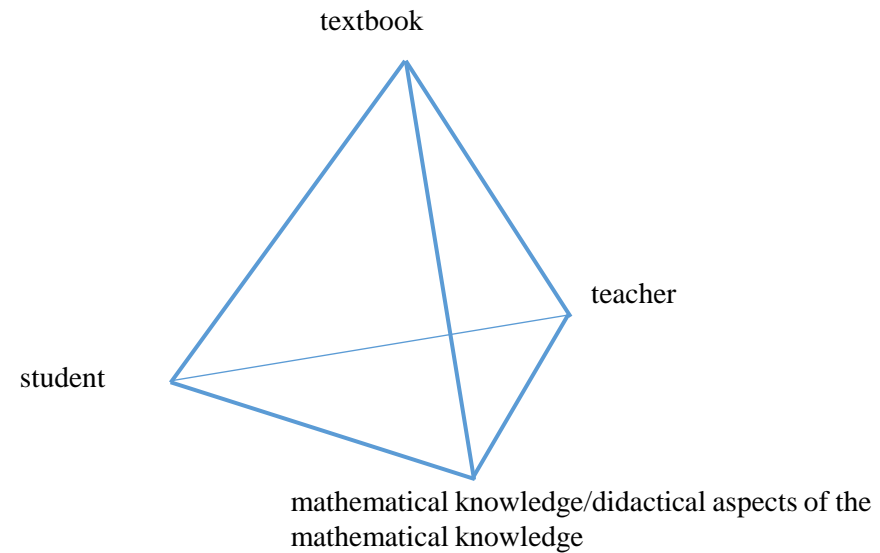
On the one hand mathematics textbooks pretend to be addressed to the student. On the other hand, most authors agree that mathematics textbooks are addressing both, the teacher and the learner . This dichotomy is associated to the issue of the nature of the knowledge that represented in textbooks, i.e. the dichotomy between a mathematical and a didactical nature of the knowledge.

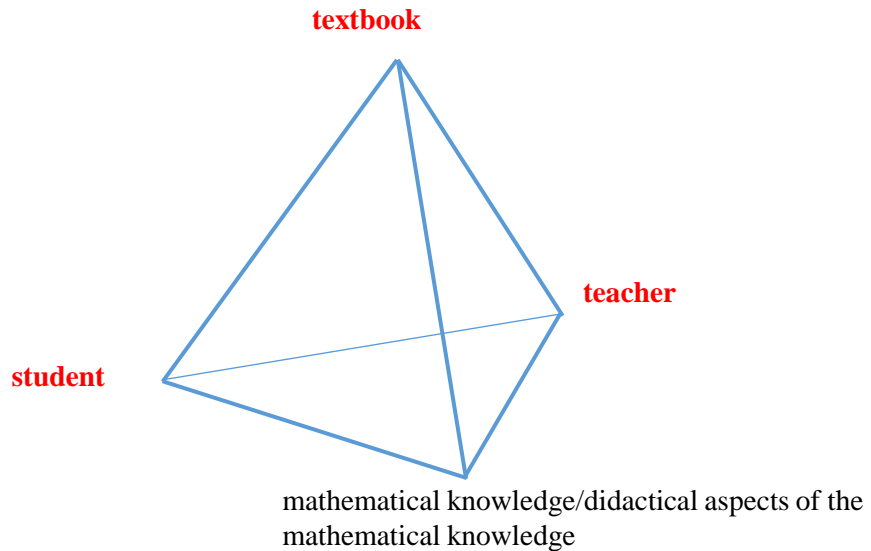
Is the textbook supposed to be mediated by the teacher or is its intention to substitute the teacher?

Most authors agree that the textbook is not in general conceived to replace a teacher, but are written to be mediated by the teacher. But nevertheless, there is a tendency to create teacher-proof textbooks.

Tetrahedron Model of Textbook Use

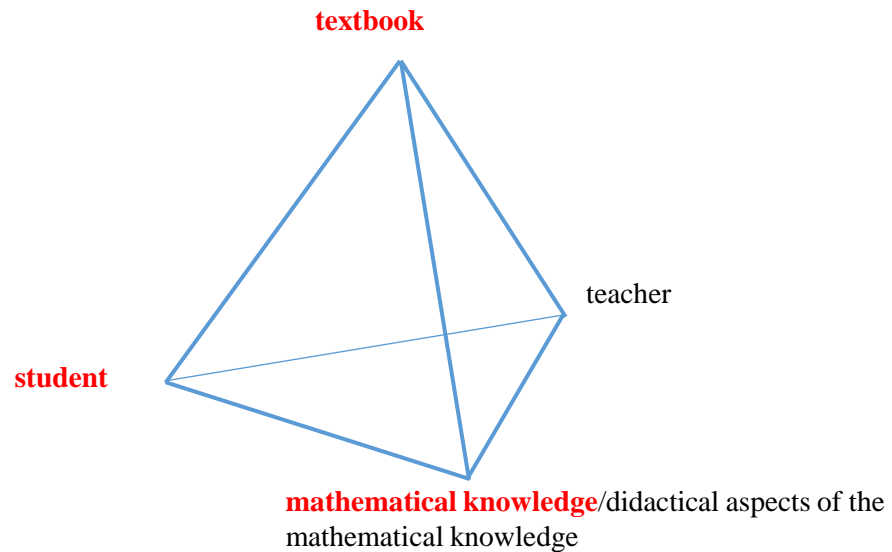
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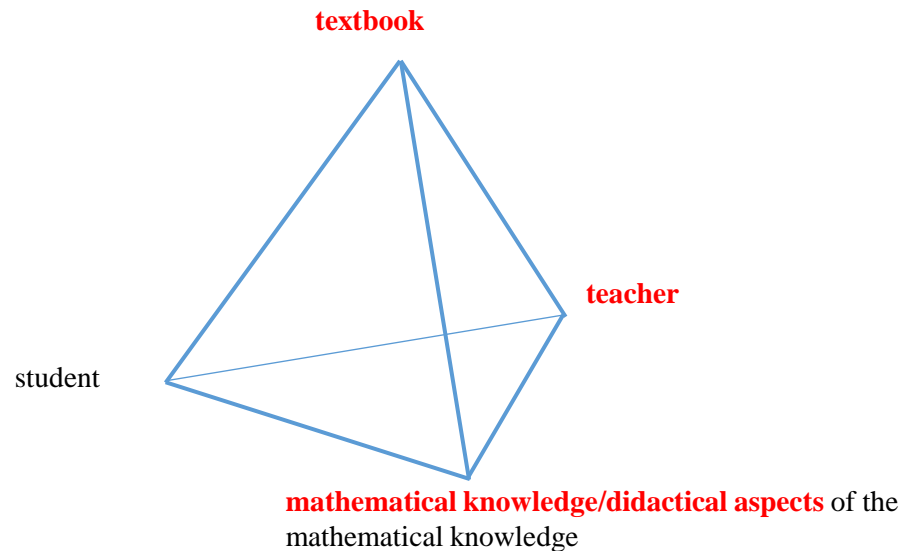
(1) student – teacher – textbook

The student is the acting subject in this triangle and the textbook is the object of his activity. The teacher mediates the use of the textbook.



(2) student – textbook – mathematical knowledge

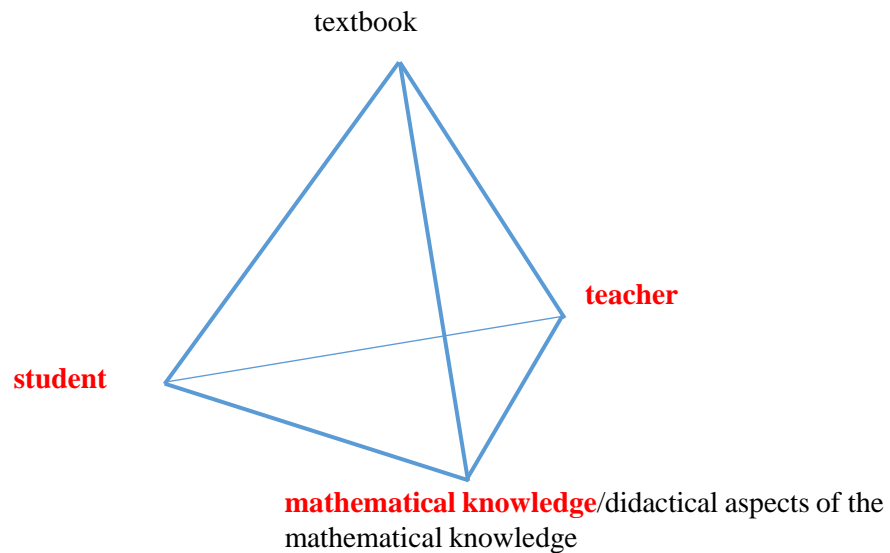
The student in this triangle uses the textbook on his own initiative without mediation by the teacher. The object of his activity is mathematical knowledge in general. The textbook is regarded as the instrument to access mathematical knowledge. It mediates between the mathematical knowledge and the student.



(3) **teacher – textbook – mathematical knowledge** (didactical aspects)

This triangle describes the teacher's use of the textbook. While the teacher acts as a mediator of textbook use in the whole activity system he is the subject of the activity in this subsystem. The object of his activity is the didactical aspects of the knowledge represented in the textbook.

(4) student – teacher – mathematical knowledge

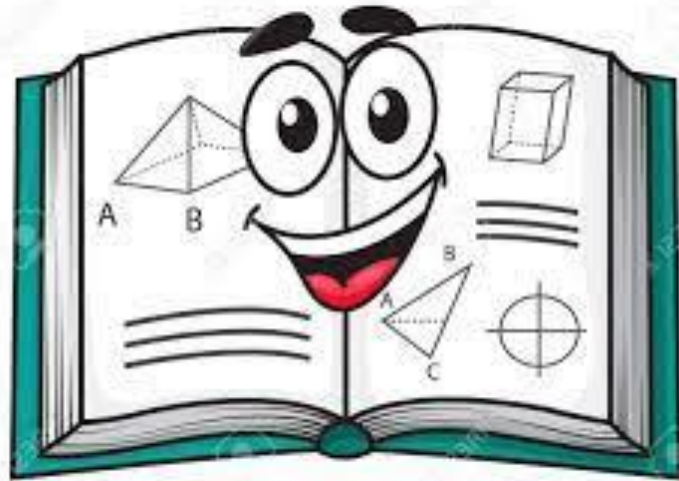


The traditional didactical triangle (calls it ‘the didactical system in the narrow sense’), which also appears in the tetrahedron-model of textbook use does not even include the textbook, but still must be considered as a subsystem of the activity ‘textbook use’. It can be seen as the complement of the triangle teacher – textbook – mathematical knowledge. The teacher implements the knowledge that is represented in the textbook without using the textbook overtly in the lesson. He acts as a mediator of the knowledge.

Basic and necessary requirements

Full and optimal requirements

GOOD TEXTBOOK



PERFECT TEXTBOOK



“As regards mathematical education, I think the message is clear. Classical proof must move over and share the educational stage and time with other means of arriving at mathematical evidence and knowledge. Mathematical textbooks must modify the often deadening rigidity of the Euclidean model of exposition.” (P. Davis, 1995)

Uhl, J., & Davis, W. (1999). Is the Mathematics We Do the Mathematics We Teach ? *Contemporary Issues in Mathematics Education*, 67–74.
(<http://library.msri.org/books/Book36/files/uhl.pdf>)

“Formalism without understanding and understanding without formalism are also possible. In any case, the ability to recite a learned proof of a theorem is not the same as understanding the theorem. The real goal is to understand.”(Uhl & Davis, 1999)

“ Conventional printed texts have a paralyzing effect on learning because they force the student into a passive, subservient role. Thomas S. Kuhn explains it best : “Science students accept theories on the authority of teacher and text, not because of evidence. What alternatives have they, or what competence?” (Uhl & Davis, 1999)

Creating a good or perfect math textbook requires great effort!

Basic and necessary requirements

The structure in the textbook should be consistent.

The structure acts as a mental map that allows students to move within and through the subject domain.

Introduce and apply consistent terminology.

Terminology is crucial for the ability to remember things that a student already learned.

Determine optimal quantity of information.

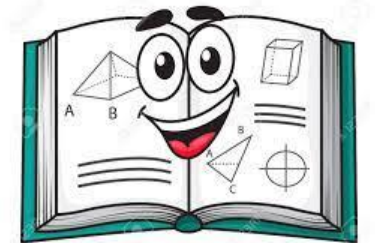
Limit the quantity of new information that you present at the same time taking care about capacities of students.

Upgrade new knowledge to learned knowledge.

We must make sure that the student has acquired the necessary knowledge before accessing the next content. The textbook should provide him/her with a clear insight into the hierarchical construction of content.

Repeat key elements to become part of long-term memory.

Choose the contents (facts, terms, concepts) that are necessary for students to know in the long run and return to them several times in the textbook.



Additional requirements

Introduce new topics by referring to what the student already knows.

Linking images to text.

Interweaving different but related topics and skills.

Teaching independent learning skills in order to strengthen metacognition.

Frequent self-assessments.

Full and optimal requirements

O'Halloran, K.L., Beezer, R.A. & Farmer, D.W. [A new generation of mathematics textbook research and development](https://doi.org/10.1007/s11858-018-0959-8). *ZDM Mathematics Education* **50**, 863–879 (2018).
<https://doi.org/10.1007/s11858-018-0959-8>

