Scientific Issues
Jan Długosz University
in Częstochowa
Mathematics XIX (2014)
143–151

THE EVALUATION OF MATHEMATICAL TEXTBOOKS ACCORDING TO THEIR TEACHING QUALITY

MARKÉTA ŠNORIKOVÁ

Abstract

The author introduces one possible option for the analysis of the textbooks.

It introduces an analysis of those teaching methods used in four textbooks. The presentation is focused on the evaluation of two parallel mathematical textbooks for secondary schools of four different publishers by two publishers Didaktis and Prometheus. It evaluates and compares the textbooks. The aim of this evaluation is to help teachers with the selection of the most suitable textbook for teaching purposes.

1. Introduction

The textbook has an irreplaceable role in the educational process. Content and structural properties of the textbooks are changed. These changes are caused by new technologies and by the change of educational system as well, that includes the framework educational programmes.

Creating a textbook authors have to fulfil specific requirements in comparison with other texts. These requirements are imposed not only on the content of textbooks but also on the structure of the entire textbook, lucidity and its visual appearance. The textbook is considered a specific construct, which differs by its characteristic structural components. These structural components ensure the use of the textbook. [1]

Jan Průcha compiled a universal taxonomy of structural components identified in textbooks of any subject. The following diagram (Diagram 1) represents all structural components according to the taxonomy by Jan Průcha. [2]

• *Markéta Šnoriková* – e-mail: snorikova.m@gmail.com
Palacký University, Olomouc.

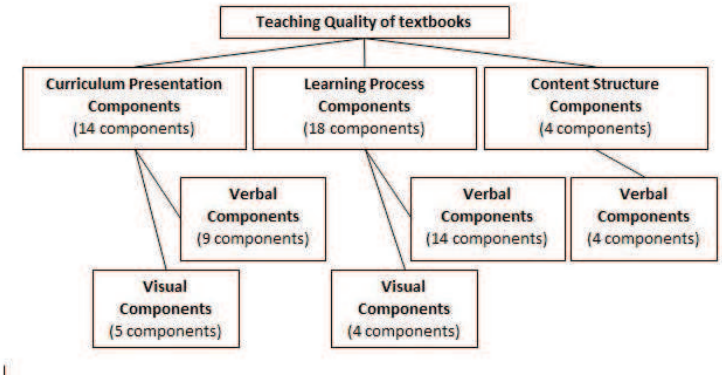


Diagram 1

Calculation of the textbook teaching quality is based on the occurrence of the structural components within a textbook. The textbook teaching quality decides the procedural efficiency of the textbook and it is expressed by quantitative factors:

1) **Partial Quotients of Teaching Quality**:
   - The Use of Curriculum Presentation Components (E I),
   - The Use of Learning Process Components (E II),
   - The Use of Content Structure Components (E III),
   - The Use of Verbal Components (E v),
   - The Use of Visual Components (E o),
2) **Total Quotient of Teaching Quality (E)**. [2]

The quotient is calculated as a percentage of the total number of components to the number of all possible components. It is expressed as percentage from 0 to 100%. The closer the value of educational facilities is to the upper limit, the higher the teaching quality is and thus greater procedural efficiency. The study of teaching quality of a textbook has two main objectives. Firstly, it determines the occurrence of structural components, and secondly, it corrects editing textbooks to enhance teaching facilities [3].

For rating purposes I have chosen four available mathematics textbooks:

- Krupka P., Polický Z., Škaroupková B., Květoňová M., Cizlerová M., *Matematika pro střední školy*, Základní poznatky, Učebnice. Vyd. 1. Brno: Didaktis, 2012, ISBN 978 – 80 – 7358 – 198 – 5.
- Odvárko O., *Matematika pro střední odborné školy*, Základní poznatky, Vyd. 1. Praha: Prometheus, 2009, ISBN 987 – 80 – 7196 – 394 – 3.

- Calda E. *Matematika pro netechnické obory SOŠ a SOU*, 1. díl. Vyd. 1. Praha, Prometheus, 1996, ISBN 80 – 7196 – 020 – 9.
- Bušek I., Boček L., Calda E., *Matematika pro gymnázia*, Základní poznatky. Vyd. 2, Praha, Prometheus, 199, ISBN 80−85849−34−8.

The textbooks were chosen intentionally. They are meant for secondary schools with the same thematic focus. They introduce the curriculum of the basic knowledge and were published in different years. The textbooks by Krupka et al. and Odvárko are newer and were released after the introduction of the framework educational programme. On the contrary, the textbooks by Calda and Bušek et al. were published prior to the introduction of the framework educational programme.

2. **Main results**

To survey the teaching quality we can use a form that contains all the structural components according to the taxonomy by Jan Průcha. The following table clearly shows which structural components the chosen textbooks contain. All textbooks are presented in Tab. 1, Tab. 2 and Tab. 3 for better comparison. For better differentiation we provide the year of the publication.

FORM OF TEACHING QUALITY	Did. 2012	Prometh. 2009	Prometh. 1996	Prometh. 1995
I. CURRICULUM PRESENTATION COMPONENTS				
A) VERBAL COMPONENTS				
1) Simple explanatory text	✓	✓	✓	✓
2) Clear explanatory text	×	×	✓	×
3) Year content summary	×	×	×	×
4) Theme content summary	✓	✓	×	×
5) Previous year content summary	×	×	×	×
6) Additional texts	✓	✓	×	×
7) Notes and explanations	✓	×	✓	✓
8) Subtexts to illustrations	✓	✓	×	×
9) Glossary of Terminology and Vocabulary	×	×	✓	✓
B) VISUAL COMPONENTS				
1) Art illustration	×	✓	×	×
2) Learning illustration	✓	✓	✓	✓
3) Photos	✓	✓	×	×
4) Maps, plans, graphs, diagrams etc.	✓	✓	✓	✓
5) Colour illustration	✓	✓	×	×
TOTAL	9	9	6	5

Tab.1

II. LEARNING PROCESS COMPONENTS	Did. 2012	Prometh. 2009	Prometh. 1996	Prometh. 1995
C) VERBAL COMPONENTS				
1) Foreword	✓	✓	✓	✓
2) Instructions how to work with textbook	✓	×	×	×
3) General stimulation	×	×	×	×
4) Detailed stimulation	✓	✓	×	×
5) Differentiation of the level of the curriculum	✓	✓	×	✓
6) Questions and tasks after a topic, a lesson	✓	✓	✓	✓
7) Questions and tasks after a study year	×	×	×	×
8) Questions and tasks before a study year	×	×	×	×
9) Instructions for tasks	×	×	×	×
10)Suggestions for extra curricular activities	✓	✓	✓	✓
11)Explicit expression of pupils' learning aims	×	×	×	×
12)Means for pupils' self-assessment	✓	×	×	×
13)Results of questions and tasks	×	✓	✓	✓
14)Links to other sources of information	×	✓	×	×
D) VISUAL COMPONENTS				
1) Graphic symbols	✓	✓	✓	✓
2) Using special colours for text	✓	✓	×	×
3) Using special type of font for parts of text	✓	✓	✓	✓
4) Using envelopes for schemes and tables	×	×	×	×
TOTAL	10	10	6	7

Tab.2

III. CONTENT STRUCTURE COMPONENTS	Did. 2012	Prometh. 2009	Prometh. 1996	Prometh. 1995
E) VERBAL COMPONENTS				
1) Content of textbooks	✓	✓	✓	✓
2) Division into thematic blocks	✓	✓	✓	✓
3) Marginals	×	×	×	×
4) Index (subject, name)	✓	✓	✓	✓
TOTAL	3	3	3	3

Tab.3

The following table (Tab.4) summarizes the total number of structural components that are assembled into groups to match the partial coefficients of textbook teaching quality.

TOTAL NUMBER OF STRUCTURAL COMPONENTS	Did. 2012	Prom. 2009	Prom. 1996	Prom. 1995
CURRICULAR PRESENTATION COMPONENTS	9	9	6	5
LEARNING PROCESS COMPONENTS	10	10	6	7
CONTENT STRUCTURE COMPONENTS	3	3	3	3
VISUAL COMPONENTS	7	8	4	4
VERBAL COMPONENTS	15	14	11	11
TOTAL NUMBER	22	22	15	15

Tab.4

From the observed number of structural components we can measure the textbook teaching quality. Proportional representation of partial and total coefficients are shown in the following table (Tab.5).

QUOTIENT OF TEACHING QUALITY (%)	Did. 2012	Prom. 2009	Prom. 1996	Prom. 1995
THE USE OF CURRICULUM PRESENTATION COMPONENTS	64	64	43	35
THE USE OF LEARNING PROCESS COMPONENTS	56	56	33	38
THE USE OF CONTENT STRUCTURE COMPONENTS	75	75	75	75
THE USE OF VISUAL COMPONENTS	56	51	44	44
THE USE OF VERBAL COMPONENTS	78	88	44	44
TOTAL QUOTIENT OF TEACHING QUALITY	61	61	42	42

Tab.5

Curriculum presentation components are most frequently present in the textbooks by Didaktis and Prometheus (2009). The same applies to verbal coefficients, because it is a new textbook produced after the introduction of Framework Education Programme. In comparison with older textbooks by Prometheus, they contain a summary of the curriculum, charts, diagrams, etc. Very important is the inclusion of a summary of the subject matter, because it helps pupils consolidate, and make global overview and the structure of the curriculum. Only the textbooks published by Prometheus contain a clear explanatory text. Although the textbook does not have the highest proportion of the system presentation curriculum coefficient, it includes schematics and diagrams to simplify the orientation and structure of knowledge. In my point of view, all textbooks could reach even higher coefficients, but they are more thematic and therefore contain a summary of the curriculum for the entire or previous year. As the textbooks contain photos and video presentations, they have a high coefficient of non-verbal components. Therefore the textbooks may be attractive but expensive, too. Only the textbooks by the Prometheus (2009) contain some artwork as non-verbal components. Artistic illustrations complement the historical contexts to enrich the theme, and to motivate students.

Learning process components are most frequently present in the new textbooks by Didaktis and Prometheus (2009). Verbal components are broaden with detailed stimulation such as motivational tasks and other interesting facts from everyday life and historical contexts. Visual components are enriched by using special colours for certain parts of the verbal text. All textbooks use a special font and separate the different parts of the text. Only the textbook by Didaktis contains instructions for working

with it. The textbook contains many different structural elements. Pupil can have some difficulties with orientation within the textbook. The textbook by Prometheus for non-technical schools (1996) does not differentiate the curriculum for basic and extended education. Fundamental weakness of all textbooks is the fact that the textbooks do not state learning objectives. The textbooks by Didaktis contain means for students' self-assessment, which is a great advantage. On the other hand, they does not contain results of the tasks and exercises, which I see as a disadvantage. The textbooks published by Prometheus (2009) contain links to other sources of information, which may be more appropriate for talented or more active pupils. Coefficient of learning control system could be a little higher if all the books were not focused thematically, because they contain questions and tasks for the entire year and the questions and tasks for the previous year.

Structural components occur in the same proportion in all the books. This corresponds with the fact that the orientation apparatus contains 4 verbal components only. All textbooks contain content, divided into the chapters, the register and do not contain marginal. The highest coefficient of verbal components can be identified in the latest books by Didaktis (56%). When we compare the older and newer textbooks, we can see the increase in the occurrence of verbal components. But the progress is not as high as in the case of visual components.

The highest representation of visual components can be seen in the textbook by Prometheus (2009) (88%). Based on our initial analysis, it was likely that a higher coefficient of visual components will be in the latest textbook published by Didaktis for its graphic design. The textbook by Prometheus contains higher number of different visual components (e.g. an art reproduction). When comparing the coefficients of verbal and visual components of the older books are balanced ratio of both factors, whereas the newer textbooks greatly outweighs the coefficient representation of visual components.

The newer textbooks by Didaktis and Prometheus (2009) have a higher total coefficient of teaching quality. After the introduction of FEP there was a significant shift in textbook processing. This corresponds with a higher total coefficient of teaching quality of newer textbooks. We can also deduce that textbooks published at the same time have the same coefficient of teaching quality. We formulated a hypothesis that the apparent difference in the overall rate of teaching quality depends on the type of school. However, it was not confirmed.

The following chart (Chart 1) illustrates the proportion of partial and total coefficient of teaching quality. The newer textbooks have the same

partial coefficients EI, EII and $EIII$. However, these textbooks have different representation of verbal and visual components. This corresponds with the fact that even though they have the same partial coefficients EI, EII and $EIII$, they have a different representation of occurrence of structural components. This implies that even if the textbooks have the same total coefficient of teaching quality, they have a different structural elements. And thus they fulfil a different function in the educational process. From this we can deduce that it is important to undergo further examining of the textbooks, which will give us a more comprehensive approach.

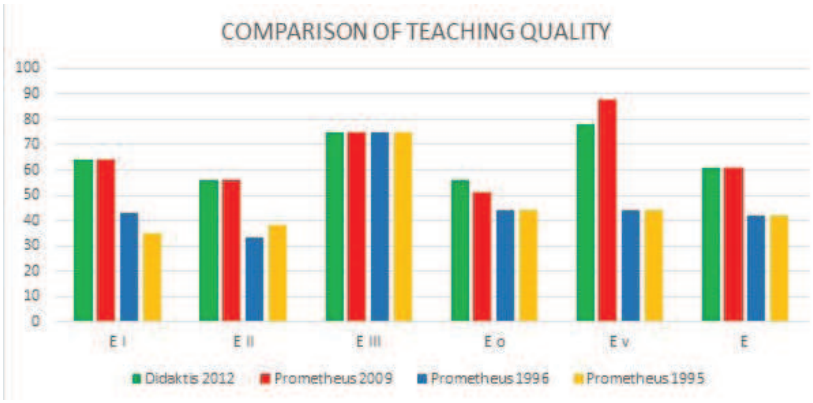


Chart 1

The same conclusion can be derived from two older textbooks, although the conclusion is drawn from the different base. The Textbooks published by Prometheus (1996) and textbooks published by Prometheus (1995), have different coefficients of EI and EII, but on the other hand, coefficients Ev and Eo are the same. It may give us a point that even though both of these books have the same total coefficient of educational quality, they contain other structural components and will once again provide a different function in the educational process.

3. **Final remarks**

From the previous conclusions we can conclude that the educational quality is only a recommended fact for evaluation and analysis of the textbooks. From the comprehensive view, it is necessary to continue with careful examination, which does not ignore the textbooks structure, for example images etc.

The educational quality predetermines the procedural efficiency in the teaching, however, it does not guarantee the fact that the textbooks will be actually used in practice; this statement is based on the fact that the textbooks published by Prometheus (1995) are still used in the teaching process. However, it may be that a consequence of the textbook with higher levels of educational quality are newer and teachers are familiar with them.

The question is, whether the educational quality is still an effective tool for the evaluation of textbooks. Calculation and didactic principle were published by Jan Průcha in 1998. Since then, the concept of the Czech educational system has completely changed. The biggest change took place after the introduction of framework educational programmes, which formed new textbooks. Nowadays, the textbooks are therefore subject of different requirements and it is more than likely that the structural elements of the textbook will change.

Another question might be whether the educational quality is the universal standard for all types of textbooks. This is a significant difference between textbooks and humanistic and technically oriented textbooks. It is evident that teaching style is totally different at technical and humanities schools, it follows that the structure of the textbooks. The structures are dissimilar. From my point of view, I think that the educational quality of textbooks is in favour of humanistic oriented textbooks. It may be derived from the fact that the selected textbooks had a lower rate of the total coefficient of the educational quality.

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Received: May 2014

Markéta Šnoriková
Palacký University, Olomouc
Faculty of Science
Křížkovského 8, 771 47 Olomouc, Czech Republic
E-mail address: snorikova.m@gmail.com