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Assessment of Mathematics Textbooks Potential in Terms of Student's Motivation and Comprehension

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Abstract

This paper discusses the role and influence of textbooks in mathematics teaching and learning in lower secondary school in the Republic of Kosovo. In particular, it focuses on their potential in enhancing student's motivation and comprehension to engage in mathematical learning. Rivers matrix and Skovsmose's learning milieus are two methods involved in analyzing the mathematics textbooks in current use in grades 6 – 9 of lower secondary school. Rivers matrix identifies key factors of the textbook content with direct impact on student motivation and comprehension. Subsequently their degree and quality of presence are examined. Using Skovsmose's learning milieus, textbook tasks and examples are scrutinized according to the extent in which they are embedded in contexts that make connections to real life. Further on, the organizing structure of content and the range of used or proposed teaching and learning activities throughout the textbooks is discussed. The article is the first of its kind in Kosovo and it has provided valuable data regarding the functionality level of the above mentioned textbooks.

Keywords: Comprehension, Mathematics textbooks, Motivation, Textbook analysis

1. Introduction

"School textbooks, because of their importance as instruments of education in children's schooling, have been the subject of research internationally for quite a long history" (Fan, 2011, p.1). Last decades this interest is rising because classroom studies and observations have shown that *"textbook has a very central function in the classroom for both teachers and student*" (Brändström, 2005, p.2).

Countries advancing in mathematics education are creating whole teams and networks of experts, which deal with the analysis, comparison and continuous improvement of mathematics textbooks as a factor with central role in contemporary mathematics teaching and learning.

Despite this, in Kosovo is not done any previous research assessing the effectiveness of mathematics textbooks in current use in any level of schooling. This paper represents the first step in that direction and its tendency is to look into the learning opportunities offered to kosovar students in low secondary school, which includes grades 6 – 9. More precisely essential pedagogical and structural textbook features which impact directly the student's comprehension and motivation are observed.

The analytical framework used for textbook analysis in this study is primarily based on the work of O'Keeffe & O'Donoghue (2009) and Skovsmose (2001), expanded with a number of observations regarding the structure of content organization as well as teaching and learning activities used and proposed throughout the textbooks.

The final aim of this paper is identifying textbook elements which can be improved in order to enhance teaching and learning.

2. The role of textbooks in student's motivation and comprehension

"*Student motivation is an essential element that is necessary for quality education ... very little if any learning can occur unless students are motivated on a consistent basis*" (Williams, Williams, 2010, p.2). In mathematics teaching and learning, a more comprehensive and motivating learning environment is provided making strong connections between mathematics content and real world, everyday experiences, history of mathematics, modern technology, other school disciplines as well as using a variety of presentation styles, methods and classroom activities. Mathematics textbook, as a primary and most important instrument in teaching and learning mathematics, must be "a provider" of these connections and activities. A textbook analysis regarding these features would be with interest, in order to give an insight of the opportunities offered to the students in terms of comprehension and motivation.

Pepin and Haggarty in their study (2008) explored different connections within mathematics and beyond mathematics that different tasks and exercises from selected English, French and German textbooks of lower secondary school would provide. One of the aspects investigated was the embeddedness of the real contexts throughout the tasks and exercises. The authors emphasized that an important issue for textbook task analysis is to what extent and in which ways the real world experiences are incorporated, considering the motivation it stimulates.

Romberg in his paper (2001) describes the research on designing of a series of mathematics textbooks for grades 5 – 8 called "Mathematics in Context", based on the Realistic Mathematics Education theory (RME). This theory emphasizes student's motivation and understanding of the mathematics they are learning. In RME, the real world, everyday experiences and school subjects different from mathematics are used as a starting point for the development of mathematical concepts and ideas. The RME originally was developed in the Netherlands, but it has been embraced by education systems worldwide, because of its effective approaches in mathematics teaching and learning.

3. Methodology

Analyzed textbooks are Matematika 6, Matematika 7, Matematika 8 and Matematika 9 (Editing House Dukagjini, Pejë), allowed for publication by the decisions of the Ministry of Education, Science and Technology of Kosovo. These textbooks are free distributed to students for one year period and students have access to their mathematics textbook at school as well as at home. According to the Kosovo curriculum these textbooks represent the basic literature for teaching and learning of mathematics in grades 6 – 9. Textbook analysis is performed with the combination of two methods – Rivers matrix (Rivers, 1990) and Learning milieus (Skovsmose, 2001). The Rivers matrix is used in identifying and investigating the presence of the following factors:

• Motivational factor – which includes historical notes, scientist biographies, career info, practical implications, applications and real world problems. As mathematics textbooks must not be isolated from modern society, they are required to provide adequate national and international context, background and application when introducing mathematics concepts and topics. Content enriched in this way is far more acceptable and interesting for students, compared to abstract and isolated mathematics information.

• Comprehension cues – which include use of colors and graphical representations. Many researchers agree that colors and illustrations are a very powerful factor in terms of student's comprehension. Comprehension can be greatly influenced by the color, layout and inclusion of graphics within a text (Dowling, 1996). Color and the presence and correct use of diagrams play a vital role in student's comprehension (O'Keeffe and O'Donoghue, 2009).

• Technical aids – which include references to calculator and computer use in the first place. According to recent research technology is a tool with great potential of use for teaching and learning of mathematics (Wiest, 2001), therefore textbooks must reflect to this view, for the benefit of students.

• Philosophical position – which includes the orientation of the textbook in terms of philosophy of education, deals with the purpose and nature of teaching and learning mathematics. Rivers matrix identifies possible emphases and philosophical orientations of a textbook. The predominant emphasis deals with the aims and nature of teaching and learning mathematics and this in turn provides a basis for identifying the predominant philosophy of a textbook (O'Keeffe and O'Donoghue 2009). The possible emphasis: utility and motivation, career goals and immediate reinforcement, proficiency and logic, reduction of threat, retention and depth of understanding, language of mathematics and active participation, critical thinking and communication. The possible philosophical orientation: reconstructionism – focus on society and changes; pragmatism – focus on problem solving; perenialism – focus on intellect and the importance of understanding; realism – focus on observation and experience; existentialism – focus on students individual learning.

According to recent research, use of this elements in textbooks is an imperative of modern mathematics teaching and learning (O'Keeffe and O'Donoghue, 2009).

Skovsmose's learning milieus (2001) provided a more fine – grained approach to the issue of the incorporated real contexts through the textbooks content which is related with motivational factor ingredients such as practical implications, applications and the involvement of real problems. More precisely this method was applied for classifying textbooks examples and tasks with respect to their contextual characteristics:

• Examples and tasks with reference to pure mathematics – context unembedded tasks.

• Examples and tasks with references to a semi reality – tasks situated in artificial reality constructed by the textbook authors, which in fact have nothing to do with the relationship between mathematics and reality (Skovsmose, 2001).

• Examples and tasks with references to a real life – tasks that make mathematics useful and worthwhile, they give to the students meaningful contexts and connections to familiar experiences (Pepin and Haggarty, 2008).
Before we go further, let us clarify some notions used in the process of analysis in order to avoid ambiguity:
• Examples represent all the tasks provided with solutions and noted in the textbooks as examples as well as all practical implications and applications that were found in the course part of the text.
•Tasks for individual work represent all the exercises situated at the end of each topic, intended for individual and independent students work.
• Word problems represent all the exercises where information on the problem is given as text and not in mathematical notation.
Let us clarify too that there was no specific method required for observing of the general characteristics of the structure of content organization as well as used or proposed teaching and learning activities throughout the textbooks.

4. Results and discussion

The data obtained from the textbooks analysis are presented in the tables below. The first table reflects the findings obtained applying the Rivers matrix to each of the textbooks involved. As one can see, Table 1 indicates the lack of most of the factors that support motivation and comprehension. The presence of historical notes and biographies is almost non-existent comparing to the number of topics included.
Humor is not used at all. On the other hand, we have a truly large number of illustrations. Many researchers have highlighted the relevant role of bright and attractive illustrations (e. g. Dowling 1996, Mikk 2000). However, these textbooks weakness regarding the illustrations matter is twofold. Firstly, the only colors used through all the illustrations are black and two or three nuances of gray. Secondly, realistic illustrations, which actually have greater weight and importance (O'Keeffe and O'Donoghue, 2009) are very few, only 3.10 % of the total number of illustrations. There is no use of colors in any of the textbooks involved. Through all the textbooks, the page background is white, while the font color is black. Sometimes a nuance of gray is used for background of the highlighted text. The use of technology is ignored at all, even though the incorporation of technology means involving more of the student's experience in mathematics learning. It also means the higher proficiency in using technology which is a highly necessary skill today.
Of all the possible emphasis outlined by the Rivers matrix, proficiency and logic is the only one coherent and predominant in the textbooks series. According to this the predominant philosophical position is perenialism, with the textbooks focusing mostly on the intellect.
Table 2 contains the data obtained applying Skovsmose's learning milieus to each of the textbooks. Table is organized based on three categories: examples, tasks for individual work and word problems. Each of these categories has three subcategories. Table gives an insight into the percentage of presence of each subcategory within the respective category through each textbook accordingly.
In their study of analyzing and comparing French, German and English mathematics textbooks of low secondary school, Pepin and Hagarty (2008) highlight the fact that in English and German textbooks half of the tasks are context embedded, while in French textbooks only a third of the tasks are such. As we can see

Table 1. The Rivers matrix

	Matematika 6	Matematika 7	Matematika 8	Matematika 9
Historical notes	1	2	1	1
Biographical notes	0	0	1	4
Humor	0	0	0	0
Colors	black, grey	black, grey	black, grey	black, grey
Tables and mathematical illustrations	253	225	142	252
Real life illustrations	8	17	2	0
Calculator use	0	0	0	0
Computer use	0	0	0	0

from the Table 2, contextual analysis of Kosovar textbooks gives us quite different results. Despite the fact that Kosovo curriculum emphasizes the establishing of the connections between mathematics and real world, as well as between mathematics and other school subjects, as some of the primary purposes in mathematics teaching, in this textbook series the context embedded exercises and tasks are in a very low percentage. The major part of the tasks is situated into the abstract mathematics world. Through all the text books there is a

Table 2. Skovmose's learning milieus

	Matematika 6	Matematika 7	Matematika 8	Matematika 9
Context unembedded examples	85.62%	76.09%	93.79%	67.92%
Semi-real examples	12.63%	19.02%	1.86%	28.34%
Real life examples	1.75%	4.89%	4.35%	3.74%
Context unembedded tasks for individual work	90.62%	78.91%	90.05%	85.60%
Semi-real tasks for individual work	5.63%	16.36%	2.62%	13.61%
Real life tasks for individual work	3.75%	4.73%	1.83%	0.79%
Context unembedded word problems	78.26%	66.45%	84.26%	57.36%
Semi-real word problems	13.04%	25.32%	9.26%	40.31%
Real life word problems	8.70%	8.23%	6.48%	2.33%

very small number of exercises and tasks (16 such items through the whole textbook series) that represent some, mostly implicit, connectivity with other school subjects. As for the problems solving issue, the results show that from the total number of the exercises involved throughout the whole series, 39.97 % of them are word problems, most of which are context unembedded.

One of the important roles that textbooks have in education is to provide teachers with ideas and activities for teaching students (e.g. Johansson, 2006). The range of methods and activities presented in the textbook is closely related with its motivating and comprehension potential for students learning, too. Erbaş, Alacaci and Bulut in their study (2012) reveal different possibilities of using student centered activities and methods for presenting mathematical knowledge in order to turn a textbook more reader – friendly and helpful for students. Classroom activities, student – centered activities and manipulative materials through all the analyzed textbooks, in our case, are very few and occasional. The worst exemplar is the textbook Matematika 8, in which even one single used or proposed activity could not be found. It is certain that these textbooks do not offer any support or help to anybody, as for the activities and the range of presentation methods found in them.

The structure of content organizing is quite simple through all the textbooks, including first a presentation of the basic knowledge on the topic, which sometimes begins with a warming activity or a real or semi - real example, but mostly not, and later come the exercises followed by the tasks for individual work which are not at all graduated in order of difficulty. This textbook structure offers very poor possibilities of use in a mixed ability class, like ours are in that level of schooling, considering that every student must be challenged in his own ability level. In Kosovo, students are later on differentiated depending on their learning abilities. Brändström, in her paper (2005) reveals a structure of three Swedish mathematics textbooks for grade 7. Every textbook chapter starts with a basic course section, followed by a diagnostic test and a follow - up section. The strand on which student works within the follow - up section is based on the result of the diagnostic test. Follow - up sections are divided into two or three strands based on the degree of difficulty. At the end there is a section with mixed tasks and a final test to verify if the student has passed the course. This is an example of the textbook meant to be used in a mixed ability students group, where students can work at their own specific levels and individual speeds.

5. Conclusions

As the results show, there is a huge difference between perspectives and approaches in analyzed textbook series and modern perspectives and approaches in mathematics teaching and learning. Knowing that Kosovo Ministry of Science and Technology gives priority to the analyzed textbooks as the main source for mathematics teaching and learning in the lower secondary school, we can conclude that kosovar students, as for the learning

opportunities offered by the curriculum materials, are situated in an abstract mathematic world with almost nonexistent connections with real life and other school disciplines, and no connection what so ever with modern technology. Furthermore, textbooks do not offer any support or help with classroom activities and teaching strategies. The existing organizational structure of these textbooks results in reduced opportunities and less challenge for whole parts of a heterogeneous group of students with mixed ability levels. This analysis brings us to conclusion that these textbooks ability to facilitate students motivation and learning is very low and working with them is not of much use.

References

Brändström, A. (2005). *Differentiated tasks in Mathematics textbooks - An analysis of the Levels of Difficulty.* (Licentiate thesis, Luleå University of Technology). Luleå: Luleå University of Technology, Department of Mathematics.

Dowling, P. (1996). A sociological analysis of school Mathematics texts. *Educational Studies in Mathematics,* 31 (4), 389-485.

Erbaş, A., Alacaci, C., Bulut, M. (2012). A comparison of Mathematics textbooks from Turkey, Singapore and the United States of America. *Educational Sciences: Theory & Practice*, 12(3), 2324-2330.

Fan, L., (2011). Textbook research as scientific research: Towards a common ground for research on mathematics textbooks. Retrieved on 28-th May 2013 from http://eprints.soton.ac.uk/id/eprint/201715

Johansson, M. (2006*). Teaching mathematics with textbooks: A classroom and curricular perspective.* (Doctoral thesis, Luleå University of Technology). Luleå: Luleå University of Technology, Department of Mathematics.

Mikk, J. (2000*). Textbook: Research and Writing*. Oxford: Lang.

Noonan, J. (1990). Readability Problems Presented by Mathematics Texts. *Early Child Development and Care,* 54, 57-81.

O'Keeffe, L., O'Donoghue, J. (2009). Mathematics Textbook Analysis: its role and significance for student comprehension and motivation. *Proceedings of Third National Conference on Research in Mathematics Education,* (pp. 283-294). Dublin, St. Patric's College.

Pepin, B., Haggarty, L. (2007). Making connections and Seeking Understanding: Mathematical tasks in English, French and German textbooks. *Paper presentation at AERA 07,* Chicago.

Rivers, J. (1990). Contextual Analysis of Problems in Algebra 1 textbooks. *Presented at the Annual meeting of the American Educational Research Association*, Boston.

Romberg, Th. (2001). Designing Middle-School Mathematics Materials Using Problems Set in Context to Help Students Progress from Informal to Formal Mathematical Reasoning. Retrieved on 14-th February 2013 from http://www.wcer.wisc.edu/ncisla

Skovsmose O. (2001). Landscapes of Investigation. *Zentralblatt für Didaktik der Mathematik*, 33 (4), 123-132.

Wiest, L. (2001). The role of computers in Mathematics Teaching and learning. *Computers in the Schools,* 17, 41-55.

Williams, K., Williams, C. (2011). Five key ingredients for improving student motivation. *Research in Higher Education Journal*, 12, 1-23