PROBLEM SOLVING IN MATHEMATICS TEXTBOOKS FOR LOWER SECONDARY SCHOOL IN KOSOVO

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Abstract

This paper's focus is the examination of how do mathematics textbooks for lower secondary school in Kosovo represent problem solving and problem solving strategies. This issue is with interest, considering that school textbooks are an important factor in contemporary mathematics teaching and learning, which center is, certainly, the problem solving. A twofold conceptual framework is established for this purpose. It includes the categorization of problem types as well as categorization of problem solving procedures. Problems are differentiated in terms of their cognitive features, contextual features as well as the form of presentation. According to their cognitive requirements, problems are categorized as routine, non-routine and grey area problems. According to their contextual nature, problems are categorized as non-contextual and contextual problems. According to their form of presentation, problems are categorized as problems in pure mathematical form and problems in textual form. The representation of the problem solving procedures is examined based on general strategies for problem solving and heuristics for problem solving. The results of a performed analysis indicate that there is a huge imbalance between the presented types of problems. The general strategies for problem solving are not applied at all, while used problem solving heuristics are very few, the frequency of their use is very low and the way of their presentation is implicit and indirect. The conclusion of the study is that analysed textbooks do not represent a good foundation for developing students' problem solving abilities as a due to high amount of routine, non-contextual problems presented in a pure mathematical form. Likewise, students have to be much more exposed to four stages of general strategies for problem solving, as well as frequent and various heuristics for problem solving.

Keywords**:** *Problem – solving, Mathematics textbooks, Lower secondary school*

Introductıon:

Over the last decades the mathematics education researchers are more and more interested in analysing, comparing and continually improving the mathematics school textbooks. This interest comes as a result of many classroom studies and observations which show that textbooks represent an important factor in contemporary mathematics teaching and learning. In fact the textbooks are regarded as one of the factors that could have a big share in shaping of the final learning outcomes.

On the other side, problem solving is the center of mathematics curriculum in primary and secondary level of schooling all over the world. Solving problems is perhaps the most significant activity in contemporary teaching and learning of mathematics, as it ensures the development of students' higher order thinking skills, as well as modelling and application skills.

The development of students skills in problem solving is, also, one of the main intentions of Kosovo mathematics curriculum for lower secondary school (MASHT, 2004a), (MASHT, 2004b), (MASHT, 2005a), (MASHT, 2005b). Of course, for the successful accomplishment of this intention, the problems that students are challenged with, should be appropriate. Likewise, the convenient procedures for solving these problems should be introduced, teached and implemented.

Because one of the fundamental goals of the Kosovo curriculum for lower secondary school is to develop students' abilities to solve problems, and since the textbooks are curricular representatives that make an important factor in the teaching and learning of mathematics in lower secondary school, the chosen aim of actual work is examining the representation of problems and problem solving procedures in mathematics textbooks for lower secondary school in Kosovo. The issue of how problem solving and problem solving procedures are represented in school mathematics textbooks has recently received much attention from researchers internationally (e.g. Fan, Zhu, 2007).

Methodology and materials:

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 all the 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 through categorisation of all the problems presented in the textbooks, as well as the examination of the problem solving procedures applied on the worked textbook examples.

Firstly, all the tasks intended for the individual students work, presented in the textbooks, were counted as problems, according to the definition that problem is every situation that needs a solution, no matter if the solution is readily available or not to the solvers (Fan, Zhu, 2007). Problems that can be solved in a straightforward way, only by applying a standard algorithm, formula or procedure available to the student, are characterized as routine

problems. Problems that require creative thinking and can not be solved with just applying a known algorithm, are characterized as non – routine problems. As grey area tasks, we classified all the tasks that could be solved only by applying a known algorithm, formula or procedure, but students have to discover which algorithm or operation to use (Marchis, 2012).

With respect to their contextual features, the involved tasks are divided in two categories. The non – contextual problems include all the problems with references to pure mathematics,while contextual problems include all the problems with reference to real life or artificial reality constructed by the textbook authors.

The third categorization is based on the problems presentation form. If the problem presented data includes only mathematical expressions and symbols, than the problem is categorized as a problem presented in a pure mathematical form. If the problem presented data includes only writen words than problem is categorized as a problem presented in a textual form. If the problem presented data includes only visual presentations than problem is categorized as a problem presented in a visual form. If the problem presented data is a combination of the two or more above mentioned elements, than the problem is categorized as a problem presented in a combined form.

This framework provides an examination of the quantitative distribution of different types of problems.

The representation of the problem solving procedures, is examined based on Polya's general strategy for problem solving and heuristics for problem solving, which are detaily presented in the literature (e.g. Fan, Zhu, 2007). Polya's general strategy for problem solving consist of four steps, the understanding of the problem, devising a plan, carrying out the plan and looking back. The actual analysis examines if the solutions presented in the textbooks through worked examples, include all of the above mentioned steps of Polya's strategy. Also the amount of different solving heuristic types used in the worked examples is examined.

Findings:

As for the situation of problems according to their cognitive features, the distribution of the routine problems is very high compared to the non – routine ones. As a detailed example, we can take the textbook Matematika 7, for which the above mentioned distribution is 177 routine problems, 51 non – routine problems and 47 grey – zone problems.

Regarding the contextual nature of the presented problems, the distribution of the contextual problems versus non – contextual ones, through out the whole series of textbooks is given in the table 2.

	Matematika6	Matematika7	Matematika8	Matematika9
Contextual problems	9.38%	21.25%	4.71%	14.4%

Table 1. The percentage of the contextual problems in the total number of the presented problems in the mathematics textbooks for the lower secondary school in Kosovo.

In their study of analyzing and comparing French, German and English mathematics textbooks of lower 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 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 the 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 problems are in a very low percentage. The major part of the tasks is situated into the abstract mathematics world. As for the distribution of the problems regarding their form of presentation, the situation is described in the table 2.

	Matematika6	Matematika7	Matematika8	Matematika9
Problems in mathematical form	81	56	228	209
Problems in textual form	156	116	74	111
Problems in visual form	14	16	0	3
Problems in combined form	111	86	47	44

Table 2. Distribution of the problems in the mathematics textbooks for lower secondary school in Kosovo, with respect to their form of presentation.

Regarding the representation of problem solving procedures and heuristics, it is observed that the majority of the worked examples is solved using only the third step of Polya's strategy. There were also examples solved using two of the four steps – the second and the third one, or the third and the fourth one. We can take as an example the textbook Matematika 7, where 19 examples are solved using two steps, of total 184 examples presented in the textbook. In the same textbook, there are only 5 examples solved in more than one way. On the contrary, there was very hard finding an example solved using three or all the four steps. More precisely, throughout the whole serie of textbooks, only one worked example is found, which is solved using the three steps of Polya's strategy, and non of the examples used four steps.

Further more, the frequency of heuristics use is very low, and there are only few types of heuristics founded in the textbooks such as "use an equation", "draw a diagram", "make a table", "work backwards". There can not be found even a single explanation or a note for any of the stages of general strategies for problem solving. Also, there can not be found even a single explicit introduction for any of the used heuristics.

Conclusions:

From the performed analysis, it is obvious that this series of textbooks does not represent a good foundation for developing students abilities for problem solving. The presentation of problems in a whole series of analysed textbooks is very poor and inadequate one. Most of the problems that students are challenged with, are routine and non – contextual problems, giving not much opportunities for developing students higher order thinking skills. Further more, students are not introduced at all with general strategies for problem solving and the use of problem solving heuristics is very low and very poor.

Recommendations:

The recommendation is that students must be much more exposed to non – routine, contextualised problems presented in different forms. Students must, also, be introduced to a variety of problem solving heuristics in an explicit way, as well as to the general procedures for problem solving. The use of the general procedures and the heuristics for problem – solving must be on everyday basis.

References:

Fan L., Zhu Y., 2007, Representation of problem – solving procedures. A comparative look at China, Singapore and US mathematics textbooks, Educational Studies in Mathematics, Springer.

Marchis Iuliana, 2012, Non – routine problems in primary mathematics workbooks from Romania, Acta Didactica Napocensia, volume 5, number 3.

MASHT, 2004a, Plani dhe programi për klasën VI të shkollës së mesme të ulët.

MASHT, 2004b, Plani dhe programi për klasën VII të shkollës së mesme të ulët.

MASHT, 2005a, Plani dhe programi për klasën VIII të shkollës së mesme të ulët.

MASHT, 2005b, Plani dhe programi për klasën IX të shkollës së mesme të ulët.

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