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**MATHEMATICAL MODELLING IN THE TEACHING-LEARNING
PROCESS IN ROMANIA**

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Abstract

For an alignment with the international teaching-learning methods, for achieving new competences and for obtaining better results in the PISA tests, we debate the Mathematical modelling which represents the connection between the processes in the real world and Mathematics. Modelling, as a teaching-learning process of Mathematics, has a highly developed theoretical context, researched and sustained even through the curriculum in different countries. Modelling helps the concret-intuitive thinking, and also helps someone keep in mind the information for a long-term. The present study answers to some basic questions: How much and how is the Mathematical modelling implemented in Romania? Which would be the plus value of the implementation in the teaching-learning process in the primary school? In the second part of this paper there are developed some examples of problems which could be the basis of the application of mathematical modelling in the primary school. We consider that these changes are quite necessary for the Romanian schooling system because they have been tested, successfully implemented and recommended to the teachers by the ministries which deal with education in many different countries-after a careful research, international projects. Even if this method is not developed in Romania, it could be successfully adopted if their results upon the students prove to be useful for their training and for a fast integration in the European labour market and so on. In this way, the alignment with efficient international standards could be done in a rhythm which is favourable for the human resource in our country.

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1. Introduction

This paper represents a basic research whose main purpose is to increase the understanding of mathematical modelling phenomenon and of the advantages of its application in the Mathematics



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teaching-learning process and so on. Its purpose is not, in fact, the research through a group of participants, but helping the primary and secondary school teachers to become aware of what mathematical modelling means. Understanding the practical side of mathematical modelling (the possibility of applying it in the daily activities) is another important goal. The practical example of other countries and the results in the international assessments are the strongest arguments in this way.

2. Theoretical Context

The varied research, which have the mathematical modelling as a base, determined the inclusion of this kind of reality approach in the educational curriculum. Many advantages were experimented by countries which have spectacular evolutions in the training focused on the fast integration in daily activities and which do not give the same high importance to theoretical training in schools. These advantages are presented in the international research of different countries such as Singapore: "in Singapore, mathematical modeling was first incorporated in the mathematics curriculum framework in 2003"(Lee &Ng, 2015, p. 3), Germany: "in Germany, for instance, mathematical modelling is one of six compulsory competencies in the new national Education Standards for mathematics" (Blum, 2011, p. 19). In the order expressed by the Italian Minister of Education in 2007, we may find: "A characteristic of practical mathematics is the solution of problems, which must be viewed as authentic, meaningful questions, often linked to daily life, and not mere repetitive exercises or questions to which the children answer simply by remembering a procedure or a rule" (Bonotto, 2010, p. 18). Iranian documents: "opportunities to explore real-life application make mathematics more meaningful for students and aid in the development of important other skills" (Bahmaei, 2011, p. 3), Erik De Corte, LievenVerschaffel (Belgium) and Brian Greer (USA) said that " a major argument for including verbal problems in the school curriculum has always been their potential role for the development in students of skills in knowing when and how to use their mathematical knowledge for approaching and solving problems in practical situations" (De Corte, E. Verschaffel, L., &Greer, 2000, p. 3), "during the last couple of decades the introduction of mathematical modelling and applications is probably - together with the introduction of information technology - the most prominent common features in mathematics curricula reforms around the world" (Blomhoj&Carreira, 2009, p. 1), "The mathematical modeling presents itself as a pedagogical strategy that complements this association between real application and the utilization of computational resources, as it provides for the construction of favorable environments for the students to choose their problems of interest, gather their own data, and participate on the investigations, analysis, discussions and reflections" (Ferreira &Jacobini, 2009, p. 26). A good idea is expressed by Neacsu in *Chapter VI Methods and techniques of arguing, counter-arguing and persuading*: "problem-solution model is considered more effective than option solution-problem, appreciating that it induces a stronger motivation" (Neacsu, 2015, p. 292).

The mathematical modelling definitions lead to the same answer which is the following: "mathematical modelling is a process of representing real world problems in mathematical terms in an attempt to find solutions to the problems. A mathematical model can be considered as a simplifications or abstraction of a complex (real) world problem or situation in a mathematical form" (Cheng, 2001, p. 64).

3. Mathematical Modelling in the Primary School

Even if the mathematical modelling seems to be closer to a theoretical concept, it has varied applications, starting from the primary school. In the higher classes, the mathematical modelling can be applied and developed even on problems which have a greater applicability, in many other domains.

Pupils should be connected to reality when they solve any kind of problem, to think about the match between the data of the problem and the reality, if they can be changed in agreement with the present (and issue that teachers should accept). They should solve more and more Mathematics problems which the community might face and they also should answer with responsibility when giving the solution. Different studies proved that when pupils in a standard / traditional class had to face Mathematics problems, they answered correctly in a lower degree than in the case when the same problem was integrated in a realistic context. DeFranco and Curcio experimental study is representative. Throughout this study, it is presented the implication in solving a Mathematics problem correctly: „328 older people go on a trip. 40 people can sit down in a bus. How many buses are needed, so that all people may go on trip?” (DeFranco, Curcio, 1997, p. 60). It is presented in two ways: Firstly, as a traditional test of Mathematics, and secondly, the problem is integrated in a more realistic background: the pupils answer to the phone by means of a teletrainer in order to order buses for the transport to a party. The reserchers concluded that 2 of 20 (in the case of classic problems lesson) answered as in the real conditions of the problem. In the opposite case, 16 of 20 answered as expected, they being involved in situations which simulated the reality, the problems being apparently real.

In „Mathematical Modelling Handbook” there are presented real Mathematics problems which make the pupils give correct answers. Look at the following example: „your neighbour is ornithologist and this weekend, he leaves for research. He asked you to feed his birds. The food vase is cylindrical, as a tree, having some holes so that the birds may feed. He asked you not to leave the vase empty because the birds would leave in the woods for food, but also you should not leave the vase full because refilling it too often scares the birds”(Gould, Murray &Sanfratello, 2012, p. 21).

This way of teaching Mathematics- *mathematical modelling*- means that teachers should add modelling activities in the training process in order to stimulate thinking, encourage pupils to discover new things by themselves, in order to generate more questions/ answers which are quite necessary in the case of a real problem. As BonottoCinziasuggests the teachers all around the world: each problem should not have only one solution anymore, and just a correct solving variant. The numbers given in the problem could be adapted to the children’s reality, they could be insufficient or too many for a certain context, which could be developed around a certain problem; the solving modality should be an open way which follows the steps of a solving framework only in case that the pupils cannot find the solution by themselves (Bonotto, 2010, p.19).

4. Recommendations for Application of Mathematical Modeling in Romania

Nowadays, teachers training should contain mathematical modelling of real phenomena. The programmes do not have this kind of initiatives, Mathematics teachers follow the traditional patterns, which help them solve more problems and exercises in a smaller amount of time. They allow, in a lower degree (if the classbooks and workbooks contain problems which are adapted to children’s reality), the

discussions/ modelling possible solutions for a real problem. The teachers' role in the teaching-learning process with the support of mathematical modelling is crucial, because s/he can bring the pupil closer to the actual reality, motivate him so that learning is achieved beyond the classroom. Moreover, she can motivate te pupil to apply Mathematics in the real life.

There are recommendations throughout the teachers' role importance for the community is demonstated (a teacher who adopts the mathematical modelling). She may simulate, by means of mathematical modelling and with the pupils' help, how much water, food or how many places for accomodation are needed on an island during the touristic season. One should start from the real figures and, then, generate answers regarding different topics. Another option is that one should start from a major question and then generate smaller problems which can be solved. An incipient form would be the methods which are also learnt in Romania: the analytical method and the synthetic method. The teacher's role is quite important because these activities could be done in groups, so that the amount of work can be divided and properly capitalized (searching for real data on the Internet, processing, making predictions according to them etc.).

If we proposed an algorithm designed in order to facilitate the practical application of Mathematical modelling in Romania, it would look like:

1. children's training in order to give "true" answers;
2. transfer the theoretical problems in real contexts;
3. the provided solutions may solve the "real" problems which are presented;
4. the interpretation of the results for more real situations.

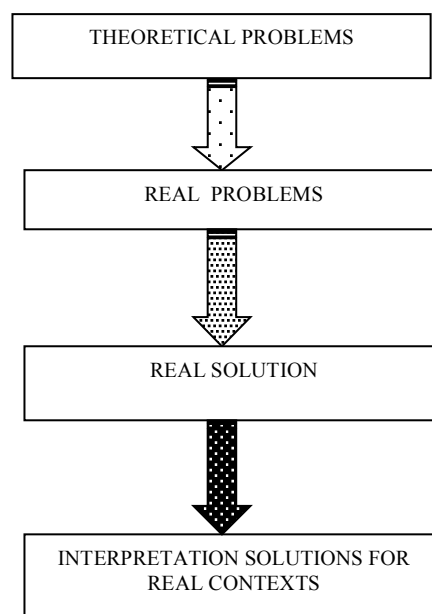


Fig. 1. From theory to practice through mathematical modeling

5. Conclusions

This paper tries to bring a contribution to the rethinking of new strategies on how Mathematics should be approached in the teaching-learning process. These strategies should lead to a correct application of the Mathematics concepts in real activities/processes.

From an educational point of view, the mathematical modelling should help the pupils to understand better and deeper the real world, to sustain the mathematics learning (by means of motivation, helping the pupils to keep in their minds the information), to contribute to the development of different mathematical skills and competences; to contribute to a proper image of mathematics (Blum, 2011, p. 19). Leaving the classic problems conventionalism in order to use problems which can be applied in the daily life, involving the computer in the teaching-learning activities, and also in the evaluation process (simulations, examples, videos containing daily situations) and thinking of new strategies (adapted to the nowadays children's thinking style) may lead to a better understanding of the information, facilitate the assimilation of theoretical information and the applicability in the real world.

Even if the amount of time seems to be limited for such activities in the Romanian education system, with a proper strategy, adapted to the class level, with a real motivation in the case of the teacher and a real awareness of the positive effect for children, one can reach performance in motivation, score and applicability, performance which is obviously higher than in the case of traditional, classic, stereotype and theoretical tests.

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