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## MODELING IN PRIMARY SCHOOL FROM THE POINT OF VIEW OF THE TEACHER

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### ABSTRACT

The present survey has been carried out with primary school teachers and concerns the problems of using the model method in the educational process. The main points of view, the possibilities for the application of modeling in the educational process in primary school, its functions and stages of implementation have been analyzed. The analysis is intended to demonstrate the extent to which teachers can adequately use the model method in view of its combination with other methods of cognition and what types of models teachers most frequently use in their practice.

**Key words:** applications of modeling, stages, functions, types of models.

### INTRODUCTION

There has been doubtless evidence of the benefits of applying modeling in the field of scientific knowledge and its role in the development of human culture. The cognitive and practical activities are connected to a constant process of constructing and using different types of models (material, ideal, logical, physical, geometrical, digital, mathematical, structural, fictional, prognostic, diagnostic, etc.) in respect with the aim, the field studied, the type of similarity examined, the features of the original that are reproduced and examined and the existence and functioning of the object in reality. Models and their potential to become a substitute for a particular object have been used in both everyday life and scientific research for a long time. Modeling is only possible when one has achieved a high degree of abstractness in thought and its importance in scientific research grows together with the degree of abstractness of science. It would be difficult to establish the exact proportional dependence between these two levels of abstractness but it certainly exists. The ability to think in abstract terms, however, is not only a privilege of scientific knowledge; it is also manifested in the educational process.

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Applying modeling in scientific research is different from applying modeling in education. Modeling in the educational process has its peculiarities and is used in 3 main aspects:

- **Modeling as a method of education** and the model as a means used by the teacher in the educational process;
- **Modeling as a method of studying** (educational-and-cognitive modeling) used by the students in their educational-and-cognitive activities);
- Modeling as a method of research in education (didactic modeling).

### SETTING THE PROBLEM AND GOAL OF THE RESEARCH

The modern vision of education is related to the possibilities for the formation and development of various competences- subject, trans-subject, key, and transversal (portable). Transversal competences seem to be essential as they are applicable to different types of activities and can be transferred from one activity to another, from one subject to another. There is a growing interest in these competences in the sphere of education because "their development in students is doubtlessly crucial as far as the formation of other specific and special competences is concerned" (1).

The term 'transversal'(portable) does not refer to the common elements in the separate subject competences but to the additional, trans-subject content of these competences that can

be applied in other fields, too (2). It is this characteristic of trans-subject-ness, portability and flexibility that makes key competences ‘a priceless tool for success in a quickly changing environment’ (2) where mere subject competences have a limited range of application.

The question arises, “Why is each competence limited and connected to a certain object, that is, to a certain field?” (2). Merdjanova, thus, sees competence not only as a function but also as an intention, i.e. as a point of view, an approach or manner of action which makes it possible and necessary for competence ‘to be formed in education and to be transferred through age and among varied activities. This is the meaning that every subject instills in the situations in which he/she acts through his/her specific competences’ (1). Together with the transversal (portable) competences a number of specific competences and competencies are formed in the students at the level of the subject that is studied, but their description, systematization and hierarchy is a matter of other, more detailed research. In these specific competences more explicit dimensions and applications of the information, communication, cognitive and other transversal competences can be found.

Analyzed as an integral personal quality, the educational-and-cognitive competence is a key transversal competence. The defining of its place within the system of transversal competences in students has been an object of a number of studies in the recent years (3). The structure of this competence includes:

- in terms of content - knowledge of models and modeling; modeling of typological and causality relations; dependence of content abstractions; mental experiments; modeling of processes and phenomena from the objective reality aimed at their explanation;
- in terms of the modeling activities employed – skills for studying objects and revealing their essential features; systematization and summarizing of the essential information of the object studied in visual, verbal, mental or other form; creation of models; selection of models (choosing the most appropriate one for a certain situation); practical and/or theoretical verification of the models; coding, decoding and re-coding of information in and through models;

transfer of knowledge acquired through the model to the actual object;

- in terms of the personality of the student - the attitude of the students to educational-and-cognitive modeling as an activity, the results from this activity; as a strategy for effective learning to turn a competence into motivated, transversal (portable) one, a competence that is not a function but an intention (manner, strategy), a competence that has become a personal quality that helps one make sense of varied cognitive situations (4).

The development of the competence for educational-and-cognitive modeling is a process related to the continuous efforts to form knowledge of models and skills for modeling, as well as the forming of attitude to the act of modeling and its results. This process has been defined in the States Standards for Primary School Education.

In the context of these regulations **the aim of the present study** is to survey the opinion of the primary school teachers on the possibilities for the application of modeling in education, its functions, cognitive nature and stages.

## DESIGN AND METHODS OF THE SURVEY

What has already been said above motivates the need to survey the opinion of the teachers on the way they apply modeling in the different stages of the educational process. The opinion of 40 primary teachers has been analyzed through the means of a partially standardized **survey card** that includes a sequence of questions with possible scaled answers, which makes it possible to determine the degree of manifestation of the different characteristics. The survey card includes questions in 5 main groups:

1. the place of modeling in the process of education;
2. the main stages of the modeling activity in the educational-and-cognitive process;
3. the functions of modeling and models in the education process;
4. relations of modeling to other methods of cognition in the education process;
5. The diversity of models and the most commonly used models in education.

The survey card includes nine questions or statements which the teachers have to answer or give their opinion on: 1. Modeling, in your

opinion, is: method of learning; method of teaching; form of knowledge; a means of cognition; an means of education and an educational activity; a way to stimulate problem-based learning in students; a sign of creative thinking. 2. What are, in your opinion, the essential stages of modeling in education: studying the object; defining the essential characteristics, features, qualities, relations between the components and the relations within the object; systematization and summarizing of the information gained through the studying of the object; creating a model (selection, construction); theoretical studying of the model; the adequacy of the model to the actual object; practical verification of the model; transferred of the acquired knowledge about the model to the studied object. 3. The main functions of modeling in education are: cognitive; heuristic; prognostic; diagnostic; inductive; deductive; explanatory; transferring; synthesizing; analytic. 4. In your opinion, which methods of cognition are most closely related to modeling in education: experimenting (in real-life situations); mental experiment; induction; deduction; systematization; abstraction; forming of hypothesis; analogy; comparison; analysis; synthesis; materialization; idealization; exploitation. 5. What types of models do you use in practice: objective; mental; functional; structural; mixed; prognostic; illustrative; descriptive; explanatory; discovering; synthesizing; graphic; symbolic; symbols and images; logic; special/geometric. 6. Which of the following

types of modeling in education do you use in your practice: constructing and ‘cognitive models’; modeling of activities; use of models while interacting in educational activities (subject-subject aspect); modeling of motivation activities as a part of the motivational sphere for both educated and educators; modeling aiming at information processing; modeling aiming at representing information; modeling aiming at systematization and summarizing; modeling of the educated’s activities; modeling aiming at cognition; modeling of the educational contents; modeling as a main educational activity; modeling as a method of transferring of knowledge. 7. What is your interpretation of the term ‘MODEL’? 8. What is your definition for ‘MODELING ACTIVITY’? 9. Name certain examples of using modeling in your teacher’s practice.

**RESULTS OF THE SURVEY**

The analysis of the answers of question 1 (fig. 1) from the survey card shows that 65% of the interviewed teachers believe that modeling is a ‘method of education’ and mainly relate modeling to the activity of the teacher in the process of education (61% define it as a teaching method), and only 35% relate modeling to the educational-and-cognitive activity of the students, defining modeling as a method of learning. A fairly big percentage (68%) of the teachers see modeling as an opportunity to activate problem-based learning and 73% think that modeling is a sign of creative thinking.

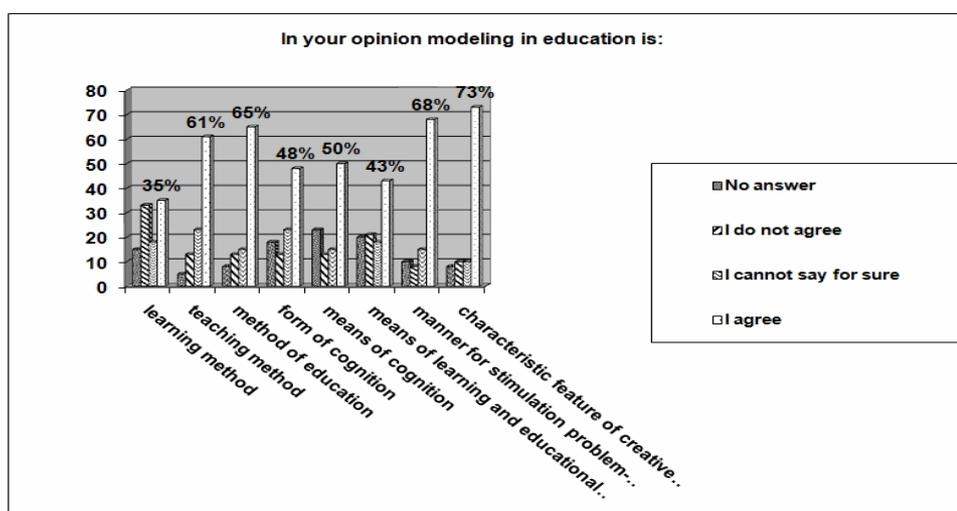


Fig. 1

The analysis of the answers to question 2 shows that creating a model (selecting one, constructing one) is the main stage of

modeling in education. This answer has been chosen by 88% of the informants. They think that the least important stage in the modeling

process is the transfer of the knowledge acquired through the studying of a model of an actual object – 61%. This fact is also confirmed by the answers to question 3 of the survey card (fig. 2) which show that only 30% of the teachers point out the transferring

function of modeling as an essential one. The cognitive function seems to be most important in the opinion of the interviewed, followed by the heuristic (83%), criteria (71%), diagnostic (58%), synthesizing (51%) and explanatory (48%).

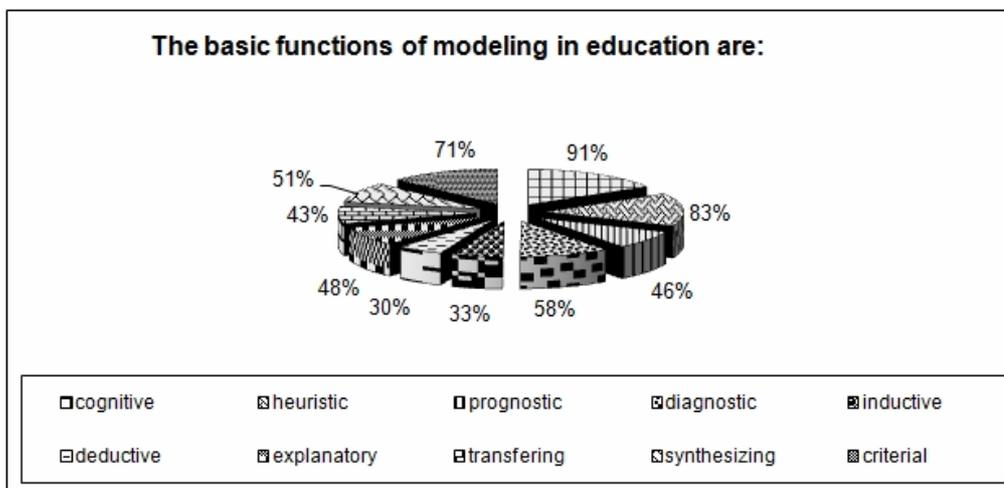


Fig. 2

Analysis as a method of cognition has been appointed as the most closely associated with modeling (78 %). Synthesis ranks second in

this classification (75 %), followed by comparison and systematization (73 %) and the mental experiment (70 %) – Fig. 3.

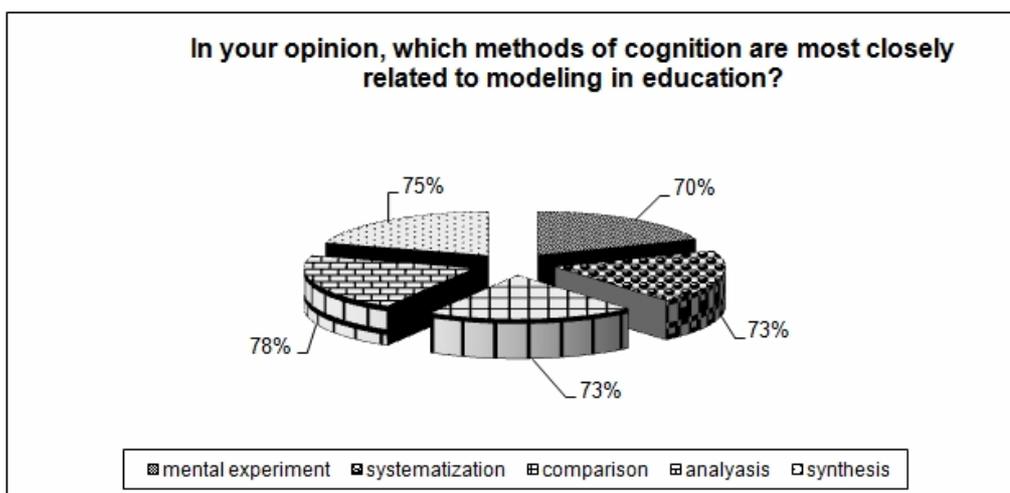


Fig. 3

Teachers claim the following types of models as the most commonly used ones in their pedagogical practice: illustrative and object models – 83%, explanatory and graphic – 75%, mental (imaginary) – 70%. Models of the functional, structural, prognostic and heuristic type hold the last position in this hierarchy.

There seems to be some inconsistency in the answers to the question, “Which of the following trends in cognitive modeling do you employ?”; 81% of the informants answer that they use modeling to achieve a cognitive effect. 91% emphasize its cognitive function (question three), while 24% define their understanding of modeling (question 7) without resorting to its heuristic, cognitive function. It is also necessary to note that more than 50% of the informants find it difficult to answer the question, “What is your idea of the concept of modeling?” Most of those who did answer the

The results from the survey are rather contradictory. The answers to question three, for example, point out the heuristic function as the basic one, while heuristic models, on the other hand, are said to be least used in practice.

question take it as a system that serves as a reference point for the re-creation or comparison of other systems. They point out that “the model” is the more complex system and employ the concept in purely pragmatic situations from our

daily routine neglecting its cognitive function. Only 15% of the teachers define the model as a system of cognitive, heuristic type which reflects the essential characteristics of the object and is specifically intended to explore and study it.

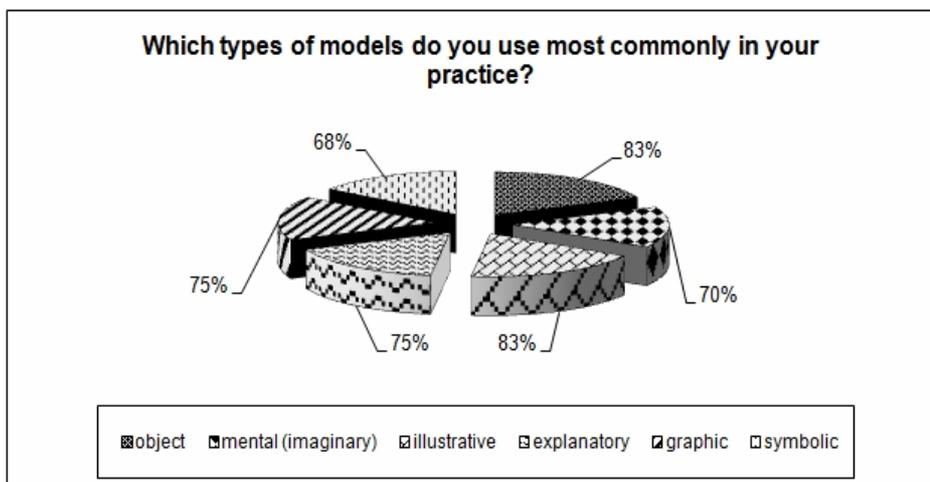


Fig. 4

Statistical data from the survey indicate that only 35% of the teachers consider it possible for modeling to be successfully employed as a learning method and a considerable part of them (61% and 68%, respectively) think that it is preeminently a teaching method and a means of stimulation students in problematic educational situations.

of models and associate modeling only with teaching activities in the process of education. The use of certain types of models is sporadic and fragmentary, which explains the inconsistency in their answers to the questions in the survey.

The analysis of the data collected during the survey leads to the conclusion that primary school teachers do not employ models and modeling systematically in a goal-oriented manner in their work; do not have knowledge of its basic stages; neglect the cognitive importance

Teachers prioritize the use of modeling in disciplines like Home Life and Technology (19%), Drawing (16%), and Mathematics (16%). Quite a few of them (31%) cannot decide how to use modeling in primary school education, but there are some (11%) who find it efficient in all school subjects. (Figure 5).

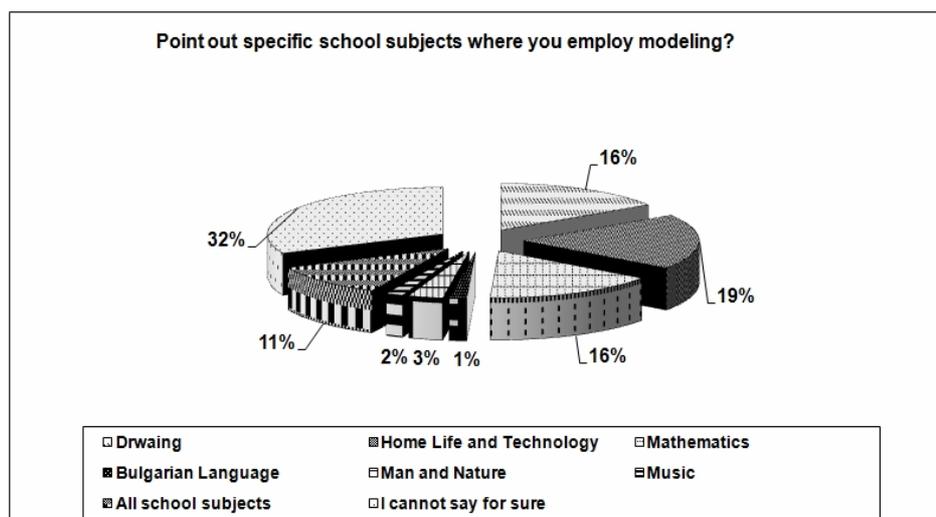


Fig. 5

## CONCLUSION

The prioritizing of Home Life and Technology as a subject where modeling is most commonly used is to a certain extent determined by the State Educational Standards for the educational content for the primary school level – cultural and educational field Life and Technologies. In the context of these requirements, the core educational content defines that, as a result of the education, the student should be able to “make models using analogy with simple mechanisms”, “design objects following instructions and samples”(5). There are conceptions created for the hierarchy of educational purposes in the education in Technology based on the ample application of models and modeling. N. Tsanev defines the following taxonomic levels: abstraction, systematic thinking, experimenting, co-operation, employing ideas and images (invention), and creating technical culture through the use of modeling in the process of education (6). The author claim that the employment of modeling as a modern method of education suggests an expedient use of its cognitive importance. He offers a theoretical model which includes three levels at which modeling is employed in the process of technological education in elementary school: education through cognition-oriented modeling, education intended to create modeling skills; education intended to employ modeling as a heuristic method (6). These concepts are in conformity with S. Plachkov, according to whom the ability to employ modeling is the most essential one among all cognitive abilities (7).

The current research demonstrates that elementary school teachers use modeling in Maths education. This is predetermined by the State Educational Standards and the core units of educational content, one of which is “Modeling” in the initial stage of the primary educational level. The student is expected: to be able to use numerical expressions to model situations defined by the relations “more than”, “less than”, “as much as” and by the arithmetic operations; to be able to describe situations from the surrounding world with the help of mathematical models; to be able to analyze the content of the results received in the solution to a problem; and to be able to make feasible conjectures based on data collected from the environment (5). M. Bogdanova has significantly contributed to the analysis of the application of modeling in primary education

in designing a complete methodological system for the application of modeling in Maths education – I-III grade (8).

In their view of the application of modeling in Drawing classes primary school teachers are obviously influenced by the State Educational Standards, according to which the core unit “The Object and Its Image” requires that the student should be able to “create real and imaginary images from memory, by impressions or based on observation or imagination” (5).

The current research shows that teachers consider modeling a teaching priority. More than 60% of them believe that “*the model is a means of facilitating the process of teaching and presenting information in an accessible way*” and “*modeling is an activity that requires the employment of a variety of models in the presentation of new information*”. Despite the fact that 91% of the informants think that the cognitive function of modeling is essential, they are inadequately aware of how students themselves can use it. In other words, they underestimate the opportunities it offers in the formation and development of the students’ own abilities to make models. This situation demands the search for adequate methods and techniques to form modeling skills as early as the initial stage of the primary level of education in the context of the necessity to develop a competence for educational and cognitive modeling in the subsequent educational stages and levels.

Educational and cognitive modeling in the elementary school is also determined by the specific environment in which it is applied. The elements that define its nature include: educational needs, motivation, goals, actions and operations conducted by the student in the process of educational and cognitive modeling, as well as the conditions for its successful realization. This in turn creates a necessity for teachers to be prepared in advance to design the environment in such a way s to stimulate the formation and development of modeling skills as early as the initial stage of the primary level of education.

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