MATH
# Mountains of Absolutely Terrifying Height
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Didactic Concept

The mathematics learning process is a subject of study of the Methodology of Mathematics Teaching discipline. The studies show that the learning-educative process at school at a certain stage and on a certain level can be viewed as functioning of a single system, consisting of three main components:

- M System of mathematical knowledge, methods, skills, etc., defined by society as necessary for its members at the respective stage of its development;

- S Students who learn the M System of mathematical knowledge, methods, skills, etc.;

- T Teachers who assist with and accelerate the assimilation of the M System by the S Students;

Methodology of Mathematics Teaching is a branch of didactics which focuses on studying the mathematics teaching process and development and enhancing of methods and means for improvement of its efficiency.

Mathematics should be taught in such a way that it would be useful for the public, rather than be isolated from real life. The contents of the school mathematics course changes over the course of history – reforms are carried out all the time. Each generation looks for an answer to the question "How should mathematics be learned, taught and assimilated"? For the proper understanding and assimilation of knowledge by the students, the teachers use diverse teaching methods and didactic aids. Some sort of teaching methodology is inherited but the new generation is always unsatisfied by it. Traditional teaching methods have stood the test of time but the teachers constantly create new, modern teaching methods.
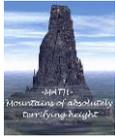
Teachers primarily use cognitive methods in the learning process. This leads to the nature of the school mathematics course becoming close to the creative process, i.e. to activation of the activity of the students, and this is one of the main trends in education. Teachers use combined cognitive methods from both groups – empirical and theoretical methods. They want the teaching of mathematics to come closer to the creative process to some extent, therefore they allow enough time and room – first for the accumulation of empirical facts stage; after that for logical organisation of the accumulated empirical facts and finally for application of the achieved results.

Observation is also often used in teaching - it is a method of studying objects and phenomena without intervention in their natural conditions of existence. We distinguish between observation and perception - it also includes the fixing of the perception results - with words, figures, graphically or with other means. Two types of observation are used - passive, where the observer is outside the phenomenon which they observe, and a second one, where they observer is a part of the phenomenon which they observe. The results of the second type of observation are better because they reflect the phenomenon more fully, more accurately and more precisely. As an empirical cognitive method, observation also has disadvantages, and some of them are neutralised by using the experiment cognitive method. Experiment is always related to observation. In the teaching of mathematics, the use of these methods leads to the formulating of plausible conclusions. These methods have different places in the different stages and different school phases of education. They are main cognitive methods in the first stage of primary education but they are also used in the junior and the senior stage of secondary education. In the learning process, these methods are used when:

- Students are shown specific learning content by using real objects or models;

- Forming of specific skills in the students;

- Solving of single problems related to the specific learning content;

- Making mathematical experiments on ideal objects, materialised as symbols, figures, equations, drawings, etc. by using a calculator or computer as a technical aid;

- Creating special didactic situations, realized on the basis of the creative process by using specific learning content.

Another didactic method is comparison. In it we look for the common and the differences between the examined objects or phenomena. The role of comparison in the learning process is to create favourable foundation for realizing of generalization or by its nature comparison is a prerequisite for the generalizations which follow the comparison process. The place of
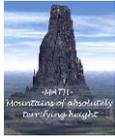
comparison in the mathematics learning process is defined by the following applications. As a method it is used more often when:

- New concepts are introduced;

- Similar theoretical issues are studied;

- Conclusions are reached based on induction or analogy;

- Similar problems are solved, i.e. problems with similar content or similar algorithms or solving models;

- Comparing already found or ready solutions for a certain problem.

Abstracting is method where one or other properties or relations of the studied object are ignored temporarily, so other properties which are considered important for the given study can manifest to the front. The nature of this method becomes clear best by examining the types of abstracting: by identification, by isolation, idealisation, realizability.

From a logical point of view, *generalization* as a method in which there is "movement" of elements from set A to set B. The opposite process is called specialization. It can be said that in mathematics, every effect is the result of specialization, i.e, the application of specialization in the mathematics learning process is in the achieving of effects from given or received assertions. From a psychological point of view there are two types of generalization. The first is a separate, not realized generalization. It is based on the cognitive methods experiment, observation and comparison and on the perception of real objects. It is called empirical generalization. Generalization is a method which is usually used after the methods comparison and abstracting. In the mathematics learning process, generalization is used with the following applications: generalization of terms, i.e. during classification; generalization of assertions; generalization of problems; systematizing of methods and means for solving entire classes of problems; use of letter symbols.

Concretization is another method which is used - a cognitive method in which there is "movement" from the common to the singular The forms of manifestation of concretization define its place in the mathematics learning process. We associate concretization with the cognitive process of abstraction.

Analysis and synthesis are main methods in the teaching of mathematics. In the case of analysis, the whole is deliberately divided into parts so that it can be studied. Synthesis is a method where the parts are assembled into a unified whole. Analysis describes a "movement" from the causes to the effects which have caused them, while synthesis is a "movement" from the causes the effects which they create. Analysis and synthesis are methods that are inseparable

from one another, they complement each other and interweave, and form the so-called analytic-synthetic method. The analytic-synthetic method is used as another form of the law of qualitative and qualitative changes. Generally, analysis and synthesis are used in the mathematics learning process when:

- The contents of the school mathematics course are studied - the contents are divided /analysed/ into separate terms, theorems, proofs, problems and their solutions.

- The terms knowledge is divided /analysed/ and studied in different grades; after which comes a synthesis of that knowledge;

- Researching a given problem or theorem - the students need to be able to distinguish between the text of the problem or the theorem from what needs to be proven or the result that needs to be achieved or what needs to be built, i.e. from its conclusion.

When mathematical knowledge is used as a modelling tool, the method used is modelling. Its essence lies in the fact that at a given moment instead of examining given object or phenomenon, other objects or phenomena are examined and some of their properties are in some respect comparable to those of the former. On the grounds of the discovered properties and relations of the latter, conclusions are made about the property and relations of the former. The examined object is an original, while the newly resulting one - a model. Modelling as a method is used for solving word problems in mathematics. In that case non-mathematical problems are modelled with mathematical objects - equations, inequalities, systems of equations or systems of inequalities. Modelling is also used for vector problems and problems which use geometric images.

Inductive approach is used in the introduction of new terms and rules in the 5th grade. With the help of introductory problems, common laws are sought and smooth transition and continuity are achieved in the introduction of new knowledge. In some cases, the introductory problems have a problematic nature and help students to walk the path of knowledge and discover the new knowledge and skills themselves. The terms and the rules of developing skills are explained and formulated in an accessible fashion, often accompanied by specific examples. For the purpose of the students writing down correctly the solution of a mathematical problem, the clear and brief solutions of selected problems of instructive nature, encompassing the possible variants, are given in the lessons. Given the complexity of the problem /compared to the previous grade/ the steps and the algorithm for solving the problems are given for many of
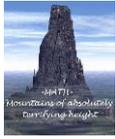
the problems. Often the problems are also accompanied by a separate and clearly visible example of how they should be written down.

It is interesting to share the fact that in the Bulgarian textbooks there is a column at the end of the mathematics lessons called "I Have Conquered Yet Another Peak" where the new knowledge and terms from the lessons are summarised and systematised.

After the new knowledge lessons usually come exercise lessons. With the use problems, the received knowledge is maintained and the gaps in its assimilation are filled. Different ways and variants of using the knowledge for solving the given problems are always examined. Important facts and rules necessary for solving the problems are reminded. That way the students are given an opportunity to show critical thinking and creativity.

The practical activities lessons are important in the teaching of mathematics in the 6th grade. They are used for developing specific skills in the students - for instance skills for drawing and making of bodies. Through the practical activities problems it is very easy for the students to understand the properties of the studied mathematical terms. In the teaching of mathematics, particular attention is given to developing skills for using and applying knowledge and skills in specific practical situations in order to develop the following competencies in the students: developing of skills for communication and analysing of various options; argumentation for a choice made for the solving of a given problem based on given criteria - it is recommended to hear more students with different reasons and arguments; forming of skills for extracting information, reading and interpreting of data specified in a different way; encouraging individual searching for information from various sources and forming of skills for work on projects, and last but not least, teamwork skills at every opportunity for group work. At the end of each topic or separate lessons cycle in the larger topics, a summary lesson is offered. These lesson give the students the opportunity to fill their gaps and successfully prepare for the Topical Control lesson through which the teacher receives feedback and has the opportunity to give grades.

The main method used in the introduction of new knowledge in the 7th grade, unlike the previous grades, is the deductive method. Attention is given to the clarification, substantiation and proving of the new assertions by using the mathematical knowledge already assimilated by the students. The systematic approach in the studying of mathematics is one of the main factors in developing the logical thinking of the students and the developing of skills for reaching
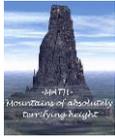
logical conclusions. This will contribute to the student's ability to adapt quickly to the changing reality. The use of this approach does not mean that students should be required to remember and reproduce all proofs. It is of practical importance for them to assimilate that type of thinking, so that they would be able to substantiate the conclusions which they reach during the solving of a given problem. With the help of introductory problems, which have a problematic nature, common laws are sought and smooth transition and continuity are achieved in the introduction of new knowledge. The "studying through practice" method is used often - it uses the experimental method which helps students walk the path of knowledge and discover the new knowledge and skills themselves. Students learn how to write down correctly the solution of a mathematical problem by parallel demonstration of a separate and clearly visible example of how they should be written down.