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Forming mathematical skills for gifted students

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Abstract

Teaching tasks and discussion solving process develop students' thinking when they are: motivating, well understood, appropriate to the achieved level of intellectually and related to real life problems. Thinking is a process of complex information processing, the end-result is "concepts-words" and "thinking-sentences." The teaching process involves empirical and theoretical thinking because it is a complete cognitive process through which students acquire the social and historical experience of humanity. Introducing the use of scientific methods for gifted students is an essential tool for attaining structural knowledge. Use of scientific methods and mental math can empower students' knowledge and help them getting structural math skills and long-lasting knowledge. These methods are useful tools for creating long-lasting, structural knowledge among students.

Keywords: Mathematical Skills, forming mathematical skills, mathematical tasks, gifted students

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1. Formation and development of students' mathematical thinking

The thinking process in a person begins when an intellectual or practical task emerges. Therefore, the qualities of thinking develop precisely while solving mathematical tasks, and in school they are presented to students not in a chaotic manner, but in a determined system of teaching tasks. Teaching tasks develop students' thinking when students are well motivated and the tasks are well understood, appropriate to the achieved level of intellectuality and related to life problems.

The key goal of mathematics teaching in general is to train the students for oral and written mathematical expression characterised with conciseness, simplicity, clarity and completeness; correct and free operationalising with mathematical categories: concepts and statements, theorems and formulas, laws and operations, procedures and mathematical models, with intuition and inner logic of mathematics' development; development of geometric intuition, spatial representation, through appropriate models and routines for proper graphical expression in the sense of practical knowledge of mathematics; development of logical thinking (first, in appropriate circumstances – through propaedeutic course, and later – in the elements of mathematics logic).

1.1. Discussion as a teaching tool that encourages thinking

In order to be efficient, teaching should secure students' involvement and motivate them to ask questions and seek answers. Since students are different in biological, cultural and intellectual aspects, the classroom methods and activities should also vary according to the students' learning methods and obtained knowledge. Leading a discussion on a topic during lessons is a useful teaching tool. However, in order to have a proper discussion and accomplish greater effectiveness, we need to follow several principles.

- the teacher should have a coherent plan for leading the discussion in order to encourage students' higher thinking levels, although s/he should not keep to that plan rigidly because you never know in which way the discussion may develop.
- the teacher should encourage interaction among students, which does not mean that teacher–student A, teacher–student B talk, but teacher–student A, B, C,… talk, and the teacher occasionally participates in the discussion.
- the teacher leaves the role of 'instant assessor' i.e., the teacher does not confirm or disregard the accuracy of the answer. Instead, the teacher should allow students to answer or simply ask them: 'Does anyone have anything to say?' This way the students are encouraged to discuss without fear of being wrong or ridiculed.
- the teacher should provide students with more time to think. On the average, waiting for the response does not last longer than a second. If we increase the waiting time, then the level of thinking will increase, as well as the number of students joining the discussion.
- The teacher should make an effort so that all students participate in the discussion. The open discussion, without correct or false answers, the purpose of which is to encourage critical thinking and not examining for grades, will be a real technique to encourage shy students. All ideas are respected and considered important.

1.2. Conditions for the development of critical thinking

In order to encourage critical thinking in schools, the following conditions should be met:

- sufficient time and opportunities for critical thinking;
- permission for students to think freely;
- accepting different ideas and opinions;
- incentives for students' active engagement in the learning process;

- providing an environment free of risk and mockery;
- expressing confidence in every student's ability to make critical decisions;
- respecting critical thinking.

In order to start thinking critically, students should:

- gain self-confidence and understand the value of their opinion and ideas;
- actively participate in the learning process;
- listen carefully to what others have to say;
- be prepared to independently form and discard certain opinions.

The main goal is to provide students with increased opportunities for critical thinking, reasoning, problem-solving and mathematical communication. We cannot expect classroom learning to be profound or enriched if students are not regularly, actively and productively engaged in cognitively challenging tasks. We can say that their life starts with the introduction of mathematical tasks in the classroom.

1.3. Formation and development of students' skills and routines

In order to provide students with skills and knowledge and develop their routines, teaching should be directed towards the student. Such type of teaching demands more from both the student and the teacher. The student must become more active, and the teacher's role is to direct the student, select and use teaching approaches, methods, techniques and materials instead of simply providing ready-made information.

The process of forming skills and routines has its characteristics, although it follows Petrov's path of cognition. We can point out the following stages from this process:

- Explaining to students the significance of the obtained knowledge or skill through emphasising its practical value;
- Formulating rules or actualising knowledge which represent the basis for the given skills and routines;
- Indicating examples for actions by the teacher;
- Students' first exercises observed by the teacher;
- Independent exercises for the students.

The educational functions of the selected tasks motivate the process of forming mathematical skills, and they are as follows:

- Revision of concepts in order to learn them properly and permanently;
- Stating the relationship between concepts (from gender to type and vice versa, intrasubject and intersubject relationships);
- Adopting the basic rules for deduction and enabling students to use them properly,
- Forming the concept of *mathematical model*;
- Discovering processes and understanding the correlations;
- Forming skills and routines for correct oral and written expression, for both spoken and symbolical language;
- Forming skills and routines to work with tools, instruments, literature etc.

Functions that develop students' creative abilities (developmental functions) and simultaneously improve the development of skills are those that are directed towards developing students' thinking, forming qualities characteristic of scientific thinking and learning the approaches for effective intellectual work. Some of them are as follows:

- Learning the methods for scientific cognition;
- Developing abilities for inductive and deductive reasoning;
- Developing skills to carry out elementary modelling and use existing or comprise new models to learn the object's properties;
- Developing skills to classify studied objects, systemise knowledge, discover reason–cause and structural relationships between objects at the level of obtained knowledge;
- Developing skills to select the means and methods to fulfil the stated goal, in accordance to the set rules;
- Developing skills to discover the links between the studied material and the practical activities;
- Learning basic qualities typical of scientific thinking.

The particular developmental functions of mathematical tasks, which are based on 'difficulties, motivate and improve skills for solving the following tasks:

- Formation and development of knowledge and skills to deductively prove or refute mathematical statements;
- Development of skills to plan solving a given task, exclude unnecessary information from the condition, complement the condition with the missing information, choose methods, means and operations to solve the task and verify the accuracy and meaning of the obtained solution;
- Formation of clear representation for the logical structure of the mathematics course, for the fact that the abstract character of mathematics as a science is the main reason for its numerous applications in other sciences, technology and life, in general;
- Formation of skills to define mathematical concepts;
- Development and improvement of skills to quickly and accurately perform various calculations, with and without the help of technical aids;
- Improvement of skills to use the language of mathematical symbols.

Understanding that students adopt this experience in a short, generalised, structured and systemised form during the process of learning is a problem for the corresponding part of empirical and theoretical thinking of learning through which this basic task of schools can be achieved. Dialectical and bidirectional transition between the empirical and theoretical, the concrete and abstract takes place during the educational process. This dialectical transition encompasses the educational process as a bidirectional process, and the educational activity as a cognitive activity, which flows into the students' cognition.

In the classroom, where teaching is directed towards the student, students ask questions, make assumptions and provide explanations; make models, experiments, observations and research; evaluate and use solutions, data and information; plan and compare projects; and use handbooks, techniques and ICT technology. In this way, students develop skills for obtaining knowledge, logical and critical thinking as well as application of the obtained knowledge.

Development of thinking and in particular the development of mental qualities – width, depth, independence, logic, mobility, concreteness, criticism, speed, creativity, target orientation, generalisation, insight etc. – is one of the most important and consistent goals and objectives of mathematics teaching.

Simultaneously, the degree to which this aim is fulfilled determines the level and effectiveness of the teaching process for the overall development of the student's personality. An important psychological and pedagogical condition for the development of quality of thinking is students' reflexive understanding of thinking as a process and their own mental capabilities. Admittedly, this complex mental activity is not only intellectual, but also personal, and 'serves' the overall development of the individual and leads to the formation of intellectual reflection.

1.4. Tasks

1. If the pattern continues as the shown below, how many dots will be in Stage 6?

1. 1 + 6; 1 + 6 + 2•6; 1 + 6 + 2•6 + 3•6, ….

2. (a) Find the sum of first *n* numbers in two ways.
(b) Find the sum of first *n* even numbers.
(c) Find the sum of first *n* odd numbers in two ways.
(d) Make similar task and solve the task.

3. In a mathematics test, the student must solve 20 tasks. The student receives 4 points for each task that is correct, and for each unsolved or incorrectly solved task he loses 3 points. On that test, the student won a total of 38 points. How many tasks did the student solve correctly?

(a) Find a similar task and solve the task.

2. Conclusion

Mathematical tasks and solving the same are an effective tool for developing mathematical activity and creativity among students and for forming mathematical skills. Scientific methods are useful tools for creating long-lasting, structural knowledge among students. I hope that this paper will motivate many teachers and contribute to maintaining mathematical talent among students and increasing love and interest in mathematics.

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