

# Formation of Mathematical Thinking Competence in Students as a Scientific Pedagogical Issue

Kenjayeva Sanobar Ibragimovna  
*Jizzakh State Pedagogical University, Uzbekistan*

**Keywords:** Student, Thinking, Mathematical Thinking, Ability, Competence, Scientific Pedagogical Problem, Pedagogy, Education, School, Mathematics, Method, Method, Interactive Methodology, Analysis, Development.

**Abstract:** School education is a part of the continuous education system that requires special attention. The door to all the opportunities necessary to achieve the effectiveness of quality education on a global scale is being opened on a large scale. How to build a 21st century school system? such questions are also being considered at the level of global education policy. Systematic work is being carried out in the environment of digitalization of education, introduction of the most advanced methods of teaching on the basis of digital technologies related to education and training, in accordance with the standards of world education. Today, global globalization processes have an impact on the development of science, education, art, culture, sports, economy, business, marketing, construction industry, production, and so on. it is known to everyone. In particular, the processes of globalization have brought about important changes in the field of education. First of all, these are characterized by transformation processes, that is, deep, new qualitative changes in the quality, efficiency, structure, and functions of education. This article talks about the reasons why the development of mathematical thinking competence is considered as a pedagogical problem and the methods of solving the problem, as well as information about the opinions of scientists, types of thinking and existing problems in school.

## 1 INTRODUCTION

It is clear from history that education is increasingly becoming a global topic, that education can positively change people's lives and ways of living, and that it is a means of developing the country's development. Moreover, today's era of globalization, the Internet, the creation of artificial intelligence and digital We are witnessing the development of technologies.

## 2 LITERATURE

To this day, the great mathematicians Al-Khorazmi, Gauss, Pythagoras, etc., with the unique problems of developing mathematical literacy and their solutions, in the process of education and training, the use of verbal forms of mathematical calculations in solving life problems, and now E.M. Mardonov, A.H. Avezov, S. Alikhanov, M.E. Jumayev, Sh.V. Imomova, M.N. Ismoilova and others, as well as Alan H. Schoenfeld, Richard Rusczyk, Joe Boaler, John Mason, Leone Burton, Kaye Stacey, Randall

Maddox, Steven Strogatz In addition, Russian scientists Ya.I. Perelman, M.A. Bantova, A.V. Beloshistaya, G.N. Berman, S.I.Volkova, D.R. Gonchar, T.E. Demidova, I.I. Martinov and others also conducted research.

Ancient Greek mathematician Pythagoras believed that numbers and geometry could be used to understand the universe. Pythagoras and his followers were interested in the spiritual development of man. According to them, there is an inextricable connection between mathematical ratios and music, and music could be used to achieve mental balance. As Pythagoras and his followers tried to unravel the mysteries of the universe through thought, they were inspired by such fields as number, proportion, geometry, and music (Riedweg, C. 2005).

The great thinker scientist Al-Khwarazmi in his work "Kitab al-muqaballa" explains the rules of mathematics and algebra in general. It also shows operations that use mathematical ideas. The main purpose of this work is to teach the basic knowledge of arithmetic and algebra, to understand their important rules and to help learn arithmetic operations. In addition, since the work shows

methods, formulas and concepts, students are expected to understand its basic environment and methods of analysis, and it provides theoretical and practical knowledge for students to perform analysis through thinking, and to apply it in practice.

Alan H. Schoenfeld is a distinguished researcher in mathematics education who has made significant contributions to the field. In his book, *Mathematical Thinking and Problem Solving*, Schoenfeld explores various aspects of mathematical thinking and provides insight into effective problem-solving strategies. Schoenfeld emphasizes the importance of developing mathematical thinking skills in students. He believes that mathematical thinking goes beyond simple calculation and includes a deep understanding of mathematical concepts, the ability to apply these concepts in a variety of contexts, and the ability to reason and solve problems effectively. Schoenfeld explores a variety of problem-solving techniques and approaches to help students solve math problems. He emphasizes the importance of persistence, flexibility and creativity in problem solving (Alan H. Schoenfeld. 2016).

Y. I. Perelman's approach to mathematical thinking was characterized by deep intuition, rigorous thinking, and great emphasis on understanding basic concepts. He believed in the power of simplicity and elegance in mathematical proofs, often sought concise explanations and avoided unnecessary complexity. He had a critical view of the mathematical community and the culture around it. In general, Perelman's views on mathematical thinking emphasized the importance of deep understanding, simplicity, and originality. He has demonstrated the power of intuition and innovative approaches to solving complex problems (Y.I. Perelman.2016).

According to M.E. Jumayev, mathematics allows children to develop thinking, attention, memory, creative imagination, observation. Also, mathematics prepares the ground for students to improve their logical thinking skills, to express their thoughts clearly, correctly and comprehensibly. The task of the teacher is to effectively use these opportunities in teaching mathematics to children (M.E.Jumayev. 2018).

We cite several reasons why the competence of mathematical thinking is considered as a scientific pedagogical problem:

1. Complex expression of the theoretical information given in the textbooks up to this day;
2. Pupils' inability to consciously master subjects due to lack of cognitive activity;

3. The inability of graduates of general education schools to correctly choose higher education institutions in the field they are interested in;

4. Formation of students' habit of using theoretical knowledge and formulas based on memorization;

5. Failure of the school teacher to guide students according to their specific competencies;

6. Students' mathematical thinking competencies are not developed;

7. Lack of systematic planning of practical training for the development of mathematical thinking competence.

### 3 RESULTS

We believe that scientific research on mathematical thinking cannot meet the requirements of the 21st century, when technology and technology are developing, and people's lifestyles are being made easier. Because, in the above-mentioned studies, it is emphasized that students use a lot of theoretical and complex scientific information by memorizing it. This causes various inconveniences and difficulties for students in completing problems and examples. Because of this, students' interest in science gradually fades. Such a situation is considered a pedagogical problem. Today's student is quickly bored with such complex theoretical knowledge, therefore, it is necessary to develop concrete methods that develop students' thinking and thinking competencies, that is, to solve problems, it is necessary to carry out new scientific and research work on this topic. For this purpose, it is appropriate to teach students practical skills and abilities that develop the ability to easily get out of difficult life situations by giving up the memorization option and thinking. During the article, you can get acquainted with some methods of solving problems through mathematical thinking.

First of all, let's pay attention to the meaning of the word thought. Thinking is a mental process that reflects the reality of the environment indirectly with the help of speech, and is a mental activity aimed at understanding social causal relationships, discovering new things and predicting (G'oziyev E. 2002).

It is known from the basics of physiology that the cerebral hemispheres are responsible for mental activity. People with a dominant right hemisphere are more emotional, which contrasts with imaginative, abstract thinking. Such persons have a humanitarian mind. If the left hemisphere dominates, the person has more practical, analytical thinking and mathematical

thinking. In general, there are 5 main categories of human thinking:

- practical;
- artistic and figurative;
- humanitarian;
- mathematician (analytical);
- universal (synthetic) thinking.

As the title of the topic indicates, we believe that mathematical thinking is the most common type of thinking that needs to be developed for schoolchildren. Mathematical (analytical) thinking is very similar to practical thinking (Keith Devlin, 2012).

The development of mathematical thinking skills is important for students' in-depth study of mathematics. This allows students to develop thinking skills in learning science, solving problems, and solving important issues. Here are some ways to develop mathematical thinking skills:

### **3.1 Encourage Thinking in the Process of Solving Problems**

In solving mathematical problems, students should be made aware that they can face several problems and solve them easily through their thinking skills. It is also important to develop these skills. Students should be encouraged to explore and tackle problems in order to develop their problem-solving thinking skills. It involves giving students input during problem-solving, asking students for input at each stage of problem-solving, and considering a wide range of problems and taking their opinions and comments into account, making joint decisions if necessary. It is also possible to sufficiently stimulate and develop students' thinking skills.

### **3.2 Reading out Math Problems**

Reading math problems also develops students' deep-thinking skills in solving all problems. In this way, students will have the opportunity to think freely among themselves, listen to each other, and get acquainted with approaches that are suitable for their own learning methods.

### **3.3 Finding Unusual Ways to Solve Math Problems**

Math questions and unusual ways to solve problems also help students develop problem-solving thinking skills. It also directs students to new approaches to problem solving, creative thinking, self-expression, and revealing leadership qualities.

## **4 ANALYSIS**

Through mathematical analysis, students examine mathematical problems and learn to think about ways to solve them. By analyzing, students will be able to understand and solve mathematical problems more clearly, and they will be able to think about and accept specific answers, and these skills will also develop.

### **4.1 Acquisition of Mathematical Knowledge through Active Observation**

Considering the variety of existing problems in the given problem, creative approach to these problems will give rise to some thoughtful questions, of course, the students should look at these questions as serious problems, and also the questions that arise in the mind of each student will be asked by other students. must orally tell and read to the students. That is, students understand mathematical knowledge through active observation, paying attention to its smallest elements in a more accurate, comprehensive and perfect way, and also learn to evaluate how much they think and how they think by comparing with their peers. Through this method, the student learns to respect the opinion of each peer as a person and to listen carefully to them. With this convenient method, finding a solution to the problem is also a little easier. Observation is one of the main tasks for students in learning and solving mathematical problems. Students will also have the opportunity to express themselves freely, find non-traditional ways to read and solve mathematical questions and problems, and acquaint themselves with approaches that match the methods they have learned.

### **4.2 Using Various Interactive Methods That Develop Intellectual Abilities in Each Session**

This method helps students to think, to think, to increase their interest in science, to analyze, to prove, to conclude, to be active in class, to have healthy competition, to compromise with each other and to work as a team.

Regular use of these and other interactive methods and mathematical thinking skills in solving problems and issues leads to achieving high results in most cases. Of course, students need such approaches in the course of the lesson. Here, you can get a closer look at one of the famous thinker Edward de Bono's famous methods for developing different thinking

techniques and methods for creative thinking and problem solving. Called the Six Thinking Hats, this method focuses on solving problems using different thinking hats. Each hat represents a different approach to thinking. There are six different hats: white hat (knowledge-based thinking), red hat (emotional thinking), black hat (critical thinking), yellow hat (positive thinking), green hat (creative thinking), and blue hat (managerial thinking).

Such methods are a clear example of work on improving the ability to think. The use of such interesting interactive methods designed for each problem-solving process can be a great reason to dramatically increase the student's creative thinking, critical thinking and problem-solving skills.

## 5 RESULTS AND DISCUSSION

It is known to everyone that the quality and content of the lessons conducted in the school are of particular importance in achieving the effectiveness of education. Therefore, it is appropriate for us to pay great attention to the organization of lessons at school. It is precisely the development of students' mathematical thinking competencies that is considered as a pedagogical problem in the school. Why here? the question is appropriate, of course. Not only mathematics, if we consider all subjects, schoolchildren cannot fully master subjects in class, and this process continues until the students graduate from school. At the same time, the student graduates from school. The result is not long in coming. It would be correct to say that the results of the entrance exams for higher education, which are held every year in the summer season in our country and continue in a traditional manner, shed much light on the issue. It is not difficult to understand what we want to say, just thinking about it is enough. If we take a closer look at the issue, the following questions and thoughts will certainly arise:

- what percentage of school graduates correctly choose a higher education institution that matches their interests;

- is it possible to compare the knowledge of the students from the general education school and the knowledge from the private educational centers;

- why do parents think about which school to send their children to, that is, it differs greatly from school to school;

- are there specific methodical manuals on ways to develop the thinking competencies of schoolchildren.

In the era of rapidly developing information technology, we are witnessing the continuous development of innovations and changes in science, education, technology, telecommunications and all other fields. These processes also have an impact on general education schools. That is, attracting the attention of today's students to education is considered as a problem. The reason is that the tools that distract students' minds and imaginations, social networks, internet games, the increasing desire to earn money from childhood, lack of interest in reading books, lack of self-confidence, some parents the consequences of disrespecting mothers, teachers, etc., easily keep them away from school, education, and thinking. Because of this, we, as a community of pedagogues, should be enthusiastic as a spreader of knowledge, a teacher of spirituality and cultural manners.

In the implementation of work aimed at students' education at school, increasing their interest in science, and developing their thinking skills, radical changes and new textbooks were developed aimed at teaching each subject from the initial stage of education. Among other things, this article also serves to solve the problems of developing students' mathematical thinking competence.

It can be said that the subjects taught in general education schools are very important for the student to become a well-rounded person in all respects and gain his place in society. In particular, if we look at the example of mathematics, mathematical elements are taught to children from the kindergarten age, this knowledge is developed in general education school, academic lyceum and later in higher education institutions and serves them throughout their life. As time goes by, the role of mathematics in life is expanding, and its branches are also increasing. Today, our way of life cannot be imagined without mathematics. If we pay attention to the lesson loads of general education schools, the largest hour of the lesson is allocated to mathematics. The role of mathematics in the development of students' mathematical thinking is incomparable. More specifically, developing mathematical thinking skills today requires students to use multiple methods to develop their thinking skills in solving mathematical problems (Kenjajeva S.I.).

## 6 CONCLUSION

The above-mentioned methods of developing mathematical thinking skills teach students to think broadly and speak freely when solving mathematical

problems, and also encourage them to analyze mathematical problems, think, and work with basic mathematical interactive activities. and we can say that it creates ample opportunities for deeper learning of mathematics and brings students' mathematical thinking skills to a high level. In particular, the use of the last method mentioned above, i.e. "Using different games, crosswords, puzzles and interactive methods in each lesson" is one of the most common methods in Finnish education, and it helps to develop students' mathematical thinking competencies. aimed at development. But this method is not widespread in our country. Because teachers use such activity only in open classes held twice a year. The method we would like to propose is that each teacher, in each lesson, should use a standard teaching method (taking attendance, asking for homework, explaining a new topic, reinforcing, evaluating and taking home) in order to develop students' mathematical thinking. assigning a task) should be abandoned and based on a new approach, create lessons consisting of interactive methods, puzzles, energizers and games. During the explanation of the topic, it is necessary to use real life examples, if necessary, with the help of questions, it is necessary to ensure that the students themselves participate in this process. For example, it is very easy to explain numbers from 1 to 9 and 0 to them based on real-life examples when introducing elementary school students to numbers. If we look at the example of the number 1, the creator of us is one, the moon, the sun, mother, father and country are one, and if we explain using certain examples from the environment that surrounds us, such as one life to live, then the number 1 means solitary in the minds of the students. meaning will remain forever. In the process of explaining the topic "Positive and negative numbers", examples of positive and negative characteristics of people in life, in the topic "Derivation", explaining the first process of clothes made of pure cotton, in the topic "Graph of a quadratic function", electric wires, argimchak, in the topic "EKUB and EKUK" using the general characteristics of family members, parents and children, in the topic "Circle and Circle" using examples such as car wheels, ball, watermelon, to show that each topic is related to life and why students' thinking skills can be developed by explaining the need.

Today, using the experience of Finnish education, which shows the highest results in PISA and PIRLS assessment programs worldwide, has created a specific system in its education system and is an example for other countries, more than 10,000 schools in our country. It can be the basis for creating

equality, healthy environment and alternative education among students in educational schools. We will cover the information about the use of interactive methods in the next articles.

## REFERENCES

- Jumayev M.E.. Boshlang'ich sinflarda matematika o'qitish metodikasi. – T.: Fan va texnologiya.- 2018. – 350 b.
- Perelman Y.I.. Qiziqarli matematika. – T: Sharq. – 2016. – Tarjimon: A.T. Xo'jaxonov.
- G'oziyev E. Umumiy psixologiya psixologiya mutaxassisligi uchun. O'quv qo'llanma II kitob. – T., 2002. – 93 b.
- Alan H. Schoenfeld. (2016). *Mathematical Thinking and Problem Solving (Studies in Mathematical Thinking and Learning Series)* Mahwah, New Jersey, USA.
- "Introduction to Mathematical Thinking" by Keith Devlin. 2012.
- Riedweg, C. (2005). *Pythagoras: His Life, Teaching, and Influence.* (W. H. Kluback & M. E. Pomeroy, Trans.). Cornell University Press. (Original work published 2002)
- De Bono, E. (1985). *Six Thinking Hats.* Little, Brown and Company.
- Kenjayeva S.I. umumta'lim maktabining ta'lim sifati samaradorligini oshirishga kompetensiyaviy yondashuv. - <https://jdpu.uz/umumtalim-maktabining-talim-sifati-samaradorligini-oshirishga-kompetensiyaviy-yondashuv/>.