PEDAGOGICAL CONDITIONS FOR OCCURRING PROBLEM SITUATIONS OF THE EDUCATIONAL ACTIVITY IN MATHEMATICS

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Abstract: This paper is about the pedagogical conditions necessary for emerging problem situations with mathematical content. The conception of problem implementation in the education is not new. Its sources might be found in the famous Socratic Method of finding the truth or in Diesterweg and some of his predecessors. There are other discussions for the presence of the problem by Skatkin and Babanski however in the form of problematic education.

Problem-based learning itself is perceived as a developing learning, in which the system of training methods is built to cause self-seeking activity by students. Problems in training, on the other hand, relate to the objective problems of the curriculum, its problematic teaching and the problematic nature of the cognitive activity of the students. It is part of the overall training system. Problems in learning may only exist under certain conditions that affect the content of the subject, the teacher's ability to adapt the teaching material and the ability of the learner to develop independent cognitive activity.

Learning is a specific cognitive process. This means that the problem in its process is not the same as the problem of thinking and knowledge in general. The didactic problem, unlike the theoretical or practical one, is described as a learning character, and it is created for learning purposes. This peculiarity of didactic problem situations does not mean that they exclude the solution of real theoretical or practical problems.

Unlike life, the learning problems that are solved in the process are distinguished by their conditionality or even "artificiality". This conditionality is due to their compliance with the aims and content of the training, the level of pupil readiness and other didactic requirements. Thus, in no way, the value of didactically problematic situations is reduced, but on the contrary, it strengthens it because it makes them highly specialized.

The use of problematic situations in training leads the student to cease of being a passive consumer of knowledge. A certain amount of knowledge he acquires through his own cognitive activity, as well as assimilation of ready conclusions of science, he is given the opportunity to carry out some or other operations and make discoveries accessible to him. With the help of the problematic situations, according to Mahmutov, the teacher "by providing the necessary guidelines organizes the learning activity of the students so that on the basis of the analysis of the facts they can independently draw conclusions and generalizations, formulate (with the help of the teacher) definitions of concepts, rules ... or independently to apply their knowledge in a new situation". (Махмутов /Mahmutov/ 1975:82).

Depending on the pedagogical learning process, problematic situations can arise either naturally, or be deliberately created. In the first case, the new knowledge that is acquired is random and without any consistency. In the second case, however, the knowledge that the subject acquires is determined, with a predetermined educational nature and a system of previous knowledge already acquired. That is why the didactic problem situations in the educational process are assessed significantly higher than those that occur at random, defined only as problematic situations.

Keywords: problem, problem situation, occurring problem situations

1. INTRODUCTION

The presence of problematic situations in mathematics education requires understanding the nature and peculiarities of science itself.

From a historical point of view, the process of learning mathematical knowledge by all students was motivated by the belief that acquiring this science helps students to master how to think and apply that in solving everyday problems. It was believed that by studying mathematics the trainees would develop their cognitive abilities.

In this respect, the students' understanding of the essence of mathematics science allows them to discover and understand new situations, to dig into mathematical knowledge from where to derive terms and concepts, methods and ideas and to adapt or modify those ideas that can address new problem situations.

Mathematics training is characterized by a high degree of processuality, which is expressed in the task solving activity. In view of this particularity, A.M. Matyushkin (1968) very precisely identifies the problem situation as the interaction of the subject with a particular task. However, in order for this interaction to take place, the problem itself must first arise.

2. CONDITIONS FOR OCCURRING PROBLEM SITUATIONS

In pedagogical literature, there is no unity in how to create conditions for problem situations. Individual authors point out different ways and means. L. Lopovok (1974) considers that a problem situation is necessary to have several basic conditions concerning the enunciation, formulation and the essence of the problem problem.

The formulation of the problem task / question should be available to students ie. terminology to be close to their life experience. It is necessary for the problem to be characterized by a relative difficulty, but not to have an overly intrusive structure and the problem that has arisen should be of interest to the students.

With regard to the mathematical education process, the choice of means to create conditions for problem situations depends on the learning material. L. Portev (1983) makes a detailed classification of the possible ways of occurrence of problematic situations in the lesson of mathematics:

1. conducting experiments;
2. Making generalizations along the path of analogy, induction, deduction;
3. Logical organization of mathematical statements;
4. optimal selection of mathematical tasks;
5. use of situations known from the life practice;
6. applying the studied material in a new way;
7. Assign students to practical tasks;
8. use in the process of training involuntary or deliberate mistakes.

The semantic meaning of the word experiment consists in observing a deliberately triggered, under certain circumstances, phenomenon, the purpose of which is to confirm or reject a hypothesis. The essence of mathematics as a deductive science excludes the broad possibility of conducting experiments, but they still find their place in this direction. An experiment in mathematics training involves an activity that creates conditions for verifying facts and relationships studied. This type of activity mainly involves performing measurements, constructing, calculating, solving tasks in private cases.

In mathematics, analogy, induction, and deduction are widely used. The analogy can be used to create problem situations not only for gaining new knowledge but also for formulating summaries. Normally new knowledge is derived from knowledge already known (theorems and rules), and the summary is based on the formulation of tasks similar to those previously resolved but of a similar nature. Induction and deduction also play a major role in reaching new knowledge, they confirm or reject the hypotheses.

The logical organization of mathematical assertions as a condition for the occurrence of a problematic situation can be considered in two aspects. The first concerns the formulation of a statement back to the one given. If it is known that each rectangular triangle has a right angle it can be formulated the opposite statement that each rectangular triangle has two angles that are not right. The second aspect concerns the already built up skills for making counter-claims, if such skills are faced, the problematic situation arises from seeking ways to prove them.

Appropriate task selection is an important condition for problem situations. The well-chosen task can serve as a means of motivating students to further expand their knowledge. In order for a mathematical task to cause a problem situation, its decision must be irrational or students can not solve it with the available knowledge.

Students' life experiences can create conditions for problem situations when this experience is associated with mathematical knowledge. The mathematical knowledge itself is given to students by being bound by real life situations. That is why life experience provides a wide range of opportunities for learning problem. Creative activity is particularly important in the process of learning mathematical knowledge. "Imagination and creativity are the two leading dominants who direct the pupil through the path of knowledge" (Stamenova 2015: 295). Placing creative tasks is one of the issues of problem situations, because "the creative product implies creative intellectual activity" (Stoimenova 2005: 28). Generating such activity is also a condition that causes a problem situation to occur.

Applying knowledge already acquired in situations other than those in which they are acquired are a prerequisite for the emergence of creative processes that are fundamental to problem situations.

Assigning practical tasks to students can also cause a problem situation. Most often these are tasks for making patterns of geometric shapes, compiling tables, constructing graphics and plans.

Often, in the process of solving simple tasks, students make mistakes, of practical or theoretical type. Clarifying these errors is a process that can provide the conditions for problem situations by asking problematic questions or compiling a task similar to the one they solve.

According to M. Mahmutov (1977), problematic situations arise under the following conditions:

- when pupils do not know how to solve the task and can not answer the question asked;
- when students need to use previously acquired knowledge under conditions other than those in which they were acquired;

- when a contradiction arises between the theoretical possible way to solve a particular task and the inability to implement it in practice;

- when there is a contradiction between a practically achieved result and an inability to justify it theoretically.

The abovementioned possible conditions for the occurrence of problematic situations in mathematics education are common and are characterized by a certain degree of generality. One of the main conditions for problem situations that is related to specific internal relationships in one situation is the presence of contradictions.

3. CONTRAINDICATIONS AS A CONDITION TO PROBLEM ARISING SITUATIONS

When examining the question of the essence of the learning process, an impression is made by many authors that it is a process built on contradictions. M.Danilov (1957) examines the nature of the contradictions in the educational process, identifies them as the main driving force, a statement supported by the Polish pedagogue K. Tomashevski (1989).

The nature of contradictions may be different, and when they concern the learning process, they can be systematized. V.I. Voytulevich (1949) categorizes contradictions as follows:

➢ Controversy between the logical structure of the exposition of the study material and the illogical way of learning it by the students.

➢ Controversy between the verbal exposition of the study material and its complete understanding by the students.

➢ Controversy between creative knowledge and its application in students' practical activities.

➢ Controversy between new knowledge and those already in use.

These contradictions reveal individual aspects of the incompatibilities that characterize the learning process but do not provide an opportunity to identify the underlying contradiction.

This question clarifies M.Danilov (1957) who concludes that the driving force in the learning process is the contradictions between the various theoretical and practical tasks involved in the learning process and the level of knowledge, skills and habits available.

The author clarifies that, in order for contradictions to occur, however, the following conditions must be existing:

1. The student understands the difficulties that faces and needs to overcome them.
2. Difficulties to take into account students' cognitive abilities.
3. Existence of logical connections in the examination of discrepancies.

The question of the contradictions in the training process is also considered by the Russian philosopher E. Ilienkov (1974). He criticizes this learning process, which only provides a certain amount of knowledge to students and develops memory by requiring knowledge to be memorized rather than rationalized. The author questions the need to develop thinking by creating contradictory situations in the learning process.

Human consciousness also hardly perceives the contradiction as a unity of opposites, it studies the opposite sides of the object of knowledge separately. First, a process of separating the components of the object of contradiction is performed, and then the process of joining the individual parts to build a complete vision for the object.

According to B. Kedrov (1983), knowledge is contradictory, on the one hand, because the internal nature of phenomena is contradictory and on the other, because the contradiction itself develops by dividing the parts that are studied and then regaining their unity. From the stated above follows that without the preliminary analysis of the individual elements of the contradiction it is impossible to construct an objective mental image, making a synthesis. The principle of separating a phenomenon into its constituent parts is an essential feature of the dialectical method.

The generalized image, as a result of the processes of analysis and synthesis, forms itself as a concept. From a dialectical point of view, the concepts also relate to each other in a system of contradictions. The main contradiction of the concepts is that they represent the unity of the objective with the subjective. Subjectivity is expressed in the abstract perception of objects, and objectivity - in the overall process, result, trends and sources. It can be said that objectivity refers to content, to the logical reflection of reality, while subjectivity affects the form, everything conditioned by man's consciousness.

When it comes to the learning process of importance there are not any, but dialectical contradictions. G. Batishtev (1963) defines them as a form of heuristic movement of thought from discoverable antinomies (two mutually exclusive contradictions that can be logically proven to be correct). The dialectical contradiction can also be seen as a process of acquaintance with the objects reflected in the thought-based activity, broken by the inherent contradictions that arise in the process of knowledge.

Apart from the dialectical in the process of knowledge, contradictions may arise from another type. The Russian philosopher E. Ilienko (1974) considers objective contradictions as a reflection of the set of subjective-theoretical and logical contradictions that arise from the process of solving theoretical problems. From this point of view, dialectical contradictions are reflected in consciousness in the form of logical contradictions that are perceived by the subject as a theoretical problem.

The issue of contradictions is seen not only from a philosophical point of view, but also from a psychological point of view. V. Zabotin (1967) considers that logically it is not possible for contradictions to be the source of problematic situations. According to him, contradictions are not a source of knowledge development, because following the logical thread, the two opposing statements must be destroyed (neutralized).

The nature of the contradictions revealed by the philosophers allows educators to use them as a means of developing active students' thinking. In the didactic context of the educational process, the contradiction is the basis for the occurrence of problematic situations.

In mathematics, the contradiction is reflected in the definition and uncertainty of the content side of the problem situation. It arises and, at the same time, is an expression of indefinable mathematical knowledge in certain textual content.

In the mathematical education process, the teacher provides problematic situations using his / her life experience. He chooses an appropriate problem situation that is most often of a bitter nature and whose nature he understands. It interprets this situation according to the learning objective and the mathematical learning content to be learned. Then the life situation is mathematized as a set of specific objects and data in arithmetic or algebraic dependence. The ordinary situation becomes problematic with the help of a contradiction that the teacher adds to the content of the situation. The final problem situation with mathematical content is presented to students.

The competence of the teacher and his ability to restructure certain situations in mathematically problematic situations is one of the basic conditions for the occurrence of problematic situations.

CONCLUSION

The learning process is an extremely complex activity, combining appropriately selected methods, tools and learning approaches. Each of them can be used to provide conditions for problem situations. These conditions in mathematics training allow the problem situations to occur and identified as an object which students will manipulate in their learning activities.

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