UDC: 37.091.3:159.954

# PROBLEM-BASED LEARNING AS A MODEL IN A CREATIVE LEARNING

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**Abstract**

Creative learning represents an issue that continuously becomes part of pedagogical and psychological treatments. Frequent and rapid changes, enrichment of knowledge on social and natural phenomena, make it impossible to include all knowledge in the curriculum. For this reason, it is more than necessary to apply creative models in the learning process, to enable students to permanently deal with the changes and problems associated with change. Various didactic modalities have been implemented, some of which have been very successful. This paper deals with problem teaching, from a psychological and didactic methodological point of view, accompanied by problem-solving models from the field of mathematics. Although problem-based learning as a creative model is applied in the treatment of contents of all fields and it finds wider application in the solution of logical/textual mathematical tasks. From the didactic point of view, problem teaching has several stages. Proper exercises when solving a problem create an experience, enabling students to solve subsequent problems.

*Keywords*: problem learning, concentration, students' creativity.

## Introduction

In everyday life, we are rarely free from facing situations that require solutions. In these cases, one is always looking for the most appropriate way to overcome the problematic situation. In the process of teaching, in schools, students are usually asked to solve tasks and problems according to a certain rule or according to an algorithm, known as common problems. Sometimes students are also faced with problematic situations for which there is no approach known or suggested by the task; instructions for the task or any example according to which the problem would be solved. In this case, we are dealing with unusual problems, which often lead to decreased concentration and self-confidence, which strengthens the students' misconception that problem solving is a feature of only certain individuals. Logical tasks, text tasks, usually represent a barrier between the subject/student and problem-solving. Program goals and strict mathematical rules often do not focus on how to solve the situation and instead always refer to the result. The mathematical rule says that one plus one equals two and that every other result is wrong, both three and one hundred would be wrong. This exact rule has enabled the loss of students' interest in dealing with problematic situations because the way of solving the problem has been reasonable yet the result, wrong, due to a random moment of distraction or a case error (one might say even an honest mistake).

Problem-solving requires a higher intellectual engagement, analyzing all possible ways and means to achieve the goal. People, even though they go to work every day, often put themselves in a dilemma, to cross the shortest road with traffic lights or to fall around the traffic load even though they have to take a longer road. And no matter how they decide, depending on which way they decide to go, they sometimes regret it because every day has its unpredictable parts.

This justifies a more flexible approach to problem-solving, accepting results, and focusing on possible omissions or mistakes, to avoid them further.
Skills for flexible problem solving and manipulation with new information, as well as logical thinking, linking all aspects of knowledge, is not only the need of certain individuals but an issue that concerns the whole population. It seems that in many countries, as soon as people hear the name Mathematics, their behavior is followed by the answer that it is intended only for specific people and not for everyone. We encounter these prejudices in students and adults, and even in the teachers themselves, who in the majority of cases replace secondary subjects with mathematics. This action ensures the strengthening of the refusal to learn mathematics. The opposite effect of purpose is part of the daily routine of school work. The saying, "Unless you learn math, there is no physical, figurative, or musical education", is common in the lower elementary school cycle.
The rapid development of all spheres of life lays the need for training individuals to deal with the problems of everyday life. Proper planning of actions and the most rational approach to new states and situations. Many of the problem situations represent peculiarities, which require original solutions. In these cases, individuals utilize previous experiences in dealing with and solving problem situations, developing their creative skills, especially critical thinking. Today, in the content of the program goals of all subjects, the primary feature is: Development of healthy individuals, who will be able to cope with frequent changes, will know how to deal with problems and come up with solutions for them.

**Stages in/of problem learning**

Teaching practices have proven that the acquisition of knowledge alone is insufficient for the formation of the individual, therefore the focus of teaching should be focused on the issue of what we can do with what we know. Different learning models have been developed to achieve the most successful learning content while helping students develop problem-solving skills. Problematic learning, as a creative model of learning, continuously increases the interest of teachers.
The progress of work during problem-based learning, as a model of creative learning, goes through several stages, including:
a) Problem definition - creating problem situations. This stage is characterized by the activity of the teacher, who defines the problem.
b) The presentation of hypotheses is the next step in compiling the problem situation (task). Students give different opinions about the problem situation. It is preferable to involve more students in this phase.
c) Problem decomposition means dividing the global problem into smaller units.
d) Problem-solving represents the key part of each student's individual work. The problem is solved by checking the hypotheses.
e) Completion. At this stage, general conclusions and discoveries are given.
f) The application of conclusions in new situations enables the control of the acquired knowledge. This is accomplished in new and practical tasks.
g) Evaluation of results and organization of the working process (Stevanovic, 2003:213-214).
The process of problem-solving is functionally related to the process of critical thinking, and such thinking enables one to know the laws of nature, society and apply them in the process of his active action (Zylfiu, 2002:291).

## The importance of attention in problem learning

The activity of the individual towards objects, towards phenomena, towards the relations of the outside world and himself is closely connected with the attention of the individual. All the psychic processes of the individual are closely connected with the attention; the knowledge of different objects, phenomena, processes, and relations between them, the different forms of the individual's behavior towards them, as well as the experience of different types of their feelings are inseparable from the individual's attention. When solving problem situations, the direction and concentration of psychic and psychomotor activity in a specific content are required. Not only the thought process but also the learning process and the memory process rely on the individual's attention (Nushi, 2002:224). For some types of learning, such as vocabulary learning, problem-solving learning, as well as learning skills and habits, attention is an important learning factor; the success of learning depends on the direction and focus of the content and the purpose. Success or failure in problem-solving largely depends on the orientation and concentration of attention. Sometimes it is necessary to examine the problem and read it until it becomes clear. For primary school students, the reading speed and comprehension capacity of the read text can be a crucial cause for the inability to solve the problem.

Therefore, apart from the fact that the text should be properly worded and easy to understand, it should be read several times by the student until it is concluded that the situation presented is understood, then onto finding ways to solve it. In this case, it should be noted that attention is the decisive factor in understanding the situation and solving the problem.

## The importance of assessment in problem learning

The results from the inspection and evaluation of students' achievements are done in writing (from the first grade to the third grade), combined (fourth grade, fifth grade, and sixth grade), and numerical (seventh grade, eighth grade, and ninth grade). Students are also numerically evaluated during secondary education. The grade, especially numerical, often does not reflect real achievements, in many cases negatively affecting student motivation.

In problem-solving learning, research work and the engagement of psychic processes to find problem-solving represent the uniqueness of this learning model. In certain cases, even though the student has followed the real paths, has discovered the solution of the enigma or mathematical problem, it ever so happens that during the execution of the simplest mathematical operations, due to speed, distraction, or lack thereof of attention they slip and thus reach a wrong final result. Teachers, relying on the wrong result, mark the whole student's work as wrong, without even noting in the personal evidence where the student went wrong.

Following up we present the results from the solving of the same mathematical tasks/ problems by three students of the same class. Out of the 20 tasks:

- Student A solved 13 tasks, all of which were correct;
- Student B solved 17 tasks, of which 13 were correct (uncertain during subtraction);
- Student C solved all the tasks, of which 13 were correct (uncertain in subtraction and very nimble), (Matijevic, 1996:156).

Based on these results, it is clear that there are three students between whom there are obvious differences, and who need different treatment when it comes to teaching. Student A needs help to increase the speed of solving tasks, student B also needs to improve speed as well as to practice subtraction, and student C needs to practice subtraction and change some essential characteristics, especially to be more attentive and careful. Such differences between students are encountered in all pedagogical activities, therefore the teacher must individually follow the development of students by noting in their own evidence the essential characteristics of development and progress of students. According to the results above, based on the evaluation aspects in schools, students A, B and C would be evaluated with a sufficient grade, and in the case of a slightly more tolerant teacher with a good grade (3). The case of student C must be looked at in other aspects as well, i.e. it must be ascertained where he went wrong. There is a possibility that he treated the problem correctly and made a mistake during subtraction due to carelessness resulting in an incorrect figure.

In the following, we present the results from the solution of mathematical tasks/problems of three students of the same parallel. From the 20 tasks set:

- Student A has solved 13 tasks, all correct,
- Student B has solved 17 tasks, of which 13 correct (uncertain during the descent),
- Student C has solved all the tasks, of which 13 were correct (uncertain in descending and very agile).

Examples of solving mathematical problems following the stages of problem learning

Example no.:1

In a class of 36 students, everyone is required to learn only one of the following languages: German, English, or French. As part of extracurricular activities, a certain number of students decide to learn another language, one of the aforementioned languages. Thus, 22 students learn English, 20 students learn French and 20 students learn German. Out of these students, 9 students learn English and German, 7 students learn English and French. (Trenceski, 1994:2-3).

Task: How many students learn only one of the languages and what are those languages?

Solution: To solve the problem posed we will use the stages of problem learning.

Creating a problem situation. At this stage, we rely on the students' knowledge. The presentation of the problem situation by the teacher is very important. The class has 36 students, of which 22 students learn English, 20 students learn French and 20 students learn German. Of these students, 9 students learn English and German, 7 students learn English and French. How many students learn only one language and what are those languages?

Definition of the hypothesis. After discussion and giving opinions by some students, it is found that according to the condition of the assignment, none of the students learn all three languages, and so we subtract the number of students who learn German and English (9), and French and English (7) from the number of students who learn English (22). In this case, we will have 22-9-7 = 6. This is the number of students learning only English. From the set task, it is noticed that no student learns all three languages.

Decomposition of the problem. This stage means dividing the problem into smaller units. In this case, the problem can be posed through the Venn Diagram (community A students learning English, community G students learning German, and community F students learning French). Since some of the students are learning two languages, then we have community intersections. From the set task, we derive the known findings. In this case, we have: $A \cap G = 9$, $A \cap F = 7$. From the total number 36 we subtract the number of students learning English 22, we will have 36-22 = 14 students for whom we are sure do not learn English.

Solving the problem. At this stage it should be defined how many students learn only German and how many only French. Student activity is individual. According to the preliminary phase we have: F. 20-7 = 13 and G. 20-9 = 11. Then we find the number of students who learn French or German or both languages at the same time: 13 + 11 = 24. From this number, we subtract the number of students who learn only English (14) and we will have 24-14 = 10. This is the number of students learning both German and French, meaning it represents the intersection number of the communities G and F ($G \cap F$).

Conclusion. Students that only learn French are 20-10-7 = 3, German-only 20-10-9 = 1.

Execution. 6 + 3 + 1 = 10 students learn one language only.

Evaluation. 22 students learn English, 20 learn French, 20 learn German, A∩G═9, A∩F = 7, G∩F = 10; 6 students learn English only, 1 student German and 3 students French only.
9 + 7 + 10 + 6 + 1 + 3 = 36
36-26 = 10 students learn only one language.

The solution to the Venn Diagram problem looks like this:

Example no.: 2
Task: The ages of a grandmother and her granddaughter add up to 75. How old is the granddaughter if the grandmother is four times older than her?
Solution: To solve this problem we can use the line technique. Students must have learned the operations of multiplication and division, as in problematic learning the students' skills must be respected. In this case, the task is intended for a minimum of third-grade students.
Creating a problem situation. The grandmother is four times older than the granddaughter. They have been together for 75 years. How old is the granddaughter? How old is the grandmother?

Decomposition of the problem. Which years give the sum of 75? What are the numbers that make up the sum called? The granddaughter years will represent one adder, and we will mark it with a line (-). We look for grandma's years with the questions: How many times is the grandmother older than the granddaughter? Four times, therefore the next collector will be marked with four lines, which will represent the grandmother's years.
Definition of the hypothesis. Years of the granddaughter (-), and the years of the grandmother (- - - -) give the sum 75.
Solving the problem. The four lines showing the years of the grandmother added to the line, indicating the age of the granddaughter, are equal to 75. That is, we have a total of 5 lines which give the output 75. 5x = 75; x = 75/5; x = 15.
Conclusion. A line is equal to the years of the granddaughter, that is, a line is equal to 15 years.
Implementation of conclusions. We can conclude that the girl was represented by a line and is 15 years old, whereas the grandmother's years are equal to four the sum of the four lines.
Evaluation. The years of the granddaughter (15) added to the years of the grandmother (4 * 15 = 60) give the result 75. 15 + 60 = 75.
Example no: 3
Task: The father is three times older than the son, and the son is three times older than the sister. How old is the father if he and his daughter are 50 together?
Solution: Similar to the previous task we can solve this task using the line technique.
Creating a problem situation: According to the task, we have the sum of the years of the daughter and the father, while the years of the son are not included in the given amount. How old is the girl? How old is the father?
Hypothesis submission: The years of the three people are more than 50, since the result of the problem posed does not include the boy's years. The father may be nine times older than the daughter.
Decomposition of the problem: We will mark the years of the three individuals using lines. Since the girl is the youngest we will mark her years with one line (-), the years of the boy with three lines (- - -), because he is three times older than the girl, and the years of the father with nine lines (- - - - - - - - -), because he is three times older than the son.
Solving the problem: We collect the lines representing the daughter's years with the lines representing the father's years. 1 + 9 = 10. According to this, it is found that 10 lines are equal to 50. The quotient of the numbers 50 and 10 will represent the years of a line, i.e. the years of the daughter which we multiply by the lines representing the years of the father and discover the solution of the task. 50/10 = 5; 9 * 5 = 45

Conclusion: The father is 45 years old and the daughter is 5 years old.
Implementation of the conclusions: Since a line is equal to five years, then we have: the daughter is 1 * 5 = 5 years, and the father 9 * 5 = 45 years.
Evaluation: The years of the daughter together with the years of the father give the number 50. 5 + 45 = 50.

## Conclusion

In problem learning, there's always a problem between the subject and the solution, the solution of which requires a higher psychic engagement. In presenting problem situations and solving problems, the individual possibilities of the subject should be respected, because the lack of prior skills and knowledge negatively affects the development of problem-solving skills and abilities. Students have the wrong belief about their inability to deal with problematic situations, so this learning model, in most cases requires the application of individual form. Proper problem posing, clarification of any less understandable notions, and student support in problem-solving is a permanent requirement. Through exercises, training for individual solutions is achieved. In this case, we must remember Descartes who stated that: "Every problem I have solved has become a rule, which has served me to solve other problems".
Problem teaching is expressed in all areas of learning, especially in the teaching of mathematics. For this reason, students face this learning model from the first grades of primary education, which represent the basis of further logical and critical development. This approach to problems greatly develops students' creativity and creative abilities, as essential pedagogical requirements for the development and training of individuals for life and work.

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