SYSTEM OF CRITERIA AND MEASUREMENT INDICATORS FOR MEASURING ABILITY TO SOLVE MATHEMATICAL PROBLEM SITUATIONS OF STUDENTS IN THE INITIAL CLASSES

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Анотация:

Овладяването на умения за решаване на математически проблемни ситуации от ученици от началните училища позволява такива ситуации да се използват като средство за активиране на учебните дейности. Правилният избор на проблемни ситуации зависи не само от учителя, но и от нивото на умения за решаване на проблеми, които учениците имат. Това налага да се диагностицират уменията за решаване на математически проблеми.

Ключови думи: **ситуация, проблемна ситуация, диагностика на умения за решаване на проблеми.**

Аннотация:

Овладение навыками решения математически проблемных ситуаций учащимися начальной школы позволяет использовать такие ситуации в качестве средства активизации учебной деятельности. Правильный выбор проблемных ситуаций зависит не только от учителя, но и от уровня навыков решения проблем, которыми обладают ученики. Это делает необходимым диагностировать навыки решения математических задачи.

Ключевые слова: **ситуация, проблемная ситуация, навыки диагностики проблем.**

Abstract:

Mastering skills to solve mathematically problematic situations by primary school students allows such situations to be used as a means of activating learning activities. The correct choice of problem situations depends not only on the teacher but also on

the level of problem solving skills that pupils have. This makes it necessary to diagnose math problem-solving skills.

Keywords: **situation, problem situation, diagnoses problem solving skills.**

Modern and creative learning aims alongside the building of a harmoniously developed personality and mastering a multitude of multi-dimensional knowledge. It is not by accident that the curriculum is built up of a variety of different disciplines. A mature place among them is mathematics, which in primary education is identified with a basic building block of mental development. Mathematical knowledge is specific, and although characterized by a certain abstraction, it is applied in very real and specific life situations. The transfer of the distant and the abstract to the close and the concrete is realized thanks to the modeling by creating in the learning environment models of real life situations. Students respond to these "patterns" and apply the knowledge, skills and habits learned during the educational process to master the specific situation. Mathematical training itself, however, is not aimed only at mastering certain situations of mathematical type, it seeks to teach students how to apply the mastered mathematical knowledge in all life situations.

Translated into the math language, problematic situations turn into mathematical problems or mathematically problematic tasks. In primary school mathematics, a large part of the tasks are solved on the basis of rules already studied. The significance of these standard rules is that they target the student in the relationship between the objects through which the solution will be found. If it is known what links are needed to solve a specific task, it does not lead to a new discovery. The process is algorithmic and leads to a quick and accurate answer. Problem situations prevent this process and force students to use learned rules in strange and atypical situations. Using heuristic methods, problem situations are solved to allow the full potential of mathematical knowledge to be unleashed by mastering psychology and the technology of applying mathematical type information in different types of situations. In order for the problem situations to be effective, it is necessary that the students in the first grades have mastered the skills to solve such situations. The availability of such skills as well as the assessment of their degree of absorption can be determined using diagnostic procedures.

In order to fully diagnose the ability to solve mathematically problematic situations, it is necessary to create a system of criteria and indicators to diagnose and evaluate this skill as a whole. The value of these results gives a general idea of the level of the problem solving skills utilized.

The system for diagnosis and assessment of the ability to solve problematic situations is based on a model of the system for diagnosis and assessment of cognitive and

creative skills which is proposed by B.Todorova. The main criterion in this system is the formation of the relevant skill (Figure 1)

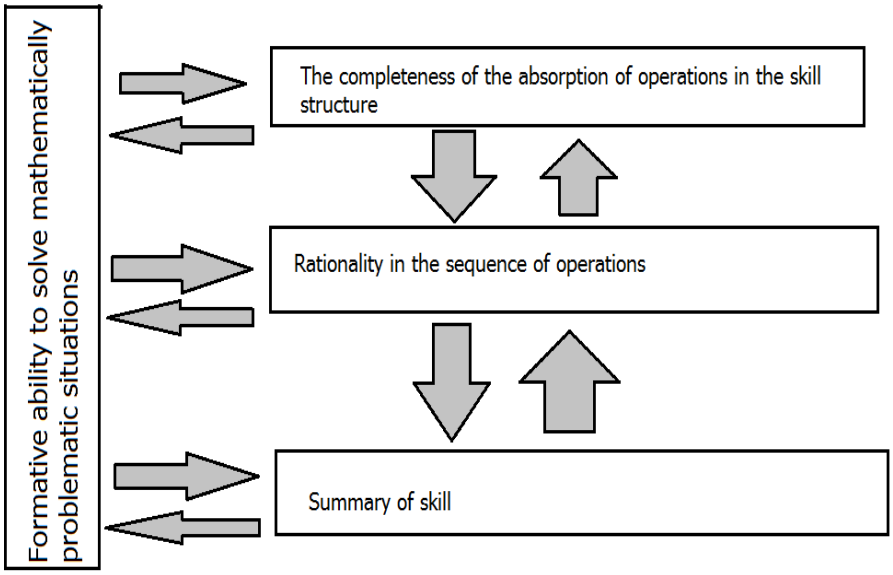

Figure №1 A system of criterion and assessment for diagnosis ability to solve problematic situations

The main criterion also includes relevant indicators that are consistent with the skill development stages mentioned by V. Razumovski (1984), which are completeness of the absorptions of operations of the skills, rationality of the sequence of operations and summary of skill.

The completeness of the absorption of operations in the structure of one skill is an indicator of the degree of absorption of both individual operations and the skill itself as a whole. To determine the completeness of problem solving skills, a fullness of the absorption coefficient is used.

$$Kc = \frac{\sum_{i=1}^{N} n_i}{N.n}$$

Kc- coefficient of completeness of the absorption operations
ni- number of absorbed operations of i student
N- total number students , which absorbs the problem solving skills
n- total number operations in structure of the skill

The coefficient of completeness of problem solving skills is determined by the ratio of the number of operations absorbed in the skill structure to the total number of operations. The values are derived from the tables defining the level of absorption of each skill in the structure of the general problem solving skill. According to the

didactic condition (Bespalko, 1988) that one knowledge is used if the coefficient K ≥ 0,7 is assumed to be full of absorption of the problem-solving skill structure is achieved when Kc ≥ 0,7.

Rationality is the next indicator that determines the problem-solving situation as an assimilation. Rationality is expressed in the sequence of operations and their optimal selection.

Presence of rationality in the process of solving problematic situations is established with the aid of a coefficient of rationality. It is calculated using the following formula:

$$\mathbf{K_r} = \frac{\sum_{i=1}^{N} r_i}{\mathbf{N.r}}$$

Kr- coefficient of rationality in the following of operation sequence
ri- number of operations which are correct used in rational sequence of i-student
r- total number operation which is necessary to apply for solving problem situation
N- total number students

The rationality ratio of problem solving skills is determined by the ratio of the number of rationally applied operations in the skill structure to the total number of operations. The values are derived from the tables defining the level of absorption of each skill in the structure of the general problem solving skill. This includes the number of students who apply individual skills at an average level because the mistakes they make are not always due to a lack of rationality in the process of solving but to computational errors. According to the didactic condition (Bespalko, 1988) that one knowledge is used if the coefficient K ≥ 0,7 is assumed that rationality in the problem-solving structure is achieved when Kc ≥ 0,7.

The last indicator defining the level of skill formation to solve problematic situations is a generalization. Generality is related to the application of the relevant skill in the system of skills needed to solve different situations. The existence of a generalization and its level is determined using a coefficient of aggregation according to the following formula:

$$\mathbf{K_g} = \frac{\sum_{i=1}^{N} g_i}{\mathbf{N.g}}$$

Kg- coefficient of generality of the skill for solving problem situationна
gi- number of situations for which i student is applied suitably skill
g- total number situations for which the skill is applied

N- total number students

Attention is being paid to mathematical problems with problem content and mathematical tasks are taken into account. There are types of tasks for which solutions have been solved problem solving skills. The definition of the final result is based on the Bespalko classification for perceptual level, according to which one knowledge is utilized if the coefficient $K \geq 0,7$, therefore a cumulative problem solving skill structure is achieved when $Kc \geq 0,7$.

After calculating the coefficients of the individual indicators, there are values that indicate whether the problem solving skill is being mastered or is still in the process of being absorbed. This information is summarized and does not reflect the extent of the skill acquisition. Bespalko (1988) offers a five-dimensional scale, which allows an assessment of the acquired skill. This scale, consistent with the indicators of the skill to solve mathematically problematic situations, acquires a certain kind (Table 1).

LEVEL OF ABSORBING	PARAMETERS OF COEFFICIENT OF ABSORBING	EVALUATION
high	over 1 0,9-1	5 4
middle	0,8- 0,9 0,7-0,8	3 2
low	under 0,7	1

Table №1 Table for assessing the skill to solve mathematically problematic situations.

The elementary school course in mathematics creates the necessary basis for further education of students and forms an organic part of the overall school process. The cognitive activity of students in mathematics education in the third grade is characterized by a number of specific features. These particularities, combined with the individual differences of the students themselves, are the reason why mathematical knowledge can be mastered at different levels in each of them. However, state educational requirements for the acquisition of certain knowledge in a given class apply to all regardless of their differences. This is where the problem arises as to how a certain learning content should be mastered by all pupils, and in the degree specified by the Ministry of Education and Science. The years of pedagogical research devoted precisely to this problem have led to a number of novelties claiming to be effectively resolved. It turns out that the application of problematic situations in the training process is the most appropriate way to raise pupils' interest in certain curricular content and hence to increase their perceptual capacity. The perceptual opportunities are increased accordingly and the degree of mastery of knowledge, skills and habits is increased. A high degree of learning, in turn, allows students to develop their full potential. The positive effect of using problem situations can only be achieved if students develop skills to solve such situations. These skills are acquired when the

teacher applies a system of specially selected exercises, which are applied systematically and purposefully.

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