

## CREATIVE ACTIVITIES FOR ACQUIRING GEOMETRY KNOWLEDGE DURING THE PROCESS OF EDUCATION IN GRADE 3

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**Abstract:** The article systematized some theoretical concepts related to creativity as process and activity.

The researcher analyzed the expected results from the education in mathematics in grade 3 and particularly from competency Cluster "Geometry figures and bodies" included in the educational program approved by the Ministry of Education of the Republic of Bulgaria. A new methodology system of work was developed and tested. The system includes tasks of a type that will facilitate the students to perform creative activities. Some of these tasks are presented in the research work.

Results of the empiric study have been processed using mathematics-statistics methods and are graphically presented. The results demonstrated that the students successfully performed creative activities during the process of acquiring geometry knowledge.

The problem-productive strategy of education applied during education in mathematics for grade 3 students provoked them to perform creativity activity and created preconditions for development in the students of knowledge, skills, competences, and competencies related to geometry figures.

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### Introduction

Creativity is a process that is changing the present life of humanity and is developing its future. Everything created in science, art, and manufacturing, is a result of individual and collective creative efforts of famous and unknown inventors.

Creative work is not an act done by people devoted to science and art. Creativity is every human activity where a person combines, changes, or creates something new.

The aim of the research is to develop and test a new methodology system of work with mathematical tasks from geometry. The system of work contains tasks that provide conditions for creative work. Also, the research work assesses the contribution of the methodology system for the development of grade 3 students' knowledge and skills.

The subject of the research work is the process of education in mathematics in grade 3.

The object of the research is the creative work of the grade 3 students in acquiring geometry knowledge during their education in mathematics.

### Literature review

According to Vigotsky (Vihotsky, 1982, p. 8) "Creativity is every practical or theoretical activity of a person that produced new results (material products, knowledge, methods, etc.). These results could be new for a particular person or innovations of importance for many people".

The researcher distinguished two types of human activity. The first type is the reproducing activity and is related to memory. Its essence "lies in the fact that people reproduce or repeat previously created and developed behavioral techniques or resurrections, updates memorized previous impressions". This is an activity where "something is done according to a pattern, sample", where "nothing new is getting created, and the activity is more or less a repetition of what has been done before". In addition to the reproducing activity there is "combining or creative" activity where there is no simply "reproduction of impressions or activities from previous experience but where new impressions and activities are being created". Vygotsky (Vigotsky, 1982, pp. 5-8) defines as creative activity "any activity of a person which creates something new. This could be some object of the external world or some construction of the mind". According to him, this "activity makes the person a creature that is facing the future, a creature which is building this future and is changing its present days".

V. Andreev (Andreev, 1995) defines creativity as a type of human activity, highlighting some features that characterize it as a complete process: the presence of a problem situation or a creative task, social and personal significance, and progressivity that contributes to the development of the society and the person; presence of objective (social and material) preconditions for creativity; the presence of subjective preconditions for creativity (personal qualities – knowledge, skills, positive motivation, creative specifics of the person); novelty and originality of the process or the result.

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The creativity of the pedagogue begins with acquiring what has been accumulated as knowledge by others (adaptation, reproduction of knowledge, and experience), but in its developed forms, this process is a transformation of established practices.

According to Sternberg (Sternberg 2012, p. 492) "Most of the researchers in the area of creativity would define it widely as a process of creation of something that is both original and precious". (Csikszentmihalyi, 1999, 2000; Lubart & Mouchiroud, 2003; Runco, 1997, 2000; Sternberg & Lubart, 1996)".

For Russinova (2008), creativity (understood as a process, activity, product) has got the following functions: reflective function – reproduces visions, models, ideas, techniques; application function – to adapt visions, models, ideas, techniques; regulative function – to exchange information, ideas, products, relations; creative function – to create new ideas, products, ways of depiction and expression, means to do this; assessing function – interprets dependencies, similarities, differences, originality.

Analyzing creativity, Rhodes (1961) distinguishes creative personality, creative product, creative process, creative environment and defines them as elements of creative activity "Some psychologists who accept the psychometric approach underlined the execution of tasks that include concrete aspects of creativity (Guilford, 1950)." These tasks include divergent production – generation of a diverse range of suitable answers. Therefore, creativity just reflects the ability to create more..."

Other psychologists have focused on creativity as a cognitive process studying the solution of problems and insight. (Finke, 1995; Langley & Jones, 1988; Smith, 1995a, 1995b; Weisberg, 1988, 1995, 1999). When using convergent insight, one brings together a unifying pattern or structure from an unstructured multitude of data. When using divergent insight, one deviates from a given form or structure in order to study what kind of applications could be found. The divergent insight can be used to understand different creative acts. (Finke, 1995).

The stage model of the creative insight proposed by Graham Wallas presents five stages of the creative process: preparation – preliminary work outlining the problem; inventing - internalizing the problem on a subconscious level of thinking; suggestion - the creative person gets the sense of solution; enlightenment or insight - the creative idea "erupts" from the subconscious to conscious readiness; confirmation – clarifying ideas, their development and confirmation.

Other researchers focused on the creativity which is manifested in scientific knowledge (Langley and Jones, 1988). These researchers believe that the memory processes (for example, spreading activation and thinking processes, thinking by analogies) explain much of the scientific insight. "We cannot study creativity if we isolate people and their products from the social and the historical environment where their activity took place. What we call "creative" is never a result of a single act". (Csikszentmihalyi, 1988, p.325) (Sternberg, 2012, pp. 492-496).

For Meerovich and Shragina (Meerovich and Shragina, 2003, p. 432), it is general understanding that creative thinking is related to the creation of something new. One of the first research works on creative thinking where factor analysis has been used was performed by a team of American scientists led by G. Guilford. Independently and in parallel with this study series of experiments on art objects have been carried out by V. Lowenfeld and K. Beittel. When comparing the results from the two studies, eight important criteria for creative thinking can be outlined: the ability to identify the problem; ability to separate from the problem as many sides and interconnections as possible, to change perceptions in such a way as to see new, hidden aspects of observation; flexibility as a skill to understand the new point of view and to give up the established understanding; originality, avoidance of the template, non-triviality, unusualness in the expressed ideas, clear intention for intellectual novelty; ability to re-group ideas and interconnections, ability to see the object from a different point of view; to seek new ways for its use, to widen its practical use; ability to abstract and analyze; to produce various ideas in undefined situations; to reduce the cost of the ideas.

Ylin (Ylin, 2009, p. 24) wrote that psychologists determine three levels of creativity: compilative, projective, and insight-creative. The synectic strategies of Gordan (Gordan, William J., 1973) are well known and are used for expanding and systematizing of creative educational situations.

### **Methodology**

The new methodology system of work was applied in the course of education in mathematics for grades 1-4 during the period between 2017 and 2021 in four schools in the Town of Stara Zagora, Bulgaria –

Petko Rachov Slaveykov second Primary school, Saint Nikolas sixth Primary school, Dimitar Blagoev Primary school and Vassil Levski Primary school.

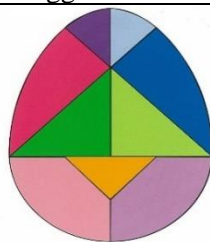
The newly developed methodology system of work incorporated non-standard geometry tasks for grade 3. To facilitate their solving, the teacher must motivate his students and apply the problem-productive strategies during education in mathematics. The first step of his methodology work is the reproductive discussion. The purpose is for the students to recall the knowledge, skills, and competencies from the competency Cluster “Geometry figures and bodies” they have acquired so far and which are necessary for solving the tasks. After that, the teacher shall apply the following methods: heuristic discussion, exercises by analogy, creative exercises.

The students propose how to solve the tasks. They work on creative activity level and perform productive activity. Problem situations are set in the tasks. For their solving, it is necessary for the students to transfer knowledge and skills in a new situation and look for interrelations between the different pieces of information they have. In some of the tasks they identify new problems in a familiar and typical situation. Students combine different known ways of work thus developing new ones. Over the course of solving geometry tasks, the students propose ideas, perform analysis and synthesis, make analogies, associate, classify, and express reasoning and conclusions.

Some tasks which have been included in the methodology system of work are presented below:

The first two tasks are related to figure modeling using parts of the so-called Columbus egg. This is a puzzle game whose base has got oval shape similar to an egg. The base is divided into 10 parts – 6 triangles and 4 segments. The task is suitable for grade 1-4 students.

Figure 1: Picture visualizing the Columbus egg

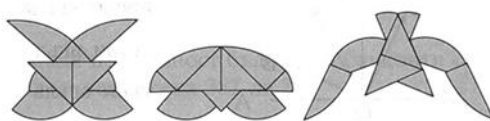


Source: Bogdanova and Temnikova (2018)

The below tasks are for grade 3 students and are developed by Bogdanova and Temnikova (Bogdanova, Temnikova, 2018, pp. 23-45):

Task: Using the elements of the Columbus egg model figures as the ones shown below:

Figure 2: Picture visualizing the task for grade 3



Source: Bogdanova and Temnikova (2018)

Task: Using the elements of the Columbus egg, model the figures as the ones shown below. Name the figures.

Figure 3: Picture visualizing the task for grade 3



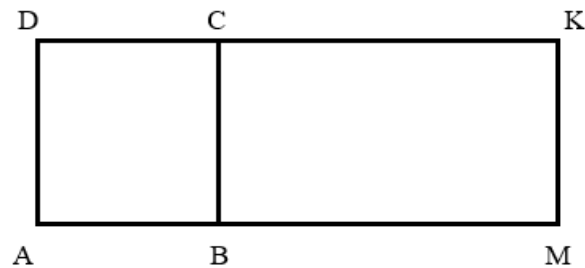
Source: Bogdanova and Temnikova (2018)

For the purposes of modeling, students have a sample figure (dissected silhouette) for each of those figures, which will facilitate their work. It will be good if the students also invent and model their own figures different from the given models. These tasks stimulate students' imagination and creative work, develop their spatial thinking.

Part of the tasks included in the methodology system of work is related to the geometry figures square, rectangle, and triangle studied in grade 3. Such tasks are developed by Bogdanova and Temnikova (Bogdanova, Temnikova, 2018, pp. 25-26), and some of them are presented below:

Task: If the circumference of the square ABCD is 80 m and the circumference of the rectangle BMKC is 140 m, what is the length of the sides of each one of the below three figures?

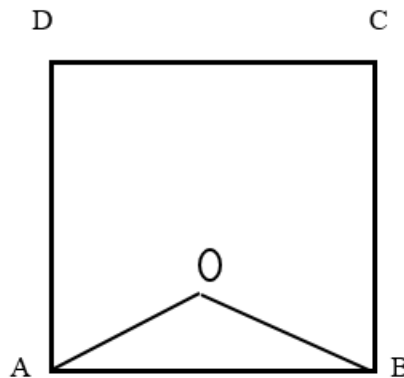
Figure 4: Picture visualizing the task for grade 3



Source: Bogdanova and Temnikova (2018)

Task: The circumference of the square ABCD is 28 cm and the circumference of the isosceles triangle ABO is 5 cm. What is the circumference of the figure AOBCDA?

Figure 5: Picture visualizing the task for grade 3

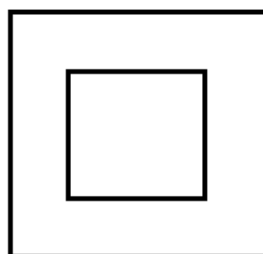


Source: Bogdanova and Temnikova (2018)

Task: The side of a square is 3 cm. How many squares with a side of 2 cm and 1 cm can be produced from this square?

Task: One ant goes around the big square, and another ant goes around the small square. The first ant passed 8 dm more than the second one. What is the distance between the sides of the big and the small square in centimeters?

Figure 6: Picture visualizing the task for grade 3



Source: Bogdanova and Temnikova (2018)

Task: The circumference of the rectangle ABCD is 48 cm. The same is the circumference of the irregular triangle MKP. The side BC of the rectangular is 11 cm which is 3 cm shorter than the side MK of the irregular triangle. The side AB of the rectangular is 5 cm shorter than the side KP of the irregular triangle. What is the length of the side KP of the irregular triangle?

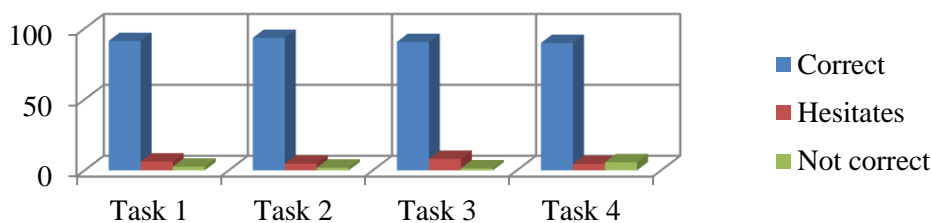
Task: There is rectangular ABCD and section KP which divides the rectangular into two smaller rectangular. The circumference of the first rectangular AKPD is 16 cm and the circumference of the second rectangular KBPC is 10 cm. Which one of the following numbers 18, 20, 22, and 24 possibly shows the circumference of the original rectangular ABCD?

Task: A construction Site has a rectangular shape with 65 m width, which is 39 m shorter than the length. The construction site must be fenced, and the fence must be positioned 2 m away from the construction site borders. How many meters will be the length of the fence?

## Results

The empiric study was performed in 2020 with 120 3-rd grade students. After the exit diagnostic, it was found out that 91.2% of the students recognized the geometry figures square, rectangular, and triangle. 93.4% of the students correctly determined the type of triangles according to the length of their sides and the size of their angles. Only 8.1% of the students made mistakes when calculating the circumference rectangular, square and triangle. 89.8% of the students correctly calculated the side of a rectangular, square and triangle by given circumference and the other sides.

Figure 7: Exit diagnostic for knowledge and skills of the students



Source: Author

## Conclusion

As a result of the applied new methodology system of work with non-standard geometry tasks the level of the compulsory knowledge and skills from competency Cluster “Geometry figures and bodies” of the 3-rd grade students asset in the expected results in the educational program increased. Their overall level of knowledge in the area of mathematics in general also increased.

The new system activated the creative work and thinking of the students, and they started proposing different ideas and solutions in the work process with this type of task. The 3-rd grade students started developing transversal competences, due to which they managed successfully to solve the problem situations set up in the tasks.

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