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FACTORS AFFECTING THE IMPORTANCE, ASSESSMENT AND DEVELOPMENT OF CREATIVITY IN PRIMARY CLASS MATHEMATICS LESSONS

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Abstract :
This article describes the concept of creativity in different ways information about views and approaches is provided. In addition, the article presents the importance of creativity in elementary school mathematics classes, ways and factors of creativity stimulation, and methods of its evaluation.

Keywords: creativity , creative approach, creativity, critical thinking, knowledge, skills, practice, levels of creativity.

The urgency of promoting creativity

Creativity is the ability to create an idea or product that is considered by experts to be both unique and relevant in a given field (Amabile, 1996 , Kaufman & Beghetto, 2009; Sternberg & Lubart, 1999). In this increasingly complex and changing world, creativity is seen as an essential skill for the 21st century (Partnership for 21st Century Skills, 2019; World Economic Forum, 2016). In recent years, there are growing calls to educate and teach creativity in schools from a young age . According to Piirto, the skill or experience needed in the 21st century includes creative abilities. Because in the age of robotics that can perform tasks according to a precise algorithm, the demand for people who can approach any situation creatively will increase. Although it is considered as a skill, today's scientists define it as a competence that allows training and development of creative abilities. Therefore, the importance of supporting creativity and creative thinking at all stages of education is recognized internationally. In education, it is important to create favorable conditions for the development of the creative potential of students. Because creative abilities lead to creativity , creativity to innovation, and news to innovations and inventions, which in turn pave the way to development and progress in every field. Creativity motivates humanity to go beyond the ordinary and transcend the existing situation. Creativity is one of the keys to success in an increasingly complex and radically changing world (Daniel and Laura, 2020). On a large scale, this means innovation in technology, quality in culture, profit in business, rejuvenation in research - in general is progress in society (Runco, 2004). But it is also an invaluable tool for man in the struggles of everyday life: creativity gives us more and better alternatives to every decision we make . As for subjective motivation. In mathematics in particular, the digital revolution has disrupted society in such a way that human creativity has become relatively less

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important. there are millions of inefficient paths that experienced human mathematicians must avoid" (Sriraman , 2009).

Creativity in education and school

Creativity is common in arts education, but not common in science, technology, engineering and mathematics education. Creativity, traditionally associated with art and literature, is characterized as an individual activity that seeks to produce something new (Bolden, Harries, & Newton, 2010). Creativity can be taught in other subjects as well. James (2015, p. 1032) stated that it is possible to create a learning environment that fosters creativity. Creativity is one of the important competencies that should be developed through education. Creativity can be fostered in a learning environment (Daniel & Laura, 2020). In addition, the development of students' creativity should be integrated with the lessons and subjects taught in schools. If we take into account that lessons in schools and other educational institutions are organized on the basis of a strict program , system and work plan, it becomes clear that developing the student's creative abilities in such conditions is a very difficult task . iq tibos quoted his famous words "kills" . When many countries examine the pedagogy of teaching mathematics in school settings, they argue that mathematics is limited to memorizing formulas or rules (Novak, 2010; Greeno, 2017). Although memorization has its place in learning, memorized knowledge is not half as useful as actually understood knowledge and makes maths class boring, causing many students to hate maths.

Encouraging creativity in mathematics lessons

Creativity has also recently been associated with mathematics and is the ability to generate new mathematical concepts and ideas (Sriraman, 2009). Decision - making can be considered a creative act of doing mathematics (Ervynck, 1991) . argue that 'more demand' (Ervynck, 1991; Sriraman, 2009). For any education that aims to prepare students for a future in mathematics or math-intensive careers, the development of creativity should be a primary goal. . Special attention should be paid to the development of students' creative abilities in mathematics in different ways , small indicators in each aspect of creativity should be developed and improved. Mathematics is closely related to creative thinking (Chan, 2016) . Mathematics is an important subject for developing students' creative abilities. It plays a unique and special role in students' creative development (Wu & Wang, 2002). Based on the important role of classroom teaching in the development of students' thinking and abilities, it is desirable to further study the ways of systematic development of students' creativity in mathematics classes. Thus , special attention should be paid to the development of students' creative abilities in mathematics in different ways (Regier & Savic, 2020). Mathematical creativity allows students to participate in designing, planning, building, implementing and inventing new ideas (Sriraman, 2004). Mathematical creativity is defined in many literatures as the ability to analyze a given problem from multiple perspectives, observe patterns, see similarities and differences, develop multiple ideas, and choose an appropriate method to solve an unfamiliar mathematical situation. Although there are many definitions of mathematical creativity, in general, it is characterized by two general trends - the ability

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to create new mathematical knowledge and to solve flexible problems (Kwon, Park and Park, 2006). In their article on the concept of mathematical creativity, Liljedal and Sriraman (2006, p. 19) also suggested that mathematical creativity at the school level can be divided into 2 main types. These are:

1. A process that leads to unusual, novel, profound solution(s) to a given problem or similar problems;
2. Forming new questions and opportunities that allow you to look at an old problem from a new perspective.

The important role of problem solving is evident in the two statements above, and creativity in mathematics can be enhanced through problem solving. While Ellwood, Pallier, Snyder, and Gallate (2009, p. 1) claim that there is considerable overlap in the literature between creativity and problem solving, Plucker, Beghetto, and Dow (2004, pp. 83-84) argue that creativity is a problem-solving is defined as an important component of making. Consequently, Posamentier, Smith, and Stepelman (2009, p. 121) claimed that "solving a problem is like inventing something new." The role of problem solving in the development of creativity is clear, so now, especially, non-standard problem, example, riddle problem, puzzles that increase critical thinking are becoming popular. Increasing creativity in mathematics classes is mainly organized using multiple-solution (open) tasks , problem-solving tools, comics, multimedia, STEM teaching tools. Chamberlin and Moon (2005, p. 38) define creativity in mathematics as the extraordinary ability to generate new and useful solutions to simulated or real practical problems using mathematical modelling. Creativity is the ability to create any composition, product or idea that is essentially new and has never been used before. Mathematical creativity involves generating new ideas and multiple solutions to mathematical problems (Noraini and Norjoharuddeen Nwoke et al. , 2017). Problem solving is the foundation of mathematics and includes solving non-algorithmic exercises. Littlewood (1953) said that a good mathematical puzzle is better than a dozen average exercises. A math puzzle challenges the mind , and people seek challenges and enjoy challenges. Mathematics is not a hard science that requires only one solution and one solution method, but a science with a wider scope that provides a combination of algorithmic-convergent and creative-divergent tasks. Creativity in education is fluidity, flexibility, new connections, imagination, tools related to use and questioning. Creativity is the student's ability to make connections between unrelated elements, identify important issues, ask questions out of curiosity, be open to new ideas, unwilling to accept routine norms, flexibility and specificity, a learning method that allows for classification into new categories. , and this should constitute norms.

Mathematical creativity development stages , level and its assessment

Ervinck (1991) proposed three necessary stages for the development of mathematical creativity:

1. initial technical stage;
2. stage of algorithmic activity ;
3. stage of creative (conceptual, constructive) activity.

The first stage refers to the practical application of mathematical rules and procedures without knowing the theoretical source. In the second stage, emphasis is placed on using procedures to perform a

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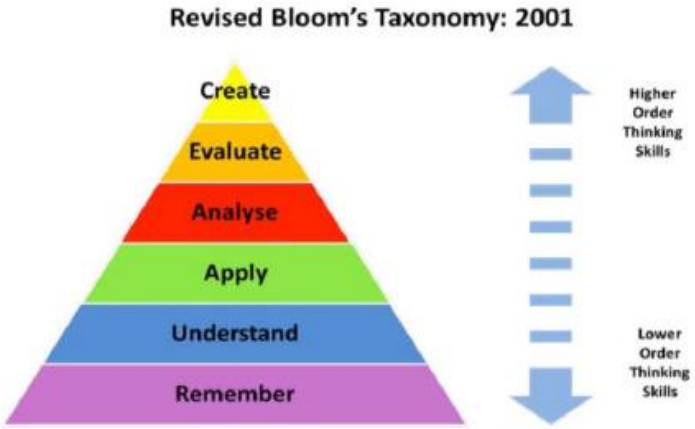
mathematical operation with knowledge of the theoretical source. Finally, the third stage involves activities not related to a particular algorithm, where it requires a new understanding of definitions or a new theorem and its proof. For example, an algorithmic solution is used to create an equation for a word problem or to solve a system of equations by linear combination or substitution .[1]

Steers (Meager, 2006) lists the following 4 stages of the creative process:

- Preparation - in this problem or question is identified, structured and determined;
- Excitement-in this, habitual thinking is removed;
- Incubation is the initial planning of a problem or idea and possible outcomes are imagined;
- Validation is where ideas are analyzed , clustered, evaluated and implemented based on a detailed plan.



A revision of Bloom's 1956 taxonomy by Krathwohl (2002, p.212–218; see Figure 4), the taxonomy in version prioritizes creativity as a higher order thinking ability. Considers creativity as a process encompassing all levels of skills represented in the taxonomy, and an alternative and more accurate representation to include increasingly higher-level skills.

it can be concluded that creativity is the ability of a person to generate new things in the form of new ideas and in real work, in the form of characteristics or incompetence, both in new work and in existing work.

assessed based on the four indicators of creativity proposed by Torrance (cited in Silver, 1997) and Guilford (cited in Klavir and Hershkovitz, 2008) . These indicators include:

a) fluency , depending on the number of correct answers given by the student;

b) flexibility refers to the number of different mathematical concepts and ideas that the student discovers, usually away from stereotypes;

c) development shows the complexity of mathematical thinking, because the student combines different parts of mathematical knowledge;

d) Originality highlights that the student's ideas are deep, new and lead to unexpected and unconventional solutions.

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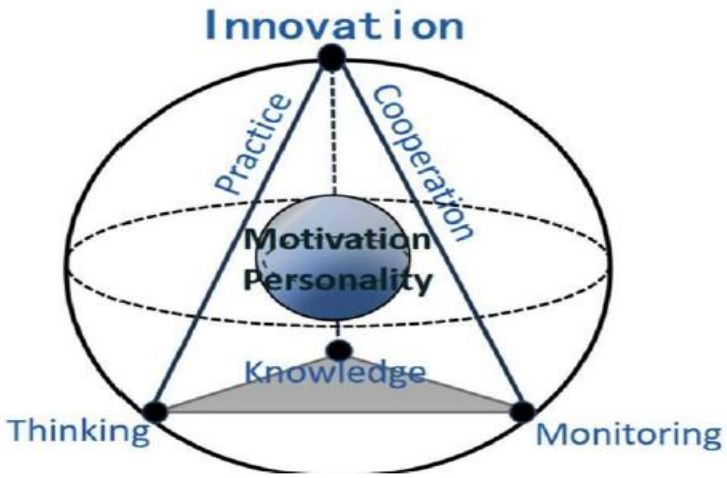
According to Sahat et al ., indicators of creativity are fluency, adaptability and novelty[2].

Factors affecting students' creative abilities



Zhang et al. (2018) show the factors influencing creativity in the above diagram. The learning power model developed by Pei (2016) consists of six elements at three levels. The first level includes knowledge and experience, strategies and revision, will and extraordinary abilities. The second level includes practice and activity, cooperation and communication, which are the two main ways of realizing personal development. The third level is criticism and innovation, which is the highest level of personal development. Creative individuals exhibit a combination of six resources that work interactively: intelligence, knowledge, thinking styles, personality, motivation, and environment (Sternberg & Lubart, 1993). Russian psychologist Krutetsky described creativity: Creativity is the process of being sensitive to problems, shortcomings, gaps in knowledge, missing elements, funds, etc.; determine the difficulty; looking for solutions, making assumptions or formulating hypotheses flaws; testing and retesting these hypotheses and possibly changing them and retesting them and finally communicating the results. It is necessary to help the student instill the characteristics of a creative personality in order to stimulate his creative abilities. "What should a creative person be?" we are looking for an answer to the question . Creativity is defined as an individual activity that seeks to produce something new (Bolden, Garries and Newton, 2010). Observations show that a creative person is an educated, risk-taking, strongly motivated and curious, critical and unconventional thinker, a broad-minded innovator. The thinking and imagination of a person with a broad worldview is also very rich, and the tool that expands the worldview is Therefore, one of the factors influencing students' ability to think creatively is their content and domain knowledge (Baer & Garrett, 2010). (Star et al., 2022) However, knowledge and knowledge can also limit creativity. Given that knowledge is mainly acquired through hands-on experiences, greater experience is more flexible. and can interfere with and limit creative thinking. A student who has a lot of experience after memorizing hard and finding a solution based on this memorized knowledge for a long time , finds it unreasonable to look for a different solution to this task.

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For example, a student who learned to find the perimeter of shapes as the sum of sides the student finds it difficult to learn other formulas and methods that determine the perimeter according to the characteristics of the shapes, and every time he is given a task about the perimeter, he uses the old method.

Intellectual abilities include three types of skills used for creative thinking:

1. experimental ability (unconventional thinking and information processing when solving new problems and requirements);
2. componential ability (observing which ideas are valuable and which are not)
3. contextual competence (promoting the fit between one's idea and the environment by communicating, receiving feedback, revising and selling one's ideas) (Sternberg and Lubart, 1995) .

To be truly creative, a person must use three skills in problem solving (Sternberg & Lubart, 1995). A person with only experiential ability (otherwise known as synthetic ability) can generate new and original ideas, but without a process of verification, may ignore the implementation of ideas. A person with only component ability (otherwise called otherwise called analytical ability) can be a critical thinker to think and analyze, but not creatively. Only a person with contextual skills can communicate ideas in an inspiring and persuasive way, not because they are of good quality, but because the presentation is strong.[3]

Mathematical creativity and critical thinking

, it is recommended by most scientists to encourage diverse and wide-ranging critical thinking. Because divergent thinking in problem solving is related to mathematical creativity (Haylock, 1997; Chamberlin & Moon, 2005). Balka (1974) divided convergent thinking , which is characterized by identifying patterns and breaking out of an established set of thinking, and divergent thinking, which is characterized as generating mathematics. turned to thinking. Runko (1993) defined creativity as "a multifaceted construct that includes divergent and convergent thinking, problem solving, self-expression, intrinsic motivation, critical thinking, and self-confidence" (IX - page , Haylock, 1987) Of course, creativity is not limited to such processes as divergent and convergent thinking. Many studies have shown that mathematical creativity includes four types of creative thinking: divergent thinking, convergent thinking, intuition and critical thinking (Balka, 1974; Er Vinck, 1991; Guilford, 1967; Haylock, 1978 ; Krutetskii, 1976; Singh, 1988; Valli, Many studies have shown that divergent thinking and convergent thinking are beneficial for mathematical creativity. Through open-ended problems, students can use divergent thinking to explore multiple solutions and then are encouraged to use convergent thinking or critical thinking to test their hypotheses.

The importance of motivation in mathematical creativity

need to engage in learning mathematics with their whole being , which leads to broad thinking in unfamiliar mathematical situations that helps them develop creatively.). Divergent thinking, which plays a major role in the creativity of individuals, is the act of seeking different solutions without making decisions , motivation and creativity are closely related to each other (Balka, 1974; Guilford, 1967;

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Haylock, 1978). The main problem of learning mathematics is that learning is difficult and boring, which affects the learning outcomes of students. Lessons should be interesting, ensure that students' motivation to learn mathematics increases, and have a strong A motivated student can achieve excellent results. Therefore, making the lessons interesting should be one of the most important goals for the teacher. Mathematics is a creative subject. This can encourage moments of delight and surprise when students solve a problem for the first time, find a more elegant solution to it, or suddenly see hidden connections . Motivation increases creativity and creativity increases motivation. So motivation and creativity work closely together.

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