

Description of Students Creative Thinking Abilities with Split Attention in Solving Math Problems

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ABSTRACT

The purpose of this study was to describe the ability of students to think creatively and identify the factors that caused the error of students who experienced Split Attention in solving the problem of building a flat side space in VIII B of SMP Negeri 2 Ulaweng, Bone Regency. The subjects of this research were three students based on their characteristics. The research instrument used a mathematical problem which consists of 5 math problems in the matter of solid geometry with flat surfaces. This research method was qualitative. From the research results, the types of errors often experienced by creative-minded students were conceptual, procedural, and factual errors. The conceptual errors existed due to misinterpretation, the procedural errors occurred due to a lack of basic mathematical operations, while factual errors appeared due to a lack of focus in understanding the problem building a flat side space.

Keywords: *Creative Thinking, Split Attention, Building a Flat Side Space.*

1. INTRODUCTION

In this era of the 21st century, creative thinking is one of the fundamental abilities that students must possess. Mathematics in schools is a means to educate students to be creative human beings. The 21st century requires students to have the skills to learn and innovate, skills in using technology and media information and be able to work and survive by using skills for life.

This is in accordance with the objectives of learning mathematics, namely to train and foster students how to think systematically, logically, creatively, critically, consistently, develop an unyielding attitude and be confident in problem-solving [1]. It was affirmed by the Ministry of Education in [2], who stated that the 21st-century learning system emphasizes the ability of learners to find out from a variety of sources, formulate problems, think analytically, and cooperate and collaborate in resolving the problems.

Mathematics in education is studied from elementary to college to make students solve problems in everyday life [3]. It is because mathematics is a fundamental of other sciences such as accounting, economics, physics, and chemistry, which in their development depend on learning

mathematics [4]. The term "learning" in the RI Law Number 20 of 2003 concerning the National Education System in Article 1 point 20 is defined as the interaction process of students with educators and learning resources in a learning environment [5]. In addition, [6] states that learning is a systematic and systemic effort to create a learning environment containing the potential to produce a learning process that leads to the development of students. Students are expected to master the fundamental topics and be responsive so that it is easy to understand the next mathematical material. The purpose of mathematics education is to assist students in thinking creatively, logically, and critically and solving problems related to everyday life. Problems in learning mathematics are generally presented in the form of separate questions, where students must be able to understand the text that is described and the images shown. Giving questions that contain separate pictures and texts to students, such as story questions that describe daily life problems, will provide an important picture of the environment around them so that they are easy to understand. However, many students have not understood separate questions, so they tend to have difficulty solving them.

According to [7], people need the ability to think creatively. This ability can be used for developing

themselves into quality human beings by combining thinking and communication skills. This is in line with the statement of [2] that creative ability is a natural potential that has been embedded in humans themselves, which means that every human being has the potential to be creative. However, along with current developments, this potential may be lost or undeveloped. In addition, [8] stated that the ability to think creatively is an ability that generates new ideas or ideas in the form of a way to solve problems. The resulting method allows it to be an alternative solution that can be used. The emerging alternatives can be innovations in human life. Changes are needed in learning mathematics. Learning mathematics must maintain a balance between the left brain, which is associated with logic, and the right brain, which is in charge of intuition and creativity, to develop simultaneously.

The ability to think creatively can be seen in its diversity from several characteristics. A person is said to have the ability to think creatively if he can fulfill the characteristics of thinking creatively. According to [9], creative thinking can be characterized by 4 components: *fluency*, *flexibility*, *originality*, and *elaboration*. Sudarma [8] further explained that these characteristics of mathematical creative thinking skills, namely (1) *fluency*, which is having many ideas or ideas in various categories of problems or questions; (2) *flexibility*, namely students who have various answers in solving problems (3) *authenticity (originality)*, which is to have ideas or new ideas that can be a problem solver; and (4) the *elaboration*, which is the ability to develop an idea or ideas that are used as a problem solver in detail.

According to students, as [10] states, problems in the *International Student Assessment Program (PISA)* were difficult. Students who can answer questions correctly on geometry material are 47.5% lower than statistics material 61.9% and number material 53.7%. This shows that students prefer geometry less.

One of the students' difficulties in geometry material lies in the difficulty of mastering concepts, finding formulas, and using formulas in solving problems resulting from memorization. Factors that cause difficulties experienced by students in completing the geometry problem is a cognitive business load, causing the students to experience the effects of *Split Attention*.

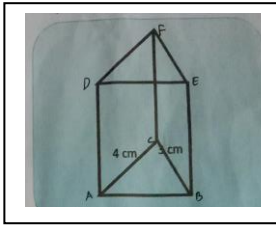
Split attention is one of the theoretical schemes of cognitive load theory. This mental effort must be made in working memory to process information received at a certain time interval (Plass et al. John, 2016). According to Ayres and Cierniak in [11], Split attention occurs when learners are required to split their attention between two or more mutually dependent sources of information (text and diagram), which have been separated either spatially or

temporally. The split-attention effect the diminishment in learning performance attributable to presenting mutually dependent but spatially separated sources of information (such as text and diagram) in the visual modality, requiring the learner to invest precious cognitive processing resources in integrating the dispersed information.

Relevant research conducted by [12] also shows that students who experience Split Attention commit factual and procedural mistakes in solving the problems. The fact that students made a mistake in defining the variables x and y that they had made. The procedural error was not able to determine the resolution steps for the problem. In addition, students also could not use addition operations correctly. Therefore, the most common mistakes were procedural errors.

Research by [11] "found a positive effect on learning for learners in self-administered attentional states, who were able to physically manipulate print-based detached-attention instructional materials by making connections between text and diagrams." Cooper & Kalyuga [11] divided attention negatively impacts working memory capacity and duration, reducing learning efficiency and comprehension. In addition, [13] states a feature of cognitive load theory is the effect of divided attention when two sources of information necessary for learning are physically or temporally separated. Therefore, learners are required to mentally integrate these sources of information to understand what is being taught. This mental integration places an increasing burden on the already limited capacity of working memory, so that schema construction and automation can be hampered and learning more difficult."

The cognitive load will continue to increase with the increasing need for students to combine various sources of information with being learned. The *split attention* effect occurs when students solve problems presented separately. Errors that often occur in solving problems are divided into three, namely: 1). Fact error due to focus. 2). Procedural error due to incorrect instructions or mathematical mission. 3). Conceptual errors due to misunderstanding or poor understanding of basic principles and ideas related to mathematical problems. This is in line with [12] that in solving problems, errors are separated into three, namely: procedural errors, factual errors, and conceptual errors. The effect of split attention is due to the selection of the teaching materials used in learning, causing the focus of students to experience the impact of split attention in absorbing the material given by students. An example of the use of teaching materials using separate images and text are shown as follows.



Look at the prism below!
If the surface area of the prism is 108 cm^2 , what is the height of the prism?

Figure 1. Example of presenting separate questions

The picture above is one example that contains separate questions because there are pictures and test questions. This causes the focus or effect of divided attention and the lack of student's creative thinking skills in seeing the problem. So this research focuses on the mistakes that are often experienced by students who experience creative thinking skills and the effects of split attention.

According to Dalyono [14], student errors are caused by internal and external factors. Internal factors consist of intelligence, talent, interest, motivation, and physical health. While external factors consist of family factors (how parents educate, relationships between family members, family economic conditions, and so on), school factors (teaching methods, curriculum, teacher-student relations, student-student relations, school discipline, school facilities, and infrastructure). Community factors (student activities in the community, mass media, friends, and forms of social life), from the statement that affects the ability to think creatively and split attention, is the method of teaching materials or methods used in learning are still less effective and do not pay attention to the cognitive load or ability of each student.

Cognitive load is associated with creative thinking skills, including cognitive, affective, and metacognitive. Aspects of cognitive skills consist of the ability to identify problems and opportunities, formulate different questions, identify relevant and irrelevant data, generate new ideas (fluency) and other ideas (flexibility), change mindsets, construct new relationships, and update plans or ideas (originality).

Thought process in which individuals produce something new and innovative, characterized by originality and diversity of ideas or objects and the interrelation of elements with relationships to solve problems with new components, including fluency, flexibility, originality, and relationships.

Several studies researched creative thinking skills [15] who studied schemes and creative thinking skills in cool-critical-creative-meaningful. [16] who researched the effectiveness of mind habits-based mathematics learning program in developing motivation for academic achievement and creative thinking among prince Sattam bin Abdulaziz University students.

From the results of the research conducted by [15], it was found that the creative thinking ability learning model was quite effective in improving the ability of teachers or prospective teachers; students with good and complete formal schemes, content, and language will also have good mathematical creative thinking skills; the completeness of the scheme determines students' mathematical creative thinking ability; and a good and complete scheme (formal, content and language) will help students to generate several alternative problem solving and find that there is a statistically significant difference between scores of academic achievement motivation and creative thinking in support of post-application.

Based on the problem description above, the researcher is interested in examining the Description of Students' Creative Thinking Abilities with Split Attention in Solving Math Problems for class VIII A students of SMP Negeri 2 Ulaweng.

2. RESEARCH METHODS

This research was conducted in the eighth grade of SMP Negeri 2 Ulaweng. The research method used in this study is qualitative research using a narrative approach. The narrative approach typically focuses on one-person research, gathering stories, reporting on individual experiences, and discussing the meaning of those experiences for the individual. The subject of the study was selected by purposive sampling by setting specific characteristics that follow the research objectives. The selected respondents were divided into high, medium, and low abilities in solving math problems. With this method, three students having different abilities were also selected for interview. The research instrument used in the study was a test consisting of 5 problems with the material of solid geometry with flat surfaces. The data collection technique used is triangulation which consists of interviews, participatory observation, and documentation. The data analysis technique used in this study is a qualitative analysis by researchers as stated (Sugiyono, 2018) Miles and Hubberman, namely collecting data, data reduction, data presentation, and the last step is concluding.

3. RESULTS AND DISCUSSION

a. The results of the study

After following the learning using the learning model that had been selected, students worked on the post-test questions on the flat-sided wake-up material. In the category classification, it is known that from 18 students, there are 8 students in the low category, 6 students in the medium category, and 4 students in the high category. Among the three categories, the low category is the largest, and the high category is the least. Meanwhile, the diversity of students'

mathematical creative thinking abilities based on observations, interviews, and documentation is shown as follows:

Table 1. Creative thinking skills

LOW	MIDDLE	High
Fluency indicator diversity		
<ul style="list-style-type: none"> - Students still have difficulty in generating ideas in solving problems - Lack of use of language or communication so that students find it difficult to convey the ideas found - Can't find out where the error is in solving the problem 	<ul style="list-style-type: none"> - Students are able to generate ideas found but there are still errors - Students are able to convey their ideas using their own language 	<ul style="list-style-type: none"> - Students can generate ideas or ideas that are found smoothly to solve problems both diverse and complex compared to others - Students master the ideas or ideas found so that they are able to convey them, explain the meaning of the questions, and use language that is easy to understand
Diversity of flexibility indicators flexibility		
<ul style="list-style-type: none"> - Generate answers but the answers produced have not varied - Students have been able to solve the problem, but have not been able to solve it from a different point of view still follow instructions or examples - Students have not been able to correct an idea even though they have solved the problem 	<ul style="list-style-type: none"> - Generates many solutions to problems but not different - Students are able to see alternative solutions from different perspective - Considering the results found but still experiencing errors 	<ul style="list-style-type: none"> - generate many ways to find alternative solutions - Students can see problem solving from different perspectives - Pay attention to various considerations or re-correct what has been answered.
The diversity of indicators of authenticity originality		
<ul style="list-style-type: none"> - Students still cannot reveal the contents of their own minds - Writing answers has not been systematic and there are still students who do not even finish or do not give answers and cannot be understood 	<ul style="list-style-type: none"> - Students have not been able to fully express their thoughts in solving problems - There are still answers that are less systematic and the alternative solutions used are poorly understood 	<ul style="list-style-type: none"> - Students can express their thoughts in solving problems - In writing the answer is still not systematic but can be understood - Students can identify the location of the error - Students can explain the answer fluently
Diversity of elaboration indicators		
<ul style="list-style-type: none"> - Added something that has nothing to do with the problem - Writing answers that are less systematic, detailed, and incomplete and there are still calculation errors 	<ul style="list-style-type: none"> - Able to find things related to the problem - Writing answers is not systematic, detailed, and incomplete but there are still errors 	<ul style="list-style-type: none"> - Develop the ideas in the problem - Writing answers are not yet systematic, detailed, and complete but there are still errors in calculations

From the data on creative thinking abilities above from class VIII A students of SMP Negeri 2 Ulaweng, we will take each one from the low, medium, and high categories according to the characteristics of students who have split attention.

From the data above, one from each category was selected.

Description of the errors of students in low categories

having Split attention are as follows: firstly, students could not convey their ideas, so they wrote two formulas, and secondly, they misinterpreted the formulas or ideas, implying that in solving problems, students were not able to solve them correctly as shown in the picture below:

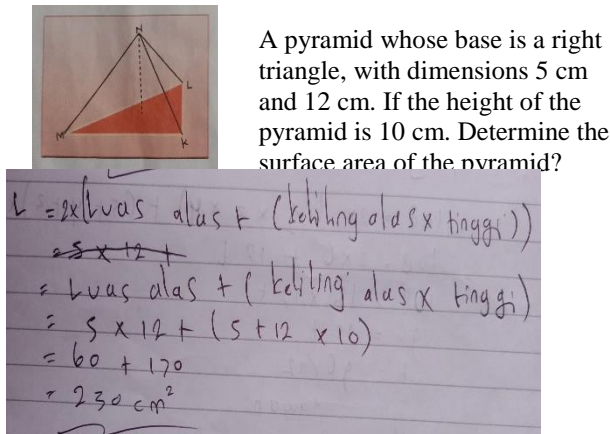


Figure 2. Student questions with low categories

From the students' answers, we found that students had factual errors, procedural errors, and conceptual errors caused by students experiencing cognitive loads.

The problem of students in the medium category who experienced Split attention is that they could not convey their ideas, so they wrote the formula wrong. As a result, the results were also wrong even though the procedures and calculations were correct, as shown in the picture below:

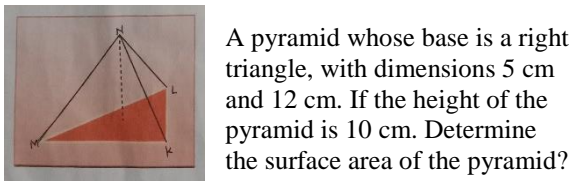


Figure 3. Student questions in the medium category

A conceptual error was found from the results of students' work in the medium category when students

misinterpreted the question and even wrote the prism formula. In the matter of saying pyramids, this is because students experience or are influenced by cognitive loads, so that it affects problem-solving.

The description of the errors of students who experienced Split Attention in the high category, on the results of their work, students wrote the formula for the pyramid $\frac{1}{2}$ area of a triangle + (circumference x height) and miscalculated. As in the image below:

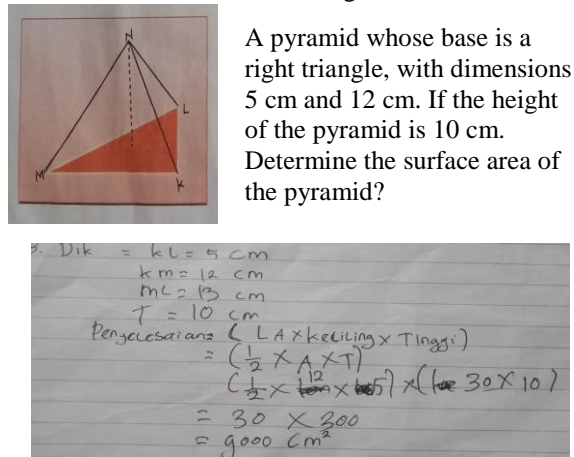


Figure 4. Student questions with high category

From the student's work results, we found procedural errors that students used the correct formula. Still, he added something that was not related to the formula, so that he miscalculated.

b. Discussion

In this study, researchers acted as educators to find out students who have the characteristics of Split Attention. In this study, students who experience Split Attention are divided into three categories, namely, low, medium, and high categories. There were three errors found. Firstly, factual errors in the low category students due to lack of focus in understanding the problems caused by cognitive loads so that students lost their focus. Secondly, the conceptual errors found in students categorized as low and medium are caused by a misunderstanding of the problem. In solving the problems, they use the incorrect formula. Third, this procedural error in all categories was caused by the instructions used by the students were not correct.

4. Conclusion

Students who experienced split attention were found to have factual errors and procedural errors. Factual errors occur when students cannot use the information given a given problem appropriately. Fact errors occur when students cannot focus on the problem, so that students lose control in thinking or are confused in solving the problem. Conceptual errors occur when students misinterpret the questions. Procedural errors occur when students cannot use multiplication, division, addition, and subtraction operations appropriately.

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