

ANALYSIS OF STUDENTS' MATHEMATICAL CREATIVE THINKING ABILITY IN THE MATH ESSENTIALS AT AN ISLAMIC MIDDLE SCHOOL IN BANDUNG

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Abstract

Creativity is an important ability for students to have in the 21st century. The ability to think creatively is very important for innovation, developing original ideas, and finding new ways of thinking for students. In the context of mathematics, the ability to think mathematically and creatively to solve problems related to everyday life is important. However, the results of previous studies have revealed that students' mathematical creative thinking abilities are still relatively low. This study aims to analyze the level of students' mathematical creative thinking ability at an Islamic Middle School in Bandung. The research method used is descriptive-quantitative. The sampling technique used is purposive sampling. The subjects in this study were 17 eighth-grade students at an Islamic Middle School in Bandung, while the data collection techniques used were tests, questionnaires, and interviews. The test consists of four questions on math essentials based on indicators of mathematical creative thinking ability: fluency, flexibility, originality, and elaboration. The questionnaire consists of 15 closed statements based on 5 attitudes related to mathematical creative thinking abilities, namely: curiosity, imaginativeness, liking challenges, courage, and respect. Unstructured interviews were conducted to validate the results of the questionnaire. The results showed that the level of students' mathematical creative thinking ability was divided into 29% of students at level 3, 24% of students at level 2, 18% of students at level 1, and 29% of students at level 0.

Keywords: creativity, mathematical creative thinking ability, math essentials

Abstrak

Kreativitas merupakan kemampuan yang penting dimiliki siswa untuk menghadapi abad 21. Kemampuan berpikir kreatif sangat penting untuk inovasi, mengembangkan ide-ide orisinal, dan menemukan jalur pemikiran baru siswa. Pada konteks matematika, kemampuan berpikir kreatif matematis penting guna menyelesaikan permasalahan matematika yang berkaitan dengan kehidupan sehari-hari. Akan tetapi, hasil studi terdahulu mengungkapkan bahwa kemampuan berpikir kreatif matematis siswa masih tergolong rendah. Studi ini bertujuan untuk menganalisis tingkat berpikir kreatif matematis siswa di salah satu Madrasah Tsanawiyah di Bandung. Metode penelitian yang digunakan adalah deskriptif kuantitatif. Teknik penyampelan yang digunakan yaitu *purposive sampling*. Subjek pada studi ini adalah 17 siswa kelas 8 di salah satu Madrasah Tsanawiyah di Bandung. Sedangkan teknik pengumpulan data yang digunakan yaitu tes, kuesioner, dan wawancara. Tes terdiri dari empat soal materi esensial matematika berdasarkan indikator kemampuan berpikir kreatif matematis yaitu kelancaran, keluwesan, orisinalitas, dan elaborasi. Kuesioner terdiri dari 15 pernyataan tertutup dengan berdasarkan 5 sikap yang berhubungan dengan kemampuan berpikir kreatif matematis yaitu: ingin tahu, imajinatif, menyukai tantangan, berani, dan menghargai. Sedangkan wawancara tidak terstruktur dilakukan sebagai validasi dari hasil kuesioner. Hasil penelitian menunjukkan bahwa tingkat kemampuan berpikir kreatif matematis siswa terbagi dalam 29% siswa dengan tingkat 3, 24% siswa dengan tingkat 2, 18% siswa dengan tingkat 1, dan 29% siswa dengan tingkat 0.

Kata kunci: kreativitas, kemampuan berpikir kreatif matematis, materi esensial matematika

INTRODUCTION

As reflected in the problems of the 21st century, the capacity for creative thought is seen as one of the human qualities that is superior to other abilities and is a crucial component in fostering national advancement (Permatasari, Budiyo, & Pratiwi, 2020). Furthermore,

creativity is necessary for students to innovate, generate original ideas, and discover new ways of thinking (Schindler & Lilienthal, 2020). That is what makes the ability to think creatively important for students to have. However, findings in the field show that students' creative thinking skills are still low.

The results of Ardiansyah and Asikin's preliminary research (2020) state that the average grade 8 student's creativity in a junior high school in Semarang City is still relatively low. This is because the average student's creativity in each class only reaches an interval of 40 to 65, for a total average of 54.90 on a scale of 100. Not much different, the research results of Permatasari et al. (2020) of 56 students at a junior high school in Surakarta City stated that 66.07% of students were at level 1, 30.36% of students were at level 2, and 3.57% of students were at level 3 of mathematical creative thinking. The low ability of students in the aspect of creative thinking also occurs in grade 10 students at an Islamic High School in Wonogiri Regency. Based on the results of observations, the minimum completeness criterion for students' mathematical creative thinking is still low, namely 61.5 on a scale of 100 (Mulyono, Rosayanti, & Kristiawan, 2020).

The above conditions are caused by various problems encountered in learning mathematics. For example, students are less active and tend to feel bored during the learning process (Mulyono, Rosayanti, & Kristiawan, 2020). In addition, the questions given only have one correct answer with completion according to the previously given formula (Mulyaningsih & Ratu, 2018). So, most students only find a single answer and usually work on routine questions. Whereas for non-routine questions that require creative thinking skills, students rarely work on them (Desmayanasari, Hardianti, I, & Rohaeti, 2020).

Another cause is the lack of training or exploration of students' thinking skills. Students do not think to the root of the problem (think fast) and have a mediocre level of curiosity to solve problems thinking creatively, so that in giving simple answers according to problem requests (Isnani, S.B.Waluya, Rochmad, & Wardono, 2020). In terms of the total percentage of mathematical creativity in Indonesian mathematics textbooks, it is still low at 10% (Ramelan & Wijaya, 2019). Meanwhile, according to Suyitno et al. (2019), the obstacles that hinder the growth of mathematical creative thinking are: 1) students as a threat; 2) parental attitudes; 3) the school syllabus; 4) teachers; 5) individuals; and 6) a lack of confidence.

So it is necessary to apply learning approaches and learning models that allow students to make observations and explorations so that they can build their own knowledge (Mulyono, Rosayanti, & Kristiawan, 2020). Learning like this can involve students directly in solving the problems given (Maulidia, Maulidia, & Andariah, 2019).

In order to understand the basic definition related to the ability to think creatively, it is necessary to know aspects of the ability to think creatively. Several aspects of the ability to think creatively include the ability to identify problems, construct various original ideas and ideas, and examine and assess relationships between choices (Desmayanasari, Hardianti, I, & Rohaeti, 2020). Creative thinking skills can be interpreted as the activities of finding problems (identifying problems), efficiency (generating ideas), flexibility (generating ideas that characterize flexible understanding), originality (generating unusual ideas), and elaboration (developing ideas) (Arnidha & Hidayatulloh, 2019).

According to Torrance (1969), the ability to think creatively includes: 1) fluency, namely having many ideas or ideas in various categories; 2) flexibility, namely having various ideas or ideas; 3) originality, namely having ideas or ideas to solve problems; and 4) elaboration, namely being able to develop ideas or ideas to solve problems in detail. Based on the indicators presented by Torrance, the ability to think creatively raises indicators in the form of authenticity as well as novelty indicators. Originality functions as a differentiator from previous ideas. As for identifying the ability to think creatively, Hayes (1990) uses three criteria, namely, 1) actions must be something original or novel, 2) actions must be seen as valuable or interesting, and 3) actions must reflect well the thoughts of the creator.

The ability to think creatively is contained as one of the key elements of the values of the Pancasila Student Profile, which consists of: 1) having a noble character; 2) global diversity; 3) mutual cooperation; 4) being independent; 5) critical thinking; and 6) being creative (Kemendikbudristek, 2021). In the Kemendikbudristek's Pancasila Student Profile Teaching Materials, the key creative elements consist of two things, namely: 1) generating original ideas and 2) producing original works and actions. Meanwhile, based on the attitude or non-attitude of the ability to think creatively, namely, 1) curiosity, 2) imaginativeness, 3) feeling challenged by pluralism, 4) daring to take risks, and 5) respect (Munandar, 1992).

Mathematical concepts that contribute to a basic understanding of mathematics should be introduced as early as possible (McFarland & Lewis, 1996). The mathematical concepts in

question are the essential material concepts of mathematics. An understanding of essential mathematical concepts is an understanding of how to use related basic concepts in solving mathematical problems (Fasha, 2015). In the details of junior high school or phase D, the essential material for mathematics consists of: 1) numbers; 2) algebra; 3) measurement; 4) geometry; and 5) data and opportunity analysis (Kemendikbudristek, 2022).

Based on the explanation that has been presented above, researchers are motivated to conduct research on the analysis of mathematical creative thinking ability. The mathematical creative thinking ability indicators used include fluency, flexibility, originality, and elaboration. Each indicator examines a different ability and stands alone. so that students with different abilities and backgrounds will have different abilities according to the mathematical creative thinking ability level. In this study, students' KBKM levels were classified based on characteristics adapted from Siswono (2010), consisting of 5 levels: level 4 (very creative), level 3 (creative), level 2 (quite creative), level 1 (almost not creative), and level 0 (not creative). The following is a table of students' KBKM levels, shown in Table 1.

Table 1. Level of Creative Thinking and Characteristic

Level	Characteristic
Level 4 (very creative)	Students are able to show fluency, flexibility, originality and elaboration in solving problem.
Level 3 (creative)	Students are able to show fluency and originality or fluency and flexibility in solving problems
Level 2 (quite creative)	Students are able to show novelty or flexibility in solving problems.
Level 1 (less creative)	Students are able to show fluency in solving problems.
Level 0 (not creative)	Students are not able to show the four aspects of the indicator in solving problem.

METHODS

The method used in this study is a quantitative descriptive method to analyze the level of mathematical creativity thinking ability of students in one of the Islamic Middle Schools in Bandung. The population in this study was all 8th grade students at an Islamic Middle School in Bandung. The sampling procedure used was purposive sampling. The subjects in this study were 17 eighth-grade students at an Islamic Middle School in Bandung. The research instruments used to collect data were tests of mathematical creativity, questionnaires, and interviews. The mathematical creative thinking ability test consists of 4 questions, with each

question based on indicators of fluency, flexibility, originality, and elaboration. The material tested on the test is essential mathematical material, which is limited to a range of material that includes numbers, comparisons, arithmetic sequences and series, and plane shapes. The questionnaire consists of 15 closed statements based on a scale of student attitudes related to creativity, including: curiosity, imaginativeness, liking challenges, daring, and respect. Questionnaire responses based on a Likert-type scale Unstructured interviews were conducted to validate the results of the questionnaire.

RESULTS AND DISCUSSION

Based on a mathematical creative thinking ability test given to 17 students at an Islamic Middle School in Bandung, it was found that the highest percentage of students were at levels 3 and 0, with a respective percentage of 29%. The results for each level are presented in Table 2.

Table 2. Level of Student's Mathematical Creative Thinking Ability

Level	Number of Students	Percentage
Level 3 (creative)	5	29%
Level 2 (quite creative)	4	24%
Level 1 (less creative)	3	18%
Level 0 (not creative)	5	29%

Table 2 shows that among the 5 levels of mathematical creative thinking ability, the 17 students in one of the Islamic Middle Schools in Bandung fall into levels 0, 1, 2, and 3. There are no students at level 4. Level 1 has the lowest quantity with a percentage of 18%, followed by Level 2, which comprises 24% of the students. 29% of the students are at level 3. However, there is also a level 0 with a percentage of 29%, which is the same as the percentage for level 3. This clearly indicates a distinction between students in the creative and non-creative categories in mathematics. It can be interpreted that the level of students' mathematical creativity at school is still low, highlighting the need for efforts to improve this ability.

Mathematical creative thinking ability consists of four indicators: fluency, flexibility, originality, and elaboration. The results of the students' KBKM tests based on these four indicators will be presented in Table 3.

Table 3. Results of Tests of Students' Mathematical Creative Thinking Ability

Indicators	Percentage		
	No Answer	Wrong	Correct
Fluency	0%	29%	71%
Flexibility	6%	53%	41%
Originality	12%	47%	41%

Elaboration	94%	6%	0%
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Based on the results of the mathematical creative thinking ability test, which included questions representing indicators of fluency, 71% of students were able to answer correctly, although not perfectly. This indicates that students have good fluency skills in problem-solving. Moving on to questions with indicators of flexibility and originality, 41% of students were able to answer correctly, but not perfectly. However, it is worth noting that the 41% of students are not entirely the same individuals. This suggests that students still lack flexibility in problem-solving and struggle with generating original ideas. Regarding the questions representing the elaboration indicator, no students were able to answer correctly, and only 6% of students reached the correct completion step. This indicates that students are still unable to develop ideas and establish connections between the information obtained to solve problems in detail.

Next, the results and discussion of the attitude questionnaire related to students' mathematical creative thinking ability, adapted from Munandar (1992), will be presented. The questionnaire measures 5 attitudes: curiosity, imaginativeness, liking challenges, courage, and respect. The results of the questionnaire are presented in Table 4.

The following are the results of the questionnaire, which are shown in Table 4.

Table 4. Questionnaire Results of Students' Mathematical Creative Thinking Ability

Attitudes	Number of Items	Total Scores	Percentage
Curiosity	4	241/340	71%
Imaginativeness	2	111/170	65%
Liking Challenges	3	161/255	63%
Courage	4	207/340	61%
Respect	2	124/170	73%

According to Table 4, courage ranks last with a rate of 61%. This indicates that the attitude of courage is significantly low when compared to the four other attitudes associated to other mathematical reasoning skills. It was further supported by the findings of the interviews, which revealed that students frequently lacked the courage to stand up for their opinions, presented issues distinct from those of their peers, were confident in the accuracy of their own responses, and successfully completed challenging assignments.

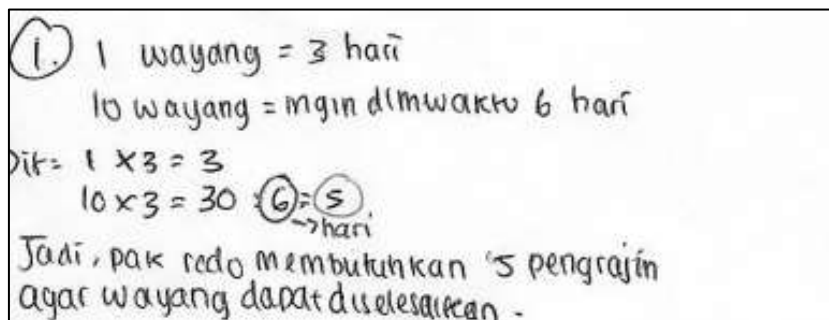
Table 4 further reveals that 63% of the respondents possessed a mindset that favored challenges. This proportion is still rather small. Interviews revealed that students still tended to feel less challenged by unusual queries. Students also lack the motivation they formerly did

to do their tasks correctly and on time. The inventive attitude receives a percentage of 65%, which is not all that different from the attitude of enjoying a task. Students that have an inventive mindset are better at problem-solving because they can provide varied examples based on what is already present.

Table 4 contains data on respect and curiosity. Students' curiosity receives a 71% rating. This attitude is a result of students' excitement for learning mathematics. Consequently, students enjoy novel or experimental activities and are eager to offer questions. However, the thing that makes this curious attitude still need improvement is that students are less interested in reading books or other sources relevant to the subject matter. The majority (73%), or appreciation, is acknowledged. Students appreciate and take into account feedback from their peers and teachers to get better at solving math problems. Students also use the opportunity to convey ideas well.

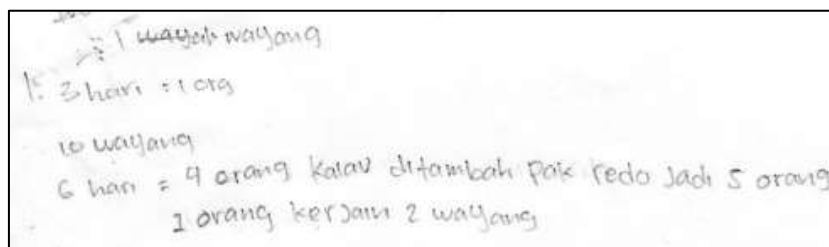
The variations in responses from students with mathematical creative thinking ability levels 0, 1, 2, and 3 will be explored for each indication in light of the discussion above. The discussion also touches on the outcomes of surveys and interviews based on perceptions of mathematical creative thinking ability. Please be aware that there are several more possible choices for the right and ideal response. The answer is discussed in the sentences that follow.

Fluency



① 1 wayang = 3 hari
 10 wayang = mgin diwaktu 6 hari
 Dit: $1 \times 3 = 3$
 $10 \times 3 = 30$ $\textcircled{6} = \textcircled{5}$
 \rightarrow hari
 Jadi, pak redo membutuhkan '5 pengrajin
 agar wayang dapat diselesaikan.

Figure 1. Fluency in Students with Level 3



\rightarrow 1 wayang wayang
 1. 3 hari = 1 org
 10 wayang
 6 hari = 4 orang kalau ditambah pak redo jadi 5 orang
 1 orang kerjain 2 wayang

Figure 2. Fluency in Students with Level 2

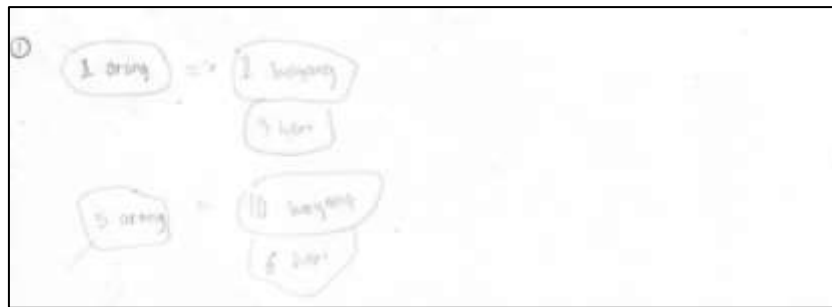


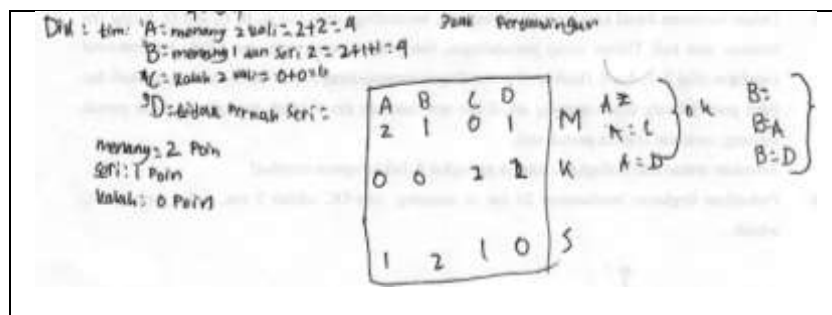
Figure 3. Fluency in Students with Level 1



Figure 4. Fluency in Students with Level 0

Figures 1 to 4 show examples of student completion of questions with fluency indicators. It can be observed that students at levels 3 and 2 include information that is known from the problems presented. Students at levels 3 and 2 take quite systematic steps to find answers and draw conclusions in the form of 5 craftsmen. However, there are still mistakes in writing mathematical symbols to describe the relationship between steps. Uniquely, in Figure 2, the students provide alternative solutions if Mr. Redo (a puppet entrepreneur figure in trouble) also works on the puppet orders. Based on figure 3 students with level 1 write down the information obtained from the problem and then it is accompanied by a direct answer and not accompanied by a conclusion. While in Figure 4, students with level 0 only write down the information obtained from the problems presented.

Flexibility



A → peringkat 1, B Peringkat 2, D Peringkat 3, C Peringkat 6

Figure 5. Flexibility in Students with Level 3

A	B	C	D	
2	1	0	0	M
0	0	2	1	K
1	2	1	0	S

1 2 4 3

$$\left. \begin{matrix} A > B \\ A > C \\ A = D \end{matrix} \right\} \text{OK}$$

$$\left. \begin{matrix} B > C \\ B \neq A \\ D = 0 \end{matrix} \right\}$$

$A = 1, B = 2, D = 3, C = 4$

Figure 6. Flexibility in Students with Level 2

A, B, D, C.

Figure 7. Flexibility in Students with Level 1

D = bidak hitam seti (0)
 C = 2 buah bidak hitam menang (0)
 B = 1 menang seti 2
 A = menang 2 bidak hitam kalah (0)

B
 D
 A
 —

Figure 8. Flexibility in Students with Level 0

Examples of students answering questions with flexibility indications are shown in Figures 5 through 8. According to Figure 5, students with level 3 add knowledge learned from the challenges provided. Students use the standings table to help them rank their solutions to

problems. Similarly, students in grades 2 and 1 who attempt to create a standings chart. However, neither is as comprehensive as those submitted by students at level 3. Meanwhile, students at level 0 merely take notes on the material offered in the problems.

Originality

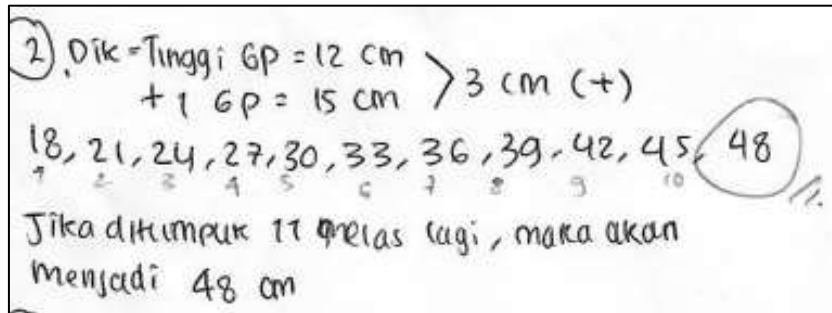


Figure 9. Originality in Students with Level 3

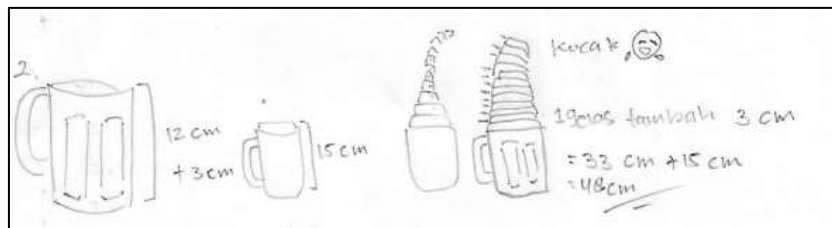


Figure 10. Originality in Students with Level 2

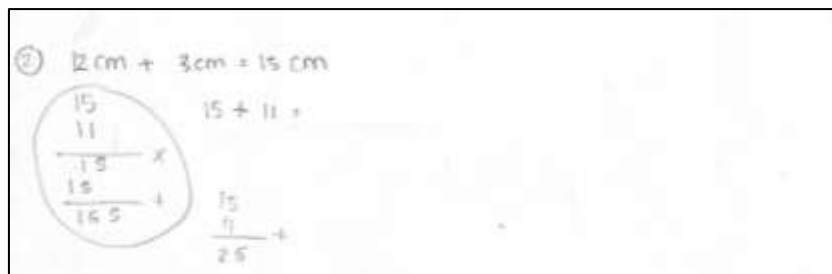


Figure 11. Originality in Students with Level 1

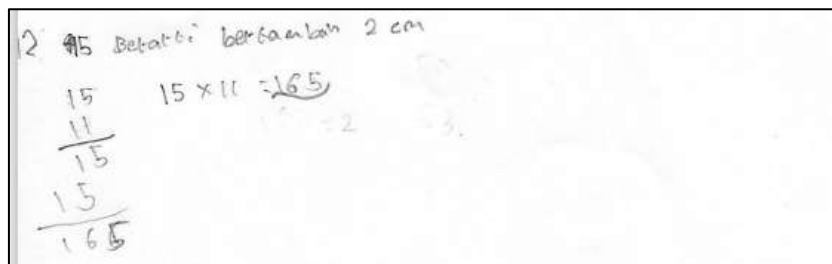


Figure 12. Originality in Students with Level 0

In Figure 9 to 12, examples of student completion of questions with authenticity indicators are presented. It can be observed that students use different solutions and show

the originality of their ideas. In figure 9 students with level 3 write down the known information briefly. He arranges the numbers based on the pattern of stacks of glasses to get the height of the glasses in 11 stacks. In figure 10, students at level 2 visualize the problem. After that, he makes an estimate so he can get the right solution. Meanwhile, students with levels 1 and 0 immediately calculate the height of 11 stacks of glasses, as shown in Figures 11 and 12.

Elaboration

dik = Diameter lingkaran = 24 cm disamping
 OC adalah 5 cm .
 Dit = panjang AC
 Penyelesaian: (menggunakan theorema pythagoras)
 $AC^2 = CB^2 + BA^2$
 $AC = \sqrt{4,9^2 + 5^2}$
 $AC = \sqrt{\quad}$ Tidak tau ñ

24 : 5 =

Figure 13. Elaboration in Students with Level 3

OC = 5 cm , AC = 10 cm

Figure 14. Elaboration in Students with Level 2

4 10 cm

Figure 14. Elaboration in Students with Level 1

7 cm karena lebih jauh

Figure 13. Elaboration in Students with Level 0

In Figure 13 to 16, examples of student completion of questions with elaboration indicators are presented. Students at level 3 strive to build thoughts as indicated in Figure 13 by writing down the material they learn. However, the concepts they attempt to develop end when the Pythagorean theorem is applied. The application of the Pythagorean theorem appears to still be a challenge for students. Students at level 2 simply record material that is already known in figure 14. Students at level 1 and level 0 in Figures 15 and 16 merely record their estimates. This demonstrates that students still struggle to formulate thoughts based on

facts and prior mathematical expertise. The fact that students frequently struggle with geometrical issues is another sign.

CONCLUSION

Mathematical creative thinking ability is a very important thing for students to have. These abilities can support students in dealing with problems in everyday life. In this study, mathematical creative thinking ability students at one of the Islamic Middle School in Bandung were divided into 4 levels, namely level 0, level 1, level 2, and level 3. Students at levels 3 and 2 tend to be able to understand what information is known from the problems presented and compiled. completion steps. whereas students with levels 1 and 0 tend to directly perform calculations on the numbers raised in the problem without looking at the context. The eligibility indicators were fulfilled by students at levels 1, 2, and 3. in contrast to the elaboration indicators, which were not fulfilled by the existing levels.

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