



Article

Students' Thinking Ability In Solving Geometry Transformation Problem Based On Bloom's Taxonomy Class Xi Sman 2 Palangkaraya

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ABSTRACT:

To solve math problems, students' thinking ability is an ability that students should have. This study aims to describe the thinking skills of class XI MIPA SMAN 2 Palangka Raya students in solving geometric transformation problems based on Bloom's Taxonomy with the classification of abilities, including: 1) remembering; 2) understood; 3) apply; 4) analyze; 5) evaluate; and 6) create. This type of research is descriptive with a qualitative approach. The subjects in this study were 32 students consisting of 16 male students and 16 female students. The research instrument was in the form of 4 test items. Check the validity of the data using the persistence of observations. Based on the results of this study.

Key words: *thinking ability; Bloom's Taxonomy Revised; geometric transformation.*

INTRODUCTION

Developments in the field of information and communication technology are now underpinned by developments in mathematics. According to Bird (2004), mathematics is a branch of universal knowledge that underlies the development of modern technology. Therefore, in order to master and create technology in the future, it is necessary to have a strong mastery of mathematics by students from an early age. Students are expected not only to be good at theory and memorizing, but also required to understand and have the ability to think to be able to solve math problems correctly and precisely.

Students in solving problems will face problems that have never been encountered or that have ever been encountered. Experience in solving problems can train students to use

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their abilities to solve problems, so that their thinking skills increase. Siswono (2008: 35) explains "there are several factors that influence the ability to solve problems, namely initial experience, mathematical background, desire and motivation, and problem structure".

Geometry transformation material is one of the materials studied by class XI MIPA 1 students of SMAN 2 Palangka Raya. In geometric transformations as well as math problems in other materials, there are many questions that require students' thinking skills, but students often experience difficulties in solving problems. Geometry transformation material includes translations (shifts), reflections (reflections), rotations (turnarounds), dilations (multiplications), and matrix transformations (Pariwara, 2020).

Based on the results of an interview with a mathematics teacher, the mathematics learning outcomes of students in class XI MIPA 1 at SMAN 2 Palangka Raya are still low due to students' low thinking skills. This is reinforced by the results of daily tests in the odd semester of 2019/2020 where only 35% of 35 students achieved the minimum completeness criteria (KKM), where the KKM set by the school for mathematics was 78. The teacher has made improvements by giving remedial, but this is not based on the identification of students' thinking skills in solving problems.

The ability to think is one of the ability life needs to be developed through the educational process. Thinking skills are very important to equip students to compete in a global world (Anjasari, 2014). The development of 21st century science requires every individual to become a qualified human resource (HR). The characteristics of quality human resources are being able to manage, use, and develop thinking skills.

Thinking ability is the ability to combine attitudes, knowledge, and abilities that enable a person to be able to change his environment more effectively. Thinking ability according to Bloom is divided into two, namely: first, lower order thinking skills which consist of three level indicators namely: remembering (C1), understanding (C2), and applying (C3). Second, higher order thinking skills which consist of three indicators, namely: analyzing (C4), evaluating (C5), and creating (C6) (Sobirin and Kusairi, 2016). This classification of thinking abilities is called the Revised Bloom's Taxonomy. If students have the ability to think at all levels of thinking, then students will be able to solve complex and varied problems.

Based on the levels proposed by Bloom, students should have the ability to think according to these levels. However, is this ability possessed by students, especially students in class XI SMA? Can students' thinking skills in solving problems be known according to the levels proposed by Bloom? Thus, one way to describe and determine the quality of student responses (answers) and their relation to thinking skills in solving math problems is to use the Revised Bloom's Taxonomy. The Revised Bloom's Taxonomy can also describe how the structure of cognitive complexity or student responses from existing levels.

Based on the description above, it is necessary to conduct research to describe how students' thinking skills solve geometric transformation questions for class XI MIPA SMAN 2 Palangka Raya.

METHODS

This type of research is a descriptive study with a qualitative approach to describe students' thinking skills in solving geometry transformation questions for class XI MIPA 1 SMAN 2 Palangka Raya in terms of the revised bloom taxonomy. This research was conducted in the odd semester of the 2020/2021 school year.

The instrument in this study was a matter of students' thinking ability tests to obtain data regarding students' thinking skills in mathematics on geometric transformation material.

To collect data in this study used a test of students' thinking skills. The test used is a test of students' thinking skills in mathematics with geometric transformation material that has been studied by students which includes indicators of students' thinking abilities, namely: 1) Remember; 2) Understanding; 3) Apply; 4) Analyze; 5) Evaluate; and 6) Create. This test is in the form of a description with the following questions:

SOAL

1. Persegi panjang ABCD mempunyai koordinat titik A(-2, 1), B(-2, -1), C(1, -1), dan D(1, 1). Persegi panjang tersebut ditransformasikan terhadap matriks $\begin{pmatrix} 3 & 1 \\ 6 & 3 \end{pmatrix}$, tentukan luas persegi panjang A'B'C'D'!
2. Bayangan titik P(a, b) oleh rotasi terhadap titik pusat (0, 0) sebesar 90° adalah P'(-10, -2). Tentukan nilai $a + 2b$?
3. T_1 adalah transformasi rotasi dengan pusat M(2,1) dan sudut putar -90° . T_2 adalah transformasi pencerminan terhadap garis $y = -x$. Bila koordinat peta titik A oleh transformasi $T_1 \circ T_2$ adalah A'(3, -4). Tentukan koordinat titik A.
4. Sebuah kamera memproses gambar dengan mentransformasikan gambar tersebut terhadap matriks $\begin{pmatrix} 1 & 5 \\ 4 & 3 \end{pmatrix}$. Selanjutnya, gambar tersebut ditransformasi lagi terhadap matriks $\begin{pmatrix} 4 & 1 \\ 8 & 1 \end{pmatrix}$. Jika kamera tersebut mengambil gambar suatu benda dengan luas 32 cm^2 , berapakah luas benda hasil potretan?

RESULTS

After paying attention to the description of the results of student answers and data analysis of all research subjects it was found that the average thinking ability of students in solving geometric transformation questions, namely level C4 (analyzing) where C4 (analyzing) is the lowest level of high-order thinking skills (Anderson and Krathwohl, p. 15). Meanwhile, at C5 (evaluating) and C6 (creating) levels, none of the students achieved it. This is in accordance with Ardhana's research (2017) which states that students have been able to reach a level of thinking up to C4 (analyzing). Meanwhile, at level C5 (evaluating) and C6 (creating) all students could not achieve it.

Based on the results of students' answers in solving geometric transformation questions, most students did not understand the concept of geometric transformation material and could not use formulas. This is because students' thinking skills are still relatively low even though most students have reached level C4 (analyzing) where C4 (analyzing) is the lowest level of higher-order thinking skills. The lack of students' ability to understand the concept of geometric transformations in using formulas to solve problems is also due to students' lack of skills in thinking skills. This is in line with the results of

research by Ardhana (2017) that there are various errors in understanding the concept by students and the ability to apply a mathematical concept that is less skilled.

DISCUSSION

The results of the research conducted on 32 students in the class who were the subject of the study are described as follows:

a. Description of Student Answers for Test Question Number 1 (One)

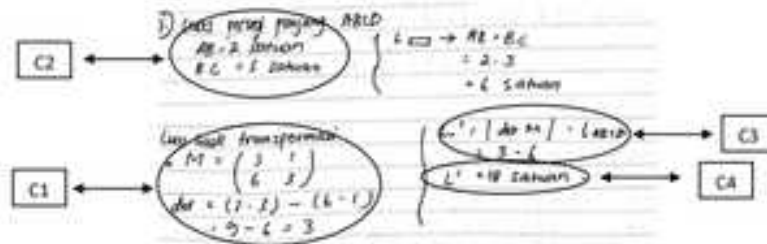
From the results of the tests given to students for question number 1 (one) related to geometric transformations, a description of students' thinking abilities was obtained based on the revised Bloom's Taxonomy, namely as follows:

Table 1. Description of the Levels of Students' Thinking Ability based on the Revised Bloom's Taxonomy for Problem Number 1 (One):

Student Code	Interpretation	Revised Bloom's Taxonomy levels
S01, S02, S03, S04, S05, S06, S07, S08, S09, S10, S11, S12, S13, S14, S15, S16, S17, S18, S19, S20, S21, S22, S23, S24, S25, S26, S27, S28, S29, S30, S31, S32.	Students are able to recall the meaning and formula of geometric transformations	C1 – Remember
S01, S02, S03, S04, S05, S06, S07, S08, S09, S10, S11, S12, S13, S14, S15, S16, S17, S18, S19, S20, S21, S22, S23, S24, S25, S26, S27, S28, S29, S30, S31, S32.	Students are able to express the concept of simple geometric transformations	C2 – Understanding
S01, S02, S03, S04, S05, S06, S07, S08, S09, S10, S11, S12, S13, S14, S15, S16, S17, S18, S19, S20, S21, S22, S23, S24, S25, S26, S27, S28, S29, S30, S31, S32.	Students are able to use concepts and formulas in the right context	C3 – Applying
S01, S02, S03, S04, S05, S06, S07, S08, S09, S10, S11, S12, S13, S14, S15, S16, S17, S18, S19, S20, S21, S22, S23, S24, S25, S26, S27, S28, S29, S30, S31, S32.	Students can already determine which formula is used and put the known elements	C4 – Analyze
-	Students are able to draw conclusions based on their answers	C5 – Evaluating
-	Students can already use alternative ways in the process	C6 – Creating

The data in table 1 describes the description of student answers that belong to a certain level/level in the revised Bloom's Taxonomy based on the questions that have been solved for number one (1). Based on these data, 32 students were only able to reach level C4 (analyze) and no students were able to reach C5 (evaluate) and C6 (create).

The following is an example of student answers for question number 1 (one):



From the results of one student's answer it can be seen that students can only reach the highest level, namely C4 (analyze). For level C1 (remembering), it can be seen that students are able to remember and rewrite the geometric transformation formula, namely the determinant of the matrix. For level C2 (understanding), it can be seen that students understand what is known in the problem. For level C3 (applying), it can be seen that students are able to use the matrix determinant formula to find the area of a rectangle after being transformed. For level C4 (analyzing), it can be seen that students are able to determine the matrix determinant formula and find the area of a rectangle after being transformed.

From the results of the data analysis of question number 1 (one), it can be seen that the average thinking ability of students in working on test questions based on the Revised Bloom's Taxonomy, there are still many students who belong to levels III and IV. Overall it can be said that almost all students of class XI MIPA 1 SMAN 2 Palangka Raya cannot reach their thinking skills at C5 (evaluating) and C6 (creating) levels.

b. Description of Student Answers for Test Question Number 2 (Two)

From the results of the tests given to students for question number 2 (two) related to geometric transformations, a description of students' thinking abilities was obtained based on the revised Bloom's Taxonomy, namely as follows:

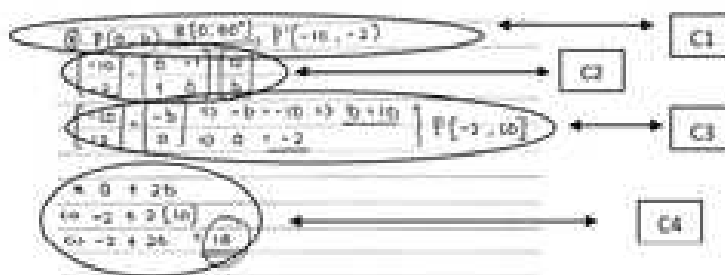
Table 2. Description of Students' Thinking Ability Levels based on Revised Bloom's Taxonomy for Problem Number 2 (Two):

Student Code	Interpretation	Revised Bloom's Taxonomy levels
S01, S02, S03, S04, S05, S06, S07, S08, S09, S10, S11, S12, S13, S14, S15, S16, S17, S18, S19, S20, S21, S22, S23, S24, S25, S26, S27, S28, S29, S30, S31, S32.	Students are able to recall the meaning and formula of geometric transformations	C1 – Remember
S01, S02, S03, S04, S05, S06, S07, S08, S09, S10, S11, S12, S13, S14, S15, S16, S17, S18, S19, S20, S21, S22, S23, S24, S25, S26, S27, S28, S29, S30, S31, S32.	Students are able to express the concept of simple geometric transformations	C2 – Understanding
S01, S02, S03, S04, S05, S06, S07, S08, S09, S10, S11, S12, S13, S14,	Students are able to use concepts and formulas in the right context	C3 – Applying

S15, S16, S17, S18, S19, S20, S21, S22, S23, S24, S25, S26, S27, S28, S29, S30, S31, S32.		
S01, S02, S03, S04, S05, S06, S07, S08, S09, S10, S11, S12, S13, S14, S15, S16, S17, S18, S19, S20, S21, S22, S23, S24, S25, S26, S27, S28, S29, S30, S31, S32.	Students can already determine which formula is used and put the known elements	C4 – Analyze
-	Students are able to draw conclusions based on their answers	C5 – Evaluating
-	Students can already use alternative ways in the process	C6 – Creating

The data in table 2 describes the description of student answers that belong to a certain level/level in the revised Bloom's Taxonomy based on the questions that have been solved for number two (2). Based on these data, 32 students were only able to reach level C4 (analyze) and no students were able to reach C5 (evaluate) and C6 (create).

The following is an example of student answers for question number 2 (two):



From the results of one student's answer it can be seen that students can only reach the highest level, namely C4 (analyze). For level C1 (remembering), it can be seen that students are able to remember and rewrite the rotation formula. For level C2 (understanding), it can be seen that students are able to construct what is known in the problem with the rotation formula. For level C3 (applying), it can be seen that students are able to use the rotation formula to find values of a and b. For level C4 (analyzing), it can be seen that students are able to determine the rotation formula and find the sum result.

From the results of the data analysis of question number 2 (two), it can be seen that the average thinking ability of students in working on test questions based on the Revised Bloom's Taxonomy, there are still many students who belong to levels III and IV. Overall it can be said that almost all students of class XI MIPA 1 SMAN 2 Palangka Raya cannot reach their thinking skills at C5 (evaluating) and C6 (creating) levels.

c. Description of Student Answers for Test Question Number 3 (Three)

From the results of the tests given to students for question number 3 (three) related to geometric transformations, a description of students' thinking abilities was obtained based on the revised Bloom's Taxonomy, namely as follows:

Table 3. Description of Students' Thinking Ability Levels based on Revised Bloom's Taxonomy for Problem Number 3 (Three):

Student Code	Interpretation	Revised Bloom's Taxonomy levels
S01, S02, S03, S04, S05, S06,	Students are able to recall the	C1 – Remember

S07, S08, S09, S10, S11, S12, S13, S14, S15, S16, S17, S18, S19, S20, S21, S22, S23, S24, S25, S26, S27, S28, S29, S30, S31, S32.	meaning and formula of geometric transformations	
S01, S02, S03, S04, S05, S06, S07, S08, S09, S10, S11, S12, S13, S14, S15, S16, S17, S18, S19, S20, S21, S22, S23, S24, S25, S26, S27, S28, S29, S30, S31, S32.	Students are able to express the concept of simple geometric transformations	C2 – Understanding
S03, S04, S05, S07, S09, S12, S14, S15, S16, S18, S20, S23, S24, S25, S26, S30, S31, S32.	Students are able to use concepts and formulas in the right context	C3 – Applying
S01, S02, S06, S08, S10, S11, S13, S17, S19, S21, S22, S27, S28, S29.	Students can already determine which formula is used and put the known elements	C4 – Analyze
-	Students are able to draw conclusions based on their answers	C5 – Evaluating
-	Students can already use alternative ways in the process	C6 – Creating

The data in table 3 describes the description of student answers that belong to a certain level/level in the revised Bloom's Taxonomy based on the questions that have been solved for number three (3). Based on these data, 18 students were only able to reach level C3 (apply), 14 students were only able to reach C4 (analyze) and no students were able to reach C5 (evaluate) and C6 (create).

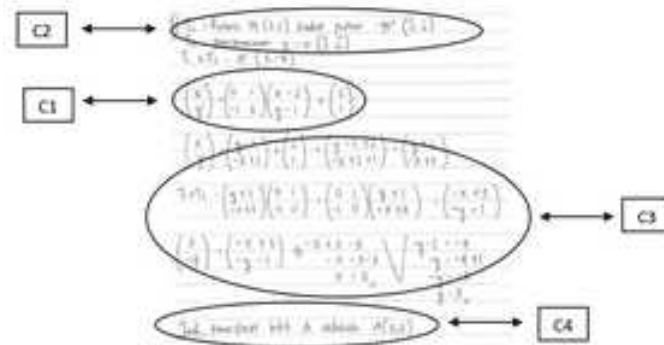
The following is an example of student answers for question number 3 (three) which reached level C3 (apply):

The image shows handwritten mathematical work for a reflection problem. It is annotated with Bloom's Taxonomy levels:

- C2** points to the initial problem statement in Indonesian: "Dik: titik pusat PA(2, 1) dgn arah putar -90°" and "Dit: menentukan spm".
- C1** points to the reflection formula: $T_P = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix} \begin{pmatrix} x-a \\ y-b \end{pmatrix} + \begin{pmatrix} a \\ b \end{pmatrix}$.
- C3** points to the final transformation matrix: $T = \begin{pmatrix} 1 & 1 \\ -2 & 1 \end{pmatrix} \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$.

From the results of one student's answer it can be seen that students can only reach the highest level, namely C3 (apply). For level C1 (remembering), it can be seen that students are able to remember and rewrite formulas for reflection. For level C2 (understanding), it can be seen that students understand what is known in the problem. For level C3 (applying), it can be seen that students are able to use the reflection formula but cannot solve the problem correctly.

The following is an example of student answers for question number 3 (three) which reached level C4 (analyzing):



From the results of one student's answer it can be seen that students can only reach the highest level, namely C4 (analyze). For level C1 (remembering), it can be seen that students are able to remember and rewrite the reflection formula. For level C2 (understanding), it can be seen that students understand what is known in the problem. For level C3 (applying), it can be seen that students are able to use the reflection formula to find x and y values. For level C4 (analyzing), it can be seen that students are able to determine the reflection formula and get the answer.

From the results of the data analysis of question number 3 (three), it can be seen that the average thinking ability of students in working on test questions based on the Revised Bloom's Taxonomy, there are still many students who belong to levels III and IV. Overall it can be said that almost all students of class XI MIPA 1 SMAN 2 Palangka Raya cannot reach their thinking skills at C5 (evaluating) and C6 (creating) levels.

d. Description of Student Answers for Test Question Number 4 (Four)

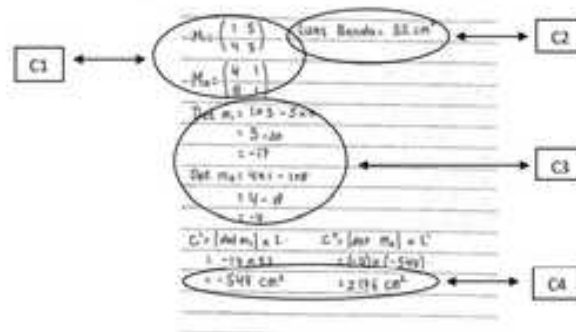
From the results of the tests given to students for question number 4 (four) related to geometric transformations, a description of students' thinking abilities was obtained based on the revised Bloom's Taxonomy, namely as follows:

Table 4. Description of Students' Thinking Ability Levels based on Revised Bloom's Taxonomy for Problem Number 4 (Four):

Student Code	Interpretation	Revised Bloom's Taxonomy levels
P01, P02, P03, P04, P05, P06, P07, P08, P09, P10, P11, P12, P13, P14, P15, P16, P17, P18, P19, P20, P21, P22, P23, P24, P25, P26, P27, P28, P29, P30, P31, P32	Students are able to recall the meaning and formula of geometric transformations	C1 - Remember
P01, P02, P03, P04, P05, P06, P07, P08, P09, P10, P11, P12, P13, P14, P15, P16, P17, P18, P19, P20, P21, P22, P23, P24, P25, P26, P27, P28, P29, P30, P31, P32	Students are able to express the concept of simple geometric transformations	C2 - Understanding
P01, P02, P03, P04, P05, P06, P07, P08, P09, P10, P11, P12, P13, P14, P15, P16, P17, P18, P19, P20, P21, P22, P23, P24, P25, P26, P27, P28, P29, P30, P31, P32	Students are able to use concepts and formulas in the right answer	C3 - Applying
P01, P02, P03, P04, P05, P06, P07, P08, P09, P10, P11, P12, P13, P14, P15, P16, P17, P18, P19, P20, P21, P22, P23, P24, P25, P26, P27, P28, P29, P30, P31, P32	Students can already determine which formula is used and put the known elements	C4 - Analyze
	Students are able to draw conclusions based on their answers	C5 - Evaluating
	Students can already use alternative ways in the process	C6 - Creating

The data in table 4 describes the description of student answers that belong to a certain level/level in the revised Bloom's Taxonomy based on the questions that have been solved for number four (4). Based on these data, 32 students were only able to reach level C4 (analyze) and no students were able to reach C5 (evaluate) and C6 (create).

The following is an example of student answers for question number 4 (four):



From the results of data analysis on question number 4 (four), it can be seen that on average students' thinking skills in working on test questions based on the Revised Bloom's Taxonomy, there are still many students who belong to levels III and IV. Overall it can be said that almost all students of class XI MIPA 1 SMAN 2 Palangka Raya cannot reach their thinking skills at C5 (evaluating) and C6 (creating) levels.

CONCLUSION

Based on the results of the research and discussion it can be concluded that, namely: The thinking ability of class XI MIPA 1 students of SMAN 2 Palangka Raya is at level C4 (analyzing) according to the Revised Bloom's Taxonomy. Where C4 (analyze) is the lowest level of high-order thinking skills. None of the students reached C5 (evaluating) and C6 (creating). Most of the students were unable to understand the concept of geometric transformations and could not use formulas to solve problems.

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