Mathematical Representation Ability of Prospective Student Teacher in Resolving Transformation Geometry Problems Reviewed in Epistemology Aspect

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Abstract. This study was conducted to describe the mathematical representation ability of prospective student-teachers based on visual indicators, mathematical expressions and written texts, and to analyze the epistemological aspects of prospective student teachers in completing transformation geometry. The research was descriptive with qualitative approach. The research subjects were 23 mathematics prospective teacher students of STKIP Singkawang. Data collection technique was in test, observation, interview and documentation form. The results of data analysis showed that the mathematical representation ability of prospective student teachers on visual indicators (50.92%), mathematical expressions (55.18%) and written texts (53.32%) are categorized as low overall. On the other hand, for the epistemology aspects, student teachers had difficulties in solving transformation geometry problems including 1) the difficulty in defining transformation geometry correctly and completely; 2) the difficulty in understanding and applying concepts; 3) in writing notation; 4) unable to work on the questions given with a complete procedure; 4) the difficulty in illustrating the questions presented in the constructing evidence.

1. Introduction
One of mathematic learnings’ objectives is to develop students’ abilities in thinking mathematically [1]. The efforts are needed to develop students’ mathematical abilities in mathemetic learning. The mathematical abilities that required to be developed is mathematical representation ability [2]. According to [3] the representation is creativity that involves the disclosure or expression of ideas and feelings and the use of various ways of doing it. With the representation, students were invited to describe, translate, express to make a model from mathematical ideas or concepts and their relationships into various mathematics form. The mathematical representation indicators are (1) making an image to clarify the problem and facilitate its solution; (2) the representation of mathematical expressions including to make a mathematical model of the problem given, to solve the problem involving mathematical expressions; (3) Written text representation including to answer the questions by using written text [4]. The importance of representation ability is the basis for the building concepts and mathematical thinking. Related to this, to do problem solving, it is first initiated by a representation of the presented problem definition. If it will be further studied in learning abstract concepts on transformation geometry, it is not enough to do it with knowledge transfer, but it takes a deep process of concept formation with a series of abstract concept formation activities called the abstraction process [5].

This study presented mathematical representation related to the transformation geometry concept. The Transformation Geometry subject is one of the compulsory subjects that must be taken by students in the mathematics education study program at STKIP Singkawang in the sixth semester. This subject aims to equip mathematics education students in one branch of geometry. This subject requires the ability of students to present geometric concepts in the abstract forms into writing or drawing forms. It happens because this subject contain symbols and transformation rules formulas and images showing the transformation from a particular point, line or field. Every geometry learner is expected to be able to analyze the objects into a geometric concept and to be able to construct a geometrical knowledge with formal evidences [6]. In solving problems related to geometry of transformation, it requires representation capabilities, where the ability of representation supports the usage of various mathematical forms in explaining mathematical ideas, translating among mathematical forms and
interpreting mathematical phenomena with various mathematical forms, namely visual (graphs, tables, diagrams and drawings); symbolic (mathematical statement, numerical or algebraic symbol), verbal (words or written text). Based on these problems, the researcher describes the ability of students' mathematical representation and examines the study of learning difficulties in terms of epistemological aspects in completing material transformation geometry.

2. Methods

The method used is descriptive. Descriptive method is research method that is used to describe, explain and answer the questions about the phenomena and events that occur at this time, both about phenomena as they are and the analysis of relationships among variables in a phenomenon [7]. Meanwhile the approach used in this study is a qualitative approach. According to Mc Millan & Schumacher in [8] a qualitative approach is an investigative approach because the researchers usually collect the data face to face and interact with the people at the research site. Qualitative research aims to explain the phenomena that occur as a whole through collecting data obtained. By qualitative approach, the researchers want to obtain in-depth data so that they can determine the ability of students’ mathematical representation in solving problems of transformation geometry. As for the learning difficulties of students from the epistemological aspects of transformation geometry subject with indicators namely concepts, visualization, principles, understanding problems, and mathematical proof. On the other hand, for the type of research conducted in this study is descriptive research.

In this study, the research subjects were STKIP Singkawang sixth semester students as many as 23 people in the 2017/2018 academic year and the object in this study was the students’ mathematical representation ability. Furthermore, the data source in this study was primary data sources form consisting of sixth semester students who was also as the subjects of the research and questions of the test given in accordance with the research guidelines. The secondary data sources were observation data, the test result documentation of the research and the interview result in photos and recordings forms.

3. Results and Discussion

This research was conducted in STKIP Singkawang where the transformation geometry material was taught in this even semester. The researcher gave a test related to geometry material for the sixth semester students of class A. The scores obtained from the test of ability representation are shown in table 1.

### Table 1. The average score percentage of the students’ mathematical representation ability for each question

| Representation Ability | Visual | Mathematical Expressions | Written text |
|------------------------|--------|--------------------------|--------------|
|                        | 1c     | 3a                       | 3b           |
|                        | 1a     | 1b                       | 3c           |
|                        | 4      | 5                        | 1d           |
|                        | 2a     | 2b                       |              |
| %                      | 50.92% | 58.33%                   | 61.11%       |
| %                      | 33.33% | 63.88%                   | 33.33%       |
| %                      | 59.25% | 48.14%                   | 49.07%       |
| %                      | 72.22% | 63.88%                   |              |
| *Based on table 1, the total score for the ability of visual representation for number 1c is 50.92%, 3a for 58.33% and 3b for 61.11%. For the ability of mathematical expression representation, the score for questioning items is 33.33% for number 1a, 1b is 63, 88%, number 3c is 59.25%, number 4 is 48.14% and number 5 is 33.33%. Meanwhile, for the ability of the words representation, the percentage of each question average score 49.07% for number 1d, 72.22% for 2a, and 63.88% for number 2b. Moreover, the test result of the ability of mathematical representation of each student based on the aspects mentioned above (visual, mathematical experiments, written text words) can be seen in table 2 below.
Table 2. Test result of the students’ mathematical representation ability for each indicator

| No | Representation ability aspects | Total score average percentages | category |
|----|--------------------------------|--------------------------------|----------|
| 1  | visual                         | 50.92%                         | Low      |
| 2  | Mathematical Expression        | 55.18%                         | Low      |
| 3  | Written word text              | 53.32%                         | Low      |

Based on the results of the mathematical representation test in Table II, it can be seen that the students’ visual representation ability is categorized as low with a percentage of 50.92%, the ability of mathematical expression is also low with a percentage of 55.18%. Similarly, the ability to represent written text words falls to the low category with a percentage of 53.32%. The researcher groups the results of student answers based on the type of representation and then describes each indicator of mathematical representation in the following table 3.

Table 3. Description of the students’ answer results for each indicator

| No | Representation Capability Indicator | The results of the work on the test questions by the prospective Singkawang STKIP teacher | Description |
|----|-------------------------------------|---------------------------------------------------------------------------------|-------------|
| 1  | Visual                              | If domain f = \{-2,-1,1,2,3\} dan \( f(t) = \{(x,y)\} \mid x^2 + y^2 = t^2, t = \text{domain } f \), then make point sketch (b)! | In type 1 answer groups, Students are able to describe function arrow diagrams, but in their understanding visually the results of the student’s work do not have an arrow that connects the domain function with the codomain function. Respondents are just pairing members, regardless of the direction of the relationship between each member or the relationship between the sets. Respondents can pair each member without understanding what functions are mapped. Respondents are confused by their own function because what they understand from a |
Type 2 answer

3. Last week, Candra sat in the right corner of the first row in his class. This week, he moved to the third row of the fourth lane occupied by Dimas last week. Dimas himself moved to the second row of the second lane which Sari occupied last week. Note the transfer of Candra and Dimas’ seats

Type 1 answer

Transcribed version

a. The first Candra seats are in row 6 and column 6. Then candra moved 2 lanes to the left and 2 rows backward. when moving the position of candra has translated 2 left and 2 units upwards which can be written with vector \[ \begin{pmatrix} -2 \\ 2 \end{pmatrix} \]
b. The first dimas seats are in row 4 and column 4. Then dimas move 2 lanes to the left and 1 row to the front. When switching positions, dimas has translated 2 left and 1 down units that can be written with vectors \([2 \ -1]\) and been able to associate or make connections from the translation concept to be shaped into the image, this is because the concept of prerequisites that the students have is still weak.

Type 2 answer

Translated version

Transformation of the sitting of candra by transformation. Last week candra was at the initial point \([0 \ 0]\). Then this week candra moved as far as 3 rows up in the fourth lane (Dimas place) then the movement or transparency is \([\begin{array}{c} -2 \\ 2 \end{array}]\). Then the transfer of candra if made in the form of transformation is by the formula of displacement or transition

\[
\begin{bmatrix} x_1 \\ y_1 \end{bmatrix} = \begin{bmatrix} x + a \\ y + b \end{bmatrix}
\]

with

\[
P(a, b) = (0, 0)
\]

\[
P(X, Y) = (-2, 2)
\]

then

\[
\begin{bmatrix} x_1 \\ y_1 \end{bmatrix} = \begin{bmatrix} -2 + 0 \\ 2 + 0 \end{bmatrix} = \begin{bmatrix} -2 \\ 2 \end{bmatrix}
\]

Dimas moves 2 steps left and 1 step down or moves from the second row of the second row if in the form of transformation

\[
\begin{bmatrix} x_1 \\ y_1 \end{bmatrix} = \begin{bmatrix} x + a \\ y + b \end{bmatrix} = \begin{bmatrix} -2 + 0 \\ -1 + 0 \end{bmatrix} = \begin{bmatrix} -2 \\ -1 \end{bmatrix}
\]

Students who answer use type 2 answers in completing the final results and provide incorrect explanations. Students do not write down the completion steps to find the final grade, researchers find writing that is less systematic, namely the use of symbols. Students do not present or sketch the results of the displacement of the given problem (translation). Students do not understand translational concepts and low problem solving skills.

2 Mathematical Expressions

Answers to questions 1a and 1b

In the answer
translated version

range of \(f\)

\(t = -2\) then \(f(-2) = (x^2 + y^2) = 4\)

\(t = -1\) then \(f(-1) = (x^2 + y^2) = 1\)

\(t = 1\) then \(f(1) = (x^2 + y^2) = 1\)

\(t = 2\) then \(f(2) = (x^2 + y^2) = 4\)

\(t = 3\) then \(f(3) = (x^2 + y^2) = 9\)

apakah \(f\) fungsi satu-satu?

The condition for an injective function is a one-to-one function if only if for any \(a_1\) and \(a_2\) with \(a_1 \neq a_2\) apply \(f(a_1) \neq f(a_2)\)

domain

\(t_1 = -2\) then \(f(t_1) = 4\)

\(t_2 = -1\) then \(f(t_2) = 1\)

\(t_3 = 1\) then \(f(t_3) = 1\)

\(t_4 = 2\) then \(f(t_4) = 4\)

\(t_5 = 3\) then \(f(t_5) = 9\)

because \(t_1 = 2\) and \(t_4 = -2\) have the same \(f(t)\) then an effective function is estimated

Problem number 3c

Type 1 answer

Translated version

With the same principle, if the points \(P(x, y)\) are translated with \(T_1 = \begin{bmatrix} a \\ b \end{bmatrix}\), then the shadow is obtained \(P'(x + a, y + b)\), mathematically can be written \(P(x, y)\)

\(T_1 = \begin{bmatrix} a \\ b \end{bmatrix}\) \(\rightarrow\) \(P'(x + a, y + b)\)

above, there is an error in understanding the function of one one. Students here do not understand the concept of one one function. Students explain that the answer above is an injective function, while the right answer is not a one-one function.

One of the indicators that can be measured in this aspect is that students are able to make equations, models or mathematical expressions from existing data / information. From the results of the work of students with type 1 questions, students have not been able to make mathematical expressions, this is due to the results of type 1 work, only repeating the direction of the questions and
Type 2 answer

Translated version

\[ N (a, b) \begin{bmatrix} 2 \\ 2 \end{bmatrix} N' (a - 2, b + 2) \] with the same principle

arranged every \((x, y)\) is translated and \(T1 = \begin{bmatrix} a \\ b \end{bmatrix}\) can

then be explained by the shadow \(P' (x + a, y + b)\) can

be written mathematically:

\[ P (x, y) T1 \begin{bmatrix} a \\ b \end{bmatrix} \rightarrow P' (x + a, y + b) \]

Type 3 answers

Translated version

with the same principle, if the points \(P (x, y)\) are

translated with \(T1 = \begin{bmatrix} a \\ b \end{bmatrix}\), then the shadow is obtained

Problem number 4

Type 1 answer

examples given. In the visual representation for the answer to type 1 respondents the conceptual understanding is low.

The results of number 3c type 2, students make cartesius diagrams first by denoting the x-axis and y-axis, after making the cartesian diagram the respondent makes an arbitrary point, here the respondent has difficulty in determining the right point and the correct image, so the respondent's image is not can present picture ability well. Furthermore, to make mathematical expressions, respondents have not yet understood, so they repeat the direction of the question in the same form

In accordance with the type 3 answer image, it can be seen that students did not work on the questions given. This means that students do not understand and do not understand in solving the given problem and weak memory.

students explain using known
Is known (i) if \( P \in s \rightarrow N(P) = P \neq P \)
(ii) if \( P \in s \) then \( m(P) = P' \in s \) is a line
Obviously for each \( P \in S \rightarrow m(P) = P \in V \)
So that the entire area of origin and the range (range) are the euclid fields in the set \( V \)
a. Surjective
Based on the provisions of (i) and (ii) if \( P \in S \rightarrow m(P) = P \neq P \)
\( P \notin s \) then \( m(P) = P \cdot \in s \) is a line \( \perp PP' \)
So that for each \( P \in v \) there is always \( P \in V \), where \( P \neq m(P) \rightarrow m \) is surjective
b. Injective
for example \( A \neq B \) where \( A, B \in V \)
If \( A \in S \) and \( B \in S \rightarrow m(A) = A' = A \) and \( m(B) = B' = B \)
If \( A \in S \) and \( B \in S \), then:
\( m(A) = A' = A \)
\( m(B) = B' \in S \perp BB' \) and \( A' \neq B' \)
If \( A \in S \) and \( B \notin S \)
Suppose \( m(A) = m(B) \) or \( A' = B' \). So \( AA' \perp S \) and \( BB' \perp S \).
This shows that from one point there are two perpendicular lines and this is not possible. So if \( A \neq B \) then \( A' \neq B' \) then it can be concluded that the last supposition is wrong. So it is proven that \( M \) is a transformation

Type 2 answer

In the answer picture of type 2 students in solving the problems given have not been able to relate the problem to the information provided with information that students have. Students in providing information on the questions and connect with information that students have and respondents are able to provide the right reasons in proving that reflection is a transformation.
Translated version

will be proven M is a transformation:

(i) It will be proven that Ms is an objective function of taking any \( x' \in v \)

\[
\text{Suppose } x' \in s, \text{ then } x = x' \text{ because } Ms (x) = x = x'.
\]

\[
\text{Suppose } x' \text{ is } \notin s
\]

From the geometry properties there are \( x \) element \( s \) to be \( xx' \) segment's axis. This means that \( Ms (x) = x' \) means that every \( x' \) has propeta member \( v \)

Conclusion: Ms is the objective function

Problem Number 5
Type 1 answer

Half a turn is isometry

A half turn reflects each plane point at a particular point. Therefore half a turn is also called reflection at a point or reflection at a point. Each isometry is a reflection of another type of line or a composition of two or more lines of reflection. Half a turn can be expressed as a product of two reflection lines. This will guarantee that half the turn is isometric. It will be proven that half is isometry.

Proof

Take points P, A and B that are not in line P as the center of play.

Submit A with \( Hp \), so \( Hp (A) = A \) 'with \( AP = PA' \)

Submit B with \( Hp \), so \( Hp (A) = B \) 'with \( BP = PB' \)

The results of student work, for each step and workmanship are correct. The student explained that \( <APA = <'A'P'A' \) is the opposite. Students can link information provided with information held by respondents. The explanation given precisely in showing half the round is isometry. This means that students understand the questions given.
Pay attention $\triangle A'PB'$ Because $AP = PA'$
$\angle APB = \angle A'PB'$ (Opposite)
$BP = PB'$
Then $\triangle APB$ dan $\triangle A'PB'$ Congruent
As a result $AB = A'B'$
So half a turn is isometry

**Type 2 answer**

Translated version
It will be investigated that half a turn is isometric
Let $P(a, b)$
Take any two points $A(x, y)$ and $B(p, q)$
Let's say $A'(x', y') = H (A)$ and $B'(p', q') = H (B)$.
Now it will be proven $|AB| = |A'B'|$

\[
|AB| = \sqrt{(p-x)^2 + (q-y)^2} \quad \text{and} \quad |A'B'| = \sqrt{(p'-x')^2 + (q'-y')^2}
\]

Because it has been obtained that $|AB| = |A'B'|$, it is evident that half the turn is isometric

**Type 3 answers**

Translated version

**Answer**
The half-round theorem is isometry

**Proof**

Let $P(a, b)$ take any two points $A(x, y)$ and $B(u, v)$
For example $A(x', y') = H (A)$ and $B'(x, y) = H (B)$
Will be proven $|AB| = |A'B'|$
Note that $|AB| = \sqrt{(u-x)^2 + (v-y)^2}$ while

So it is evident that $|AB| = |A'B'|$ 'which is from the proof above obtained that

$|AB| = \sqrt{(u-x)^2 + (v-y)^2}$ together with

$|A'B'| = \sqrt{(x-u)^2 + (y-v)^2}$

So it is proven that half a turn is isometry

Sketch: Let P (a, b). Take any two points A (2,3) and B (0,4)

With A $\rightarrow x = 2$ and $y = 3$
B $\rightarrow x = 0$ and $y = 4$

Problem number 1d

Type 1 answer

In question 1d students are assigned to provide a complete explanation of the transformation. In type 1 answers students explain with known information. students are able to connect known information to questions with information that students have. students are able to explain the definition of transformation by linking it into functions even though in

Translated version

Transformation is a mapping of points in a plane to a set of points in the same plane. A mapping can be said to be transformed if the mapping is a one = one (injective) mapping and a (surjective) mapping.
explaining it is less systematic. The correct answer to transformation is a wise function from \( v \) to \( v \) which can be expressed \( T: V \rightarrow V \).

For type 2 answers, students cannot explain with the right answer. This is because in the stage of exploring information about transformation, students do not understand a concept from mathematics.

Questions number 2a and 2b

Type 1 answer

Translated version

a. Reflection and Rotation
The reason for reflection (reflection) is because if you see the picture, when you see the hand holding the ballpoint it looks like a mirror. His paintings are similar to one another, as if there were diagonal lines that mirrored the image. The painting or the size is also the same if we suppose the hand painting above is the object, then the hand painting below is a reflection like the nature of reflection which is an isometry. Both paintings are the same as maintaining distance.

The reason for rotation (rotation) is because it is noted that the hand painting below looks like a shadow from a hand painting rotated at an angle of 80 degrees by using a transformation that is reflection and rotation will obtain image I

b. Rotation
The reason is because the yellow, green and brown fish in the painting are the same size but different directions. This causes the fish paintings and the lines that
decorate them to look like swirling effects of the swirling paintings, this is what we will get.

Type 2 answer

Translated version

a. Reflection transformation equation of the line \( y = -x \) (mirror). If the points \((a, b)\) and reflect on the line \( y = -x \), we get the reflection or shadow point \( E(a', b')\) with the reflection transformation equation is \( a' = b \) and \( b' = -a \).

This reflection transformation can be written as follows:

\[
A(a, b) \rightarrow y = -x \rightarrow E(-b, a)
\]

b. Transformation of rotation is transformation by the process of rotating any point one to a certain point (certain central points).

A rotation point is determined by three elements

1. Center point of rotation
   A fixed point used as a starting point to determine the direction and angle of rotation
2. Large rotation angle
   The size or angle of rotation determines the distance of rotation, its size can be expressed in degrees, radians, or fractions of a full rotation.
3. Direction of rotation angle
   A rotation is said to have a positive direction (+) if the rotation is opposite to the direction.
Type 3 answers

Translated version

a) In figure 1, it is a non-isometric transformation because the transformation used does not maintain a distance between two points so that it changes the size of a geometry object. The transformation used to obtain image 1 is reflection.

b) In Figure 2, an isometric transformation which maintains the distance between two points so that it does not change size. The transformation used to obtain image 2 is translational (shifting), reflection (reflection) because the distance is the same between one point and another. And the shadow does not change shape, size, and rotation. Because the transformation by the process of turning any other point to a certain point (the center of rotation)

Type 4 answer

Observe the image (1) what are the transformations that can be used to obtain the image (1). Explain in full Answer

a) In the picture (1) the transformation used is the Reflection (reflection) transformation where the initial shape is a hand producing a hand-shaped shadow as well (this is a transformation term, namely coliation) with the opposite hand drawing.

In figure (1) it also maintains the distance between 2 points so that it does not change the size of a geometry object (this is a transformation term that is isometry). So it can be concluded image (1) the transformation used is Reflection (reflection).

For type 3 answers, students give answers in solving a given problem is still wrong. Students in applying the linkages of images presented with the concept of transformation, in the form of reflection, translation, dilation and rotation are not appropriate. From the picture presented by the students, giving explanations in the form of written texts, which only revolve around the distance in which the shadow does not change shape and size, the information that has been explored is not yet deep.

For type 4 answers, students write good answers. Students can connect between images presented with shadows formed from the image with translation, reflection, rotation and dilation, except that in providing explanations of information excavated in written text not too deep.
In picture (I) the transformation used is also transformational rotation, where the initial position of the painter's hand rotates to another position by rotating and producing the same shadow isometry.

b) In figure (II), which is a picture of fish where the transformation used is transformation (reflection), where the initial shape of the fish that is mirrored produces a fish's image with the opposite image.
In picture (II), it is a picture of fish = fish where the transformation used is transformation (rotation) wherein the picture shows the rotation of fish of the same colors.

The analysis results of the mathematical representation test for visual indicators, mathematical expressions, and the overall written text are as follows: 1) superficial presentation of information for the provided questions; 2) low problem solving capabilities; 3) low conceptual understanding, low reasoning; 4) weak in the procedure; 5) weak memory; 6) wrong application of the linkages of the presented images with the concept of transformation.

This is in line with the research of [9] which states that high-ability students fulfills three indicators: presenting data or information from a problem to table representation; solving problems involving mathematical expressions; and writing steps to solve mathematical problems with words. Low-ability students fulfill two indicators of mathematical representation ability, which are solving problems involving mathematical expressions and writing steps to solve mathematical problems with words. Research from [10] supports the aforementioned research, stating that students with high mathematical abilities at the stage of understanding the problem are described by gathering information that is known and asked in the questions in the form of written text representation. The subject also uses word representations to explain the information contained in both known and asked questions in order to solve the problem. On the other hand, at the stage of planning problem solving, the subject uses symbol representation and representation in table form to clarify and simplify problems. Then the subject collects the facts from the question along with a logical reason to make a mathematical model and determine the relationships used in the mathematical model. Next, for epistemology aspects that are reviewed and described include understanding and applying concept aspects, principle aspects, understanding problem aspects, visualizing aspects and mathematical proof aspects.

a. Understanding and applying concept aspects

Students in the high group were able to understand the mathematical representation ability questions, were able to identify the elements that were known and the elements being asked, so that they were able to answer questions with the stages of work in accordance with the right concepts and procedures. For the students who were able to give the right statement but had difficulty in stages of completion both in procedure and concept terms were found to have some errors when resolving the problem of transformation geometry. This was happened because students did not understand the basic concepts of transformation geometry subject. On the other hand, the low group students could not explain any steps or stages in solving geometry transformation problems and had difficulty in defining complete and precise transformation geometry and had difficulty in understanding and applying concepts in accordance with the command questions.

b. Principle aspect

In this aspect, the students were expected to be able to solve geometry transformation problems by determining the principles that will be used in problem solving. In the upper group students, they were able to mention the isometry characters and could provide explanations with the right reasons from the statements given to the ability of representation problems about transformation geometry.
Furthermore, for the middle group students cannot write the reason correctly, but can write the notation correctly and to explain the incomplete definition. On the other hand, in the low group students could not answer the questions related to the isometry principle and the reasons given are incorrect.

c. Aspects understand the problem

The results of the study in this aspect are expected to enable students to understand the statements of questions questioned to solve the problem using the appropriate steps according to the procedure. For upper group students can solve the problem with the correct procedure, but there is an error in writing the notation. This is due to inaccuracy during the process. Then in the middle group students can understand the problem presented, but can not work on the questions given with a complete procedure. While the low group students cannot solve the problem with the right procedure. So the problem cannot be solved. This is because low group students do not understand the command questions.

d. Aspects visualize

The visualizing aspect is expected to foster logical thinking in order to be able to analyze the information obtained. In high group students, they are able to answer questions, fluent in expressing the results of ideas and present them in the form of images completely and precisely. High groups can also illustrate illustrations into concrete forms to clarify the problem being solved. Furthermore, in the middle class students, the illustrations poured in the form of images were incomplete. While for low group students cannot illustrate information obtained visually in the form of images. This is because they are confused to illustrate the commands of the questions they read in the form of images.

e. Aspect of mathematical proof

The results of the study showed that high group students could use their knowledge to solve transformation geometry problems including the ability of students to be able to put mathematical ideas correctly and construct appropriate evidence, to complete the verification stage by writing conclusions, but conclusions that were made were not immediate. Then for the middle group students have not been able to interpret the problem in solving the problem of proof. The results of the verification process carried out are not coherent and the final results prove wrong. Whereas for the low group, the answers written are wrong, where in this case the students have difficulty starting the construction of evidence and the low group students do not write the final conclusions.

The results of the study are in line with the study of [6] which states that there are 5 kinds of student difficulties in terms of epistemology aspects related to transformation geometry courses namely a) learning difficulties related to difficulties in applying concepts; b) learning difficulties related to the difficulty of visualizing geometric objects; c) learning difficulties related to difficulty determining principles; 4) learning difficulties related to understanding problems; 5) learning difficulties related to difficulties in mathematical proof. Especially in mathematical proof students experience difficulties, among others, do not know to start construction of evidence, can not use definitions (concepts) and principles that have been known and tend to start construction of evidence with what must be proven.

4. Conclusions

Based on the results of the research carried out on the analysis of students' mathematical representation abilities in completing the geometry transformation material, conclusions were obtained as follows:

1. The ability of mathematical representation of prospective teacher students on visual indicators (50.92%), mathematical expressions (55.18%) and written texts (53.32%) as a whole are categorized as low. The results of the analysis of the work of representation ability test questions for visual indicators, mathematical expressions, and the overall written text between a) in providing information extracted from the questions presented are not very profound; b) low problem solving capabilities; c)
low conceptual understanding, low reasoning; d) not smooth in the procedure; e) weak memory; f) wrong in applying the linkages of the images presented with the concept of transformation.

2. In the epistemology aspect as a whole it was found that student difficulties in solving transformation geometry problems include a) difficulties in defining transformation geometry correctly and completely; b) difficulties in understanding and applying concepts; c) errors in writing notation; d) unable to work on the questions given with a complete procedure; e) difficulties in illustrating the questions presented in the form of drawings and f) difficulties in constructing evidence.

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