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Analysis of Middle School Students' Mathematical Representation Ability on Triangle Material Based on Learning Style

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Abstrak

Perlu adanya penelitian yang dapat mendeskripsikan kemampuan representasi matematis siswa ditinjau dari gaya belajar mereka. Penelitian ini menggunakan pendekatan kualitatif deskriptif. Subjek dari penelitian ini adalah 20 siswa kelas VII-D SMPN 4 Jember. Pengambilan sampel subjek dengan menggunakan teknik purposive sampling. Teknik pengumpulan data melalui angket gaya belajar, tes kemampuan representasi matematis dan wawancara. Analisis data dilakukan dalam tiga langkah yaitu reduksi data, penyajian data, dan penarikan kesimpulan. Siswa yang memiliki gaya belajar visual dominan pada kemampuan representasi visual, dan siswa yang memiliki gaya belajar auditori dominan pada kemampuan representasi verbal. Sedangkan pada siswa yang memiliki gaya belajar kinestetik terlihat dominan pada kemampuan simbolik. Sehingga pembelajaran matematika yang memperhatikan gaya belajar siswa diperlukan, agar dapat mempermudah guru untuk memberikan stimulus yang tepat pada setiap kelompok sehingga memperoleh respon positif dari siswa dalam merepresentasikan ide-ide matematikanya.
Kata Kunci: Gaya Belajar; Kemampuan Representasi; Segitiga.

Abstract

There is a need for research that can describe students' mathematical representation abilities in terms of their learning styles. This study uses a descriptive qualitative approach. The subjects of this study were 20 students of class VII-D SMPN 4 Jember. The subject sampling was by using purposive sampling technique. Data collection techniques through learning style questionnaires, mathematical representation ability tests and interviews. There were 3 steps of data analysis, namely data reduction, data presentation, and drawing conclusions. Students who have a visual learning style are dominant in visual representation abilities, and students who have an auditory learning style are dominant in verbal representation abilities. Meanwhile, students who have a kinesthetic learning style are dominant in symbolic abilities. So that learning mathematics that pays attention to student learning styles is needed, in order to make it easier for teachers to provide the right stimulus to each group so as to get a positive response from students in representing their mathematical ideas.
Keywords: Learning Style; Representational Ability; Triangle.

I. INTRODUCTION

Mathematics is an essential scientific discipline because it teaches how to solve a problem (Cahyani, Fathani, & Faradiba, 2023; Chusnuah & Setianingsih, 2019; Malasari et al., 2017). There are many problems in applying mathematical concepts in everyday life (Nurrawi et al., 2023; Mutaqin et al., 2023). However, the concept is considered difficult to understand because of the abstract concept of mathematics. Therefore, to make students easier in facing an abstract mathematical problem, the solution can be in a simpler form or mathematical model to represent the problem. These forms and models are called representations (Andari & Lusiana, 2022; Lusiana et al., 2018; Mulyadi & Fiangga, 2022).

The representations are expressions of mathematical ideas that are displayed as a result of students' interpretation in processing information to find solutions to the problems (NCTM, 2000; Khoerunnisa & Maryati, 202). In learning mathematics, representations can be found in various forms such as pictures, graphs, tables, diagrams, mathematical notation, contextual situations, and words or phrases used to understand and communicate mathematical ideas (Ulfa & Sundayana, 2022; Iskak et al., 2020; Rahmadian et al., 2019; Yee & Bostic, 2014).

Based on the results of the interview with one of the math teachers at SMP Negeri 4 Jember, it was found that most students still found it difficult in solving triangle questions. This occurred because they could not translate the questions correctly. This finding is in line with the research of Iskak et al. (2020) which stated that 94.1% of students were still not able to do the process of translating the questions to appropriate visual, verbal and symbolic representations in solving triangle problems. In addition, research conducted by Yustika and Roesdiana (2019) stated that only 31.57% of representation skills were categorized good. This happens because students are not good at accurately describing the questions given, using inappropriate equations, and misunderstanding of ideas from pictures correctly. Therefore, this study is expected to deeply investigate the representation abilities of students in working on triangle problems.

The low ability of students' mathematical representation can be influenced by several factors (Tristiyanti & Afriansyah, 2017; Azkiah & Sundayana, 2022; Pebrianti & Puspitasari, 2023). One of them is learning style (Qomarudin et al., 2018). There are three learning styles that students have in the learning process, namely visual learning styles, auditory learning styles, and kinesthetic learning styles (DePorter & Hernacki, 2013). Visual learning style is a learning style in which students learn best when they see the pictures they are studying. Auditory learning style is a learning style that relies

on the student's hearing to capture information. Kinesthetic learning style is a learning style through motion, requiring each student to touch something that provides certain information in order to remember it.

Representational abilities and learning styles are closely related to each other. Representational ability refers to students' ability to process information and build a description of the problems given. Learning styles, on the other hand, refer to students' preferences in obtaining and processing information in questions. Thus, students' learning styles can influence their representation abilities. For example, students with a visual learning style tend to get information by looking at pictures, and their visual representation skills are much better than those with kinesthetic learning style (Marifah et al., 2020). Research of Marifah et al. (2020) is only limited to visual representation abilities. This research will therefore discuss further about visual, verbal and symbolic representation abilities based on student learning styles (visual, auditory and kinesthetic) with different materials.

Based on the statement above, the research on the representational abilities of 7th grade students in working on triangle problems in terms of the student's learning style is worthy investigating.

II. METHOD

This study used qualitative research with descriptive analysis methods (Sidiq & Choiri, 2019). This study investigated the students' representation abilities on triangular material based on their learning styles. This research was conducted in the class of 7-D, Junior High School 4 Jember. The research subjects consisted of 20 students of class 7-D, then six people were selected consisting of two visual student, two auditory students and two kinesthetic students. The method of sampling selection was purposive sampling. Subjects were selected based on the tendency of students' learning styles, and based on the results of a questionnaire that was filled out by students before. The data collection techniques used were learning style questionnaires, mathematical representation ability tests and interview guidelines. Before the research instruments used, the instruments were tested for validity; namely readability and content validity. The instrument validation was carried out by a lecturer from master degree program of Mathematics Education of Universitas Jember.

The questionnaire used was a learning style questionnaire taken from DePorter dan Hernacki (2013). The total items of the questionnaire were 120 statements. Each answer in the questionnaire would be given score of 1 both for visual learning style indicators and other learning styles. Therefore, the maximum score for each learning style is 20. The written test used was three questions about circumference and area of triangle. Besides, the interview was conducted directly with the students.

The data was analyzed in three steps, namely data reduction, data presentation, and drawing conclusions (Wulandari & Ishartono, 2022). Data reduction focuses on the indicators of each item; the ability to represent visual, verbal and symbolic. After the data is presented in the form of a description, the conclusions are drawn related to students' mathematical representation abilities according to learning styles.

III. RESULT AND DISCUSSION

Based on the questionnaire of students' learning styles that were distributed via google form, it showed that most of the students of 7-D were visual learners. Of the twenty students responding the questionnaire, 10 students were visual students, 5 auditory students, and 5 kinesthetic students. Then, the researchers took two students for each learning style. For visual learners, the researcher selected students whose scores were 18 and 17. For auditory learners, the students with scores of 19 and 17 were chosen. For kinesthetic learnings, students who obtained scores of 17 and 16 were taken. After the samples were selected, these students were tested for getting their representation ability from the test given. The students were grouped based on the category that were based on the previous study (Sari et al., 2020). The students are said to have high representation ability if they meet three types of representation. If they meet the two types of representation, they will be grouped as moderate ability of representation. Lastly, they will be considered to have low representation ability only if they meet one type representation.

The following is the result of students' representation ability based on the learning styles.

A. Representation Ability of Visual Students

Students with visual learning styles could complete all questions by using pictures. This was supported by the result of student V1 on the following figure.

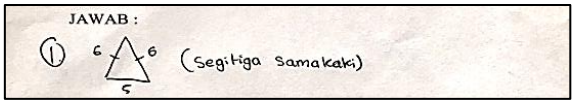

Figure 1. Answer Result of Student V1

As seen from Figure 1, V1 was able to create a picture and also wrote down the type of triangle drawn.

However, there was error in the size of the triangle. The circumference should be 18 cm.

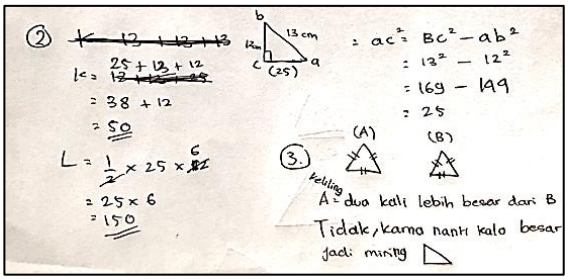

Figure 2. Answer Result of Student V1 on question 2 and 3.

In Figure 2, student V1 could draw a right triangle, but the area and circumference results were inaccurate

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because the student was less attention to detail. In addition, student V1 did not write down the units in his answer.

From the question number 3, student V1 could describe started from drawing equilateral triangles, labeling the sides, and labeling large and small triangles. However, he made errors in drawing the conclusions verbally. The following is an excerpt from interview with student V1:

Researcher : Did you still remember how to find the sides of triangle as asked in the question number 2?

*V1 : Yes Mam, from the picture, this side square minus this side, Mam *taking a paper to draw**

researcher : Yes, but don't forget the squared root.

V1 : Gosh, I forgot, Mom. It is hard to memorize the formula, Mam. So, I always draw to remember.

researcher : Alright, then, please explain how you solve the question number 3

V1 : Difficult, Mam, I can't explain it, but I can draw the question.

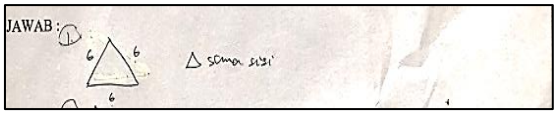

Figure 3. Result Work of Student V2

From the figure 3, on the question number 1, the student V2 could draw and mention the type of triangle correctly.

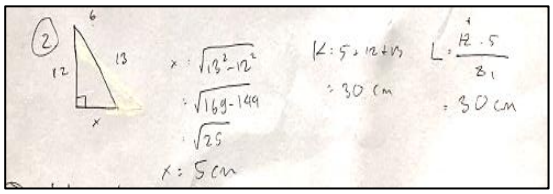

Figure 4. Result Work of Student V2

From the picture, the student V2 could answer correctly but his answer was incomplete in terms of using symbols in mathematics, both in using the Pythagorean formula and finding the area and circumference. This is supported by the following interview excerpts.

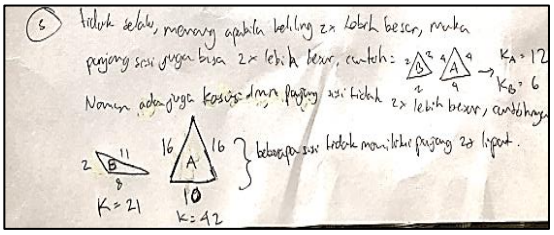

Figure 5. Result Work of Student V2

From the Figure 5, student V2 could accurately describe the problem. It could be seen that student V2 described the problem by exemplifying the size of the perimeter and sides of the triangle. However, student V2 made a mistake in translating the meaning of the question. What was asked in the second triangle problem was an equilateral triangle, student V2 added a scalene triangle. The following is an excerpt from an interview with student V2:

Researcher : Did you still remember how to find sides as asked from the question number 2?

V2 : Yes Mam, the squared root from the higher number squared minus the lower number squared

researcher : Exactly, why didn't you answer with the symbols that have been explained?

V2 : I didn't really understand with the symbols, Mam. There are too many symbols.

researcher : Ok, next number 3, why did you

add scalene triangle?

V2 : I guess the meaning of the question is for all equilateral triangle so I exemplified with scalene triangle.

Based on the previous statement, it was concluded that the representation ability of student V1 was low because it was only visuals. On the other hand, student V2 had moderate representation abilities due to he could interpret both visual and verbal. However, both answered and explained in the same way, involving pictures. Therefore, they were dominant in the ability of visual representation. This is in line with previous research(Marifah et al., 2020; Natonis et al., 2022) which states that visual representation is dominant for students with a visual learning style, because students are able to convey their ideas using pictures.

B. Representation Ability of Auditory Student

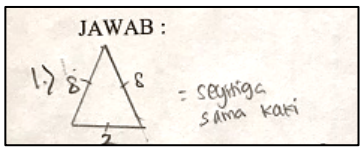

Figure 6. Result Work of Student A1 on Number 1

As seen in Figure 6, student A1 answered question number 1 correctly but he made errors in describing the similarity symbol of an isosceles triangle. Student A1 was more active verbally.

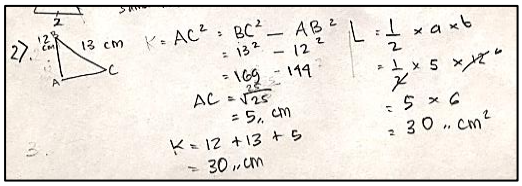

Figure 7. Result Work os Student A1 on question 2

In question number 2, student A1 drew a right triangle but the right angles were drawn incompletely. But the student wrote symbols and mathematical units properly and answered question number 2 correctly.

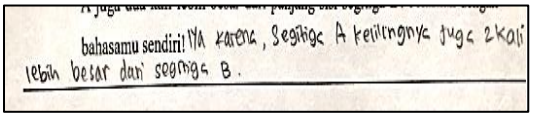

Figure 8. Result Work of Student A1 on question number 3

In question number 3, student A1 gave the correct answer verbally to the point instructed from the question. The following is an excerpt from an interview with student A1:

Researcher : Did you still remember how to find sides as asked from the question number 2??

A1 : I did, Mam, because what was asked about the circumference and area, the sides must be there, so I first looked for one of the sides using the Pythagorean, namely by squaring the result of subtracting the squared hypotenuse and the squared perpendicular, then after getting the sides, just look for the circumference and area.

Researcher : Ok, could you explain how you answered question number 3?

A1 : Yes ma'am. Because it's an equilateral triangle, so if triangle A has 2 times the sides of triangle

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B, then the perimeter is also 2 times. Because triangle A has 2 times the side B, if you add up all the sides it becomes 6 and the B one becomes 3. 6 is 2 times 3 so it's true that the circumference is 2 times bigger.

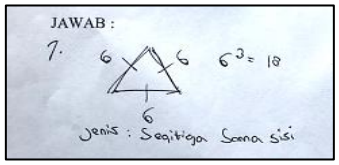

Figure 9. Result work of Student A2 on question number 1

In Figure 9, student A2 drew the triangle correctly and also named the type of triangle correctly.

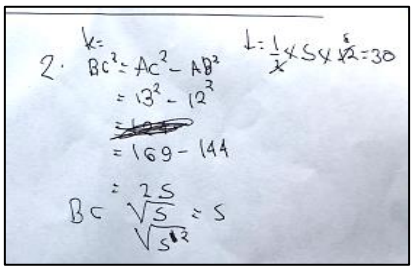

Figure 10. Result work of Student A2 on question number 2

Furthermore, in question number 2, student A2 did not describe the right triangle asked for by the question, he was not careful enough so that the circumference was not answered and was not correct in writing mathematical symbols.

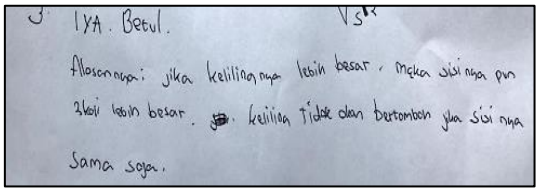

Figure 11. Result Work of Student A2 on question number 3

In question number 3, students provided accurate and clear answer. Even though it was only in verbal form, the intent of student A2's answer could be well understood. The following is an excerpt from an interview with student A2:

Researcher : Did you still remember how to find sides as asked from the question number 2??

A2 : Yes Mam. To find the perimeter and area, you must know all the sides of the triangle. Then, I found the sides of the triangle using the Pythagorean formula, for a right triangle using the formula for the hypotenuse squared minus the perpendicular squared then the result is the square root. The sides that are already known were then inserted to the area and perimeter formulas. The formula for the area of a triangle is half times the base times the height. But, when finding out the perimeter of the triangle, I was blank, I forgot, even though I could answer number 3, Mam.

Researcher : Ok, could you explain how you answer question number 3?

A2 : Yes Mam. In my opinion, if the sides are twice bigger, then the circumference is also twice bigger. Because in finding the circumference, we need sides, especially in equilateral triangle, Mam.

The representation ability of student A1 is moderate because it meets verbal and symbolic criteria. Besides, student A2 has also moderate representation ability for the same reason as student A1. From the

interviews described earlier, it can be seen that student A1 and A2 were more dominant in using their verbal abilities and were very good at explaining verbally than previous visual students. This is in line with previous research (Hidayat, 2020; Natonis et al., 2022; Sinaga et al., 2016) which states that dominant verbal representations are owned by students with an auditory learning style. Because they tend to absorb learning through teacher's giving a verbal direction, they are able to deal with problem situations based on the problems given and make conclusions.

C. Representation Ability of Kinesthetic Students

Students with a dominant kinesthetic learning style are those who are easy to observe, because they cannot stay still while working. They think by moving a pen, their feet or tapping on the table. Here are the results of K1 students.

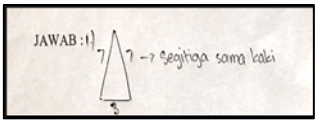

Figure 12. Result Work of Student K1 on question number 1.

From the figure, it was seen that the student K1 was not accurate in determining the size of picture. However, he was correct in writing the type of triangle.

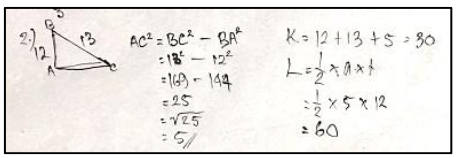

Figure 13. Result Work of Student K1 on question number 2

In the question number 2, student K1 was not quite accurate in drawing a right-angled triangle. Beside the wrong size, student K1 also did not draw the right-angled symbol on the triangle. The use of symbols was correct when using Pythagoras, but he did not include the correct units.

Figure 14. Result Work of Student K1 on question number 3

In question number 3, student K1 was also not quite right in answering. When viewed from the answers, student K1 had difficulty in understanding the questions, could not describe the questions and solve them using symbols. This analysis was supported by interviews which showed that K1 students still did not understand the concept of circumference and types of triangles. Below are the results of interview with K2 students.

Researcher : *Did you still remember how ti find sides as asked from the question number 2?*

K1 : *Yes Mam. For example, if the upright side is a, then the hypotenuse is c. So, to find the side of the base, or for example b, is b squared equal to c squared minus a squared*

researcher : *All right, could you explain how you answered the question number 3?*

K1 : *I don't really understand the question, Mam. So, I don't think it's the same, because one side is the other side.*

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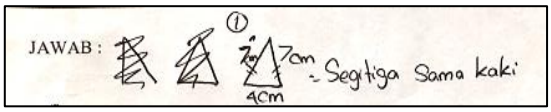

Figure 15. Result Work of Student K2 on question number 1.

From the figure, the student K2 could draw and name the type of triangle.

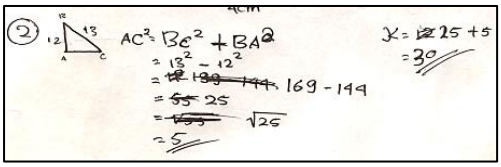

Figure 16. Result Work of Student K2 on question number 2

In question number 2, the depiction of a right-angled triangle was not quite right because there was no symbol for the angles. In addition, the student was not careful so he did not answer the area requested. However, K2 students could write the correct formula for finding the side of the base.

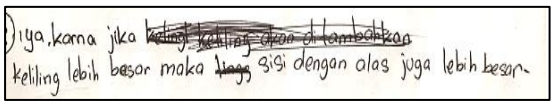

Figure 17. Result Work of Student K2 on question number 3

In question number 3, different from student K1, student K2 could answer even though he used wrong terms, namely the sides and base were distinguished. Even in an equilateral triangle, side and base are one unit so only the sides should be mentioned.

researcher : Did you still remember how to find sides asked by the question number 2?

K2 : IYes ma'am, ac squared and bc squared minus ab squared. I forgot to find the area; it should be half the base times the height.

researcher : All right, how did you explain the question number 3?

K2 : So, the side of triangle A is twice as big as side B. In my opinion, the perimeter must also be twice as big because the way to find the perimeter of an equilateral triangle is that the perimeter of triangle is equal to 3 times the side.

K1 student have low representation skills because he only meets symbolic criteria, while student K2 meets moderate criteria because they meet symbolic and verbal criteria. Nevertheless, the two students could explain the formula used in detail as described in the interview above. This is in accordance with previous research (Amalia et al., 2021; Hidayat, 2020; Natonis et al., 2022; Sinaga et al., 2016) which states that the dominant symbolic representation is owned by students with kinesthetic learning styles because they tends to absorb learning through teaching done by the teacher in a symbolic direction, such as when giving examples of questions and exercises. In addition, factor that causes kinesthetic students to immediately answer without explaining the detailed steps is the nature of demonstrating and seeing directly. Finally, they are getting used to solving problems.

IV. CONCLUSION

Based on the results of the study, it can be concluded that students' representation abilities based on learning styles are different. Visual learning style students are dominant in visual representation abilities, and auditory students are dominant in verbal representation abilities. Meanwhile, kinesthetic students are dominant in symbolic abilities. The representation abilities possessed by students with the same learning style also differ depending on the way of students' expressing ideas based on their senses.

For further research, it is hoped that this research can be used as a basis for creating teaching and learning that can improve students' representation abilities based on their learning styles, both in learning models and learning media.

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