ANALYSIS OF STUDENTS' MATHEMATICAL REPRESENTATION
ABILITY IN VIEW OF LEARNING STYLES

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Abstract. This study examines students' mathematical representation abilities from the perspective of learning styles. Learning styles play an important role in understanding mathematical concepts. The visual style uses pictures, the auditory style involves hearing, and the kinesthetic style involves physical movement. This study focuses on three learning styles: visual, auditory, and kinesthetic. The descriptive qualitative method was used in class VII-F students of SMP Negeri 2 Kuningan, there were 8 research subjects representing each learning style. Data was collected through questionnaires, representation ability tests, and interviews. The results show that most students have a visual learning style (42%), while kinesthetic and auditory are 30% and 28%, respectively. The representation ability test reveals that visual students have high mathematical representation, while kinesthetic and auditory are categorized as moderate. Students confirmed the importance of learning styles for understanding. The teacher's challenges include selecting a model according to student styles and understanding individual needs. Need improvement in discussing, concluding, and summarizing activities. Further efforts are needed to understand student differences and develop strategies to improve mathematics learning.

Keywords: Mathematical Representation Ability, Learning Style


Kata Kunci: Kemampuan Representasi Matematis, Gaya Belajar

INTRODUCTION

Mathematical representation ability is the ability of students to express from a new perspective of mathematics that is displayed by students as a model or way of solving the problem they are facing because of the interpretation of their thoughts (Sanjaya et al., 2018). This mathematical representation ability is closely related to learning mathematics which forms students in several groups based on learning styles, it can make it easier for teachers to provide the right stimulus to each group to obtain a positive response from students in representing their mathematical ideas.

One technique that influences learning, processes, and communication is the characteristics of student learning styles. If the teacher can adjust to the different learning styles of their students, students will have an interest in learning mathematics (Falah & Fatimah, 2019; Magdalena, 2015). Learning style refers to individual habits and preferred way of absorbing, processing, and retaining new information and skills (Rezaeinejad et al., 2015). Based on the results of the work of the three students, students who have a visual learning style, students who have an auditory learning style and students who have a kinesthetic learning style can solve the given flat shape problem well even though there are some mistakes made by students who have a learning style. auditory learning and students who have a kinesthetic learning style so that the results obtained are not quite right. The three subjects represent problems by using representations in the form of words, graphs, tables, mathematical expressions, and symbol manipulation (Islamiah et al., 2022; Natonis et al., 2022).

The results of research conducted by Skirkandeke F.M Nation, Firda Daniel and Netty J.M. Gell (2022) namely students' representation abilities based on different learning styles, students who have a dominant visual learning style in visual representation abilities, students who have a dominant visual learning style. auditory learning style on verbal representation abilities, students who have a dominant kinesthetic learning style on symbolic representation abilities. However, this study focuses on indicators of mathematical representation ability, namely visual representation: Representing data or information from representation to representation of diagrams, graphs or tables, representation of mathematical equations or expressions: creating equations or mathematical models from other representations given and representations of words or text written: wrote the interpretation of the representation.

The novelty in this study, namely the problem of the mathematical representation ability used is categorized based on the type of student learning style, of course with the existence of questions that are categorized based on the type of learning style it is hoped that students will not make students feel bored when working on questions.
METHOD

The research method used in this research is descriptive qualitative. The research was conducted at SMP Negeri 2 Kuningan, Kuningan Regency. Collecting research data using a questionnaire, the data collected is used to identify the 3 types of learning styles that each student has. The research sample consisted of 38 students at SMP Negeri 2 Kuningan. Students were selected through purposive sampling. Questionnaires were given to students at the beginning of the study to differentiate the learning styles each student had. The test questions given in class VII-F have gone through the validation stages, the types of questions that are given in stages with the distribution of questions according to visual, audio and group types. The questions with the visual learning style type contain story questions and display pictures, the questions with the auditory learning style type the researcher prepares questions made with sound while the kinesthetic type questions can be done together or in groups.

Participants will be given several statements and statements in the interview process to find out how mathematical representation abilities are in terms of learning styles. The data obtained was analyzed using the data analysis model popularized by Miles and Huberman. The model is divided into three stages, namely data reduction, data presentation and drawing conclusions.

RESULTS

The research was conducted at SMP Negeri 2 Kuningan, aiming to describe students' mathematical representation abilities based on learning styles. Based on research conducted at SMP Negeri 2 Kuningan, the results of the research can be explained as follows: Filling out the questionnaire in class VII-F was attended by 36 students out of a total of 38 students. Analysis of this learning style questionnaire with the Guttman scale, the percentage results obtained were 42% for the visual learning style which consisted of 15 students from 36 students, 30% for the kinesthetic learning style which consisted of 11 students from 36 students and 28% for the auditory learning style which consisted of of 10 students out of 36 students.

Mathematical Representation Ability of students who have a visual learning style

The mathematical representation ability of students who have a visual learning style is categorized as high with the average student who has a visual learning style being able to achieve all three indicators of mathematical representation ability. The first indicator is visual representation: SNF students can present data or information back in the form of images, such as when drawing a flat shape of a right-angled trapezoid and calculating its area.
SNF students show good skills in drawing flat shapes and calculating various sizes such as the perimeter and area of flat shapes and complete with their units. The second indicator is the representation of mathematical equations or models: SNF students are also able to create mathematical models from other representations given, such as when looking for a mathematical equation of a mathematical problem.

SNF students can finish correctly but the deficiencies in the rupiah unit are not written down. The third indicator is the representation of words or written text: The ability of SNF students to understand word problems and interpret them shows that they are also able to write interpretations of a mathematical representation.
SNF students can complete correctly and systematically in solving them. At the SNF student interview stage:

**Script 1 SNF student interview**

<table>
<thead>
<tr>
<th>Researcher</th>
<th>Do you like learning by seeing, for example by looking at the pictures the teacher gives?</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNF student</td>
<td>Yes</td>
</tr>
<tr>
<td>Researcher</td>
<td>Do you easily remember what you see than what you hear?</td>
</tr>
<tr>
<td>SNF student</td>
<td>What Si</td>
</tr>
<tr>
<td>Researcher</td>
<td>How is the learning situation at home? Should there be silence or should there be music?</td>
</tr>
<tr>
<td>SNF student</td>
<td>Silence, because when there's music it tends to be disturbed.</td>
</tr>
<tr>
<td>Researcher</td>
<td>Do you feel uncomfortable when other students are noisy?</td>
</tr>
<tr>
<td>SNF student</td>
<td>Yes, especially when playing behind the scenes.</td>
</tr>
<tr>
<td>Researcher</td>
<td>Are you aware of the visual learning style?</td>
</tr>
<tr>
<td>SNF student</td>
<td>Yes</td>
</tr>
</tbody>
</table>

In the overall assessment, SNF students demonstrated good abilities in understanding and solving mathematical problems with visual representations. Students who have this visual learning style are more thorough in reading and writing. The accuracy of students in understanding word problems can be done well because this visual learning style obtains good information, especially mathematics lessons, so that student learning styles are not the same as one another (Himmi et al., 2022)

**Mathematical Representational Ability of students who have a kinesthetic learning style**

The mathematical representation ability of students who have a kinesthetic learning style is categorized as moderate with the average student who has a kinesthetic learning style being able to achieve indicators of mathematical representation ability. The first indicator is a visual
representation: RNP students can present data or information back in the form of images, such as when drawing a flat shape of a right-angled trapezium.

![Figure 4. Completion of RNP student questions](image)

However, they are not able to apply the formula to calculate the area of a right-angled trapezoid, so the solution is not quite right. The second indicator is the representation of mathematical equations or models: RNP students are also able to create mathematical models from other representations given, such as when looking for a mathematical equation of a mathematical problem.

![Figure 5. Completion of RNP student questions](image)

The solution is not equipped with a flat shape, but the solution is correct and the RNP can understand the purpose of the problem given. The third indicator is the representation of words or written text: the RNP student's ability to interpret questions and solve them with written answers shows that he can write an interpretation of a mathematical representation.

![Figure 6. Completion of RNP student questions](image)
The final value is correct but incomplete in the absence of a formula that will be used in the solution. At the RNP student interview stage:

**Script 2 Interview RNP students**

<table>
<thead>
<tr>
<th>Researcher</th>
<th>Are you confident when speaking in front of the class?</th>
</tr>
</thead>
<tbody>
<tr>
<td>RNP Student</td>
<td>Not so confident</td>
</tr>
<tr>
<td>Researcher</td>
<td>How do you understand difficult mathematics learning?</td>
</tr>
<tr>
<td>RNP Student</td>
<td>Ask the teacher directly.</td>
</tr>
<tr>
<td>Researcher</td>
<td>Do you feel more confident when learning is action, for example exercising?</td>
</tr>
<tr>
<td>RNP student</td>
<td>No, but I like futsal.</td>
</tr>
<tr>
<td>Researcher</td>
<td>Do you sit neatly and orderly during the lesson?</td>
</tr>
<tr>
<td>RNP student</td>
<td>No</td>
</tr>
<tr>
<td>Researcher</td>
<td>Do you like to disturb other friends during the lesson?</td>
</tr>
<tr>
<td>RNP Student</td>
<td>Sometimes</td>
</tr>
</tbody>
</table>

Based on conversations between researchers and RNP students about kinesthetic learning styles in learning mathematics. RNP is classified as a very active student and pays attention to every instruction given. Every student who has a kinesthetic learning style that is identical to the character of these mobile students becomes a supporting factor for students in building enthusiasm and absorbing learning well. This kinesthetic learning style obtains information by prioritizing the senses of taste and physical movements (Supit et al., 2023).

**Mathematical Representational Ability of students who have an auditory learning style**

The mathematical representation ability of students who have an auditory learning style is categorized as moderate with the average student who has an auditory learning style being able to achieve indicators of mathematical representation ability. The first indicator is visual representation: AZZ students can present data or information in the form of images well, such as when drawing a flat shape of a right-angled trapezium and calculating its area.

![Figure 7. Completion of AZZ student questions](image-url)
Even though there were some deficiencies in the completeness of the completion, in general AZZ students were able to solve visual representation problems correctly. The second indicator is the representation of equations or mathematical models: AZZ students can make mathematical models from other representations well, such as when looking for equations and solving them systematically.

![Figure 8. Completion of AZZ student questions](image)

However, there were several inaccurate answers and a lack of completeness in the placement of rupiah units. The third indicator is the representation of words or written text: AZZ students can write an interpretation of a mathematical representation, because of their ability to interpret questions and solve them with written answers.

![Figure 9. Completion of AZZ student questions](image)

AZZ students can complete the units correctly but not complete. At the AZZ student interview stage:

**Script 3 AZZ student interview**

<table>
<thead>
<tr>
<th>Role</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Researcher</td>
<td>How is your learning style when you accept or absorb learning mathematics?</td>
</tr>
<tr>
<td>AZZ student</td>
<td>It's easier to explain than to write.</td>
</tr>
<tr>
<td>Researcher</td>
<td>Judging from the way the settlement looks neat and systematic</td>
</tr>
<tr>
<td>AZZ student</td>
<td>yes, I cheat hihiihi.</td>
</tr>
<tr>
<td>Researcher</td>
<td>Are you happy with video learning?</td>
</tr>
</tbody>
</table>
The AZZ student stated that it was easier for him to understand learning mathematics when it was explained orally than by reading in writing. This shows that the learning style is more inclined to the auditory approach or learning through hearing. There was a student who felt insecure when working on the problem but during the learning process and the process of working on the problem it was seen that the student wanted to do it according to the instructions given by the researcher. The learning process requires students to be able to control themselves, where students must be able to control themselves not to do things that are fraudulent when tests and exams are carried out (Yovita & Ahmad, 2019).

**DISCUSSION**

In previous research, there were representational abilities that had visual learning styles categorized as very good and representational abilities that had auditory and kinesthetic learning styles were categorized as sufficient (Komala & Afrida, 2020). However, in this study, in accordance with the previous discussion, focusing on indicators of representational ability, the results of representational abilities with visual learning styles were categorized as high, and mathematical representation abilities with auditory and kinesthetic learning styles were categorized as moderate. In this study, it aims to describe students' mathematical representation abilities based on their learning style. Data was collected by filling out a questionnaire about learning styles in class VII-F at SMP Negeri 2 Kuningan. The results of the questionnaire analysis show that most students have a visual learning style, followed by a kinesthetic learning style and an auditory learning style.

First, the researcher explored students' mathematical representation abilities with a visual learning style. The results show that students with a visual learning style show the ability category in the three indicators of mathematical representation ability. Able to present data in the form of images properly, such as drawing flat shapes and calculating the circumference and area of flat shapes. In addition, students are also able to make mathematical models from other representations given and write interpretations of a mathematical representation. The interview
results also show that students with a visual learning style tend to understand material more easily when it is presented in the form of pictures or visuals.

Second, the researcher observed the ability of students' mathematical representations with kinesthetic learning styles. The results show that students with a kinesthetic learning style have moderate abilities in the three indicators of mathematical representation abilities. They can present data back in the form of images but are less able to apply formulas in solving. Even so, they are still able to create mathematical models from other representations and write interpretations of a mathematical representation. Interviews show that students with a kinesthetic learning style are more comfortable in action learning and tend to be active in the learning process.

Third, the researcher analyzed the ability of students' mathematical representations with auditory learning styles. The results show that students with an auditory learning style have moderate abilities in the three indicators of mathematical representation ability. They can present data in the form of images well, but there are some deficiencies in the completeness of the solution. Even so, they are still able to create mathematical models from other representations and write interpretations of a mathematical representation. Interviews show that students with an auditory learning style prefer oral learning and tend to be more confident when learning takes place.

CONCLUSION

This study observes the importance of understanding students' learning styles in developing mathematical representation abilities. The results showed that students with a visual learning style had a high ability to understand and represent mathematical problems through pictures and mathematical models. Students with a kinesthetic learning style have moderate abilities, they can present data back in the form of images, but they still need to improve their ability to apply formulas in solving problems. Students with an auditory learning style also have moderate abilities, they can present data back in the form of images, but there are some deficiencies in the completeness of the completion.

RECOMMENDATIONS

Several recommendations have been made by researchers; (1) teachers need to provide training and guidance to students to improve their mathematical representation skills based on their learning style with a complete interpretation of problems and mathematical solutions, (2) researchers must provide variety in learning mathematics, including the use of technology and
practice questions according to students' learning styles, and (3) students with a hyperactive kinesthetic learning style need to be investigated further to determine the factors that influence their ability to solve math problems.

ACKNOWLEDGMENTS

The author is grateful to STKIP Muhammadiyah Kuningan for supporting the course of this research, especially to my supervisor, Mr. Reza Muhamad Zaenal, M.Pd. who have sacrificed their time, energy, thoughts to guide and provide advice in completing this research. The author also thanks all parties at SMP Negeri 2 Kuningan so that the research can run smoothly.

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