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Analysis of mathematical reasoning ability of class VIII in view of Bobbi DePorter's learning style

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Abstract**:** This study aims to analyze student mathematical reasonings abilities in terms of learnings style according to Bobbi DePorter. This research is descriptive qualitative research. The subject of this study was students of class VIII A and VIII F at SMPN 13 Magelang. The instruments used include learnings styles questionnaires, test questions with indicator of mathematical reasonings abilities, interviews, and documentation. The result of the study showed that from 58 students there were 30 students with visual learning styles, 15 students with auditory learning styles, and 13 students with kinesthetic learnings style. Class VIII students at SMPN 13 Magelang tend to have a visuals learnings style. The mathematical reasoning abilities of student with visuals learnings style is classified at the moderate level with a percentage of 61.8%, Auditory learning style is classified as medium level with a percentage of 69.3%, and kinesthetic learning style is classifieds as low level with a percentage of 54.7%. So it can be concludes that the mathematical reasonings abilities of class VIII student at SMPN 13 Magelang is classified as moderate.

Keywords: Bobbi DePorter's learning style; Mathematical reasoning ability; Opportunity

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INTRODUCTION

One of the vital parts in human activity is learning/education, because it is a guide for human development towards certain goals. Forming basic mathematical abilities to solve problems in everyday life is the goal of mathematics education. According to NCTM (2000) basic math skills have 5 parts consisting of *problem solving abilities*, *connection*, *reasoning and proosf*, *communications*, and *representation*. Depdiknas (in Putri & Yuliani, 2019) stated that mathematics education aims to be able to use reasoning abilities to solve mathematical problems well. According to Tim Puspendik (2012), students who have minimal thinking skills, will find it difficult to learn mathematical theory and face various mathematical problems, because they are unable to connect existing ideas/facts to form a logical conclusion. This is because reasoning can be trained through mathematical material and can be understood with reasoning abilities. So mathematical reasoning and mathematical material are two things that cannot be separated.

Based on the results of the initial test using indicators of mathematical reasoning skills for class VIII students of SMPN 13 Magelang, it was shown that reasoning skills that could solve mathematical questions were relatively low with an average percentage of 44%, where they had not been able to reach indicators of mathematical reasoning skills. This is because the majority of students only remember formulas and do not understand mathematical theory/concepts, so it is difficult for them to determine the correct way and solve problems

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when they are asked logical questions. Concept knowledge in learning mathematics is very important so that students do not experience mistakes in dealing with mathematical problems, so that conceptual knowledge needs to be instilled by educators in students (Rahmiati & Roesdiana, 2021). In line with the results of research from Cahya and Warmi (2019) which shows the average percentage of the mathematics reasoning skills of junior high school students is 49.41% and is still classified in the low category.

According to Handayani and Ratnaningsih (2019), there are several factors that can affect students' mathematical reasoning skills, such as learning styles. While learning styles are interpreted by absorbing, processing, and managing the information obtained (DePorter & Hernacki, 2013). The way of learning is also defined by the strategy that is preferred and often used to think and understand the material. According to Sutrisna and Istiqomah (2016) student style in learning will be formed from the ways/patterns that students do repeatedly when studying. Types of learning styles are divided into three, including visual, auditory, and kinesthetic types (DePorter & Hernacki, 2013). According to DePorter & Hernacki (2013), the visual type is a way of learning for a person to determine the sense of sight, then the auditory learning style is a way of learning for someone to use the sense of hearing, and finally the kinesthetic type is a way of learning for a person using motion or touch.

Each student has a different way of learning. These different types of learning methods have a major influence on various types of reasoning and student learning outcomes. In line with opinion Azrai et al. (2017) suggesting how to learn will show the characteristics of a person based on the experience they have, so that it becomes an important key to progress towards the learning stage. Besides that, Maftuh (2020) also mentions that a person has various ways/styles/characteristics in receiving information in order to achieve the success of a learning process. The way of learning and mathematical reasoning ability has a significant influence (Sumaeni et al., 2020).

Opportunity is part of Mathematics in the second semester of class VIII SMP/MTs equivalent according to the 2013 curriculum. This material is one of the materials in which there are problems that require reasoning to solve the problems given. Therefore, efforts are needed to advance reasoning skills, such as accustoming students to practicing from a young age on various kinds of questions containing indicators of mathematical reasoning abilities. From this explanation, this study aims to (1) analyze mathematical reasoning abilities with visual learning styles of class VIII students of SMPN 13 Magelang; (2) analyzing mathematical reasoning abilities with auditory learning styles of class VIII students of SMPN 13 Magelang: (3) analyzing mathematical reasoning abilities with kinesthetic learning styles of class VIII students of SMPN 13 Magelang.

METHOD

This research is descriptive qualitative research which is located at SMPN 13 Magelang class VIII A and VIII F for the 2021/2022 academic year with a total of 58 students. The tool used in this research is a learning method questionnaire adopted from a book entitled "Quantum Teaching" by DePorter et al. (2000), tests of mathematical reasoning abilities, interviews, and documentation. According to Milles and Huberman (in Sugiyono, 2019) the analysis used includes the collection, reduction and presentation of data, and drawing conclusions. All subjects were given a learning method questionnaire and reasoning skills trial questions, then 9 students were selected for the type of learning method (visual, auditory, and kinesthetic) based on the results of the reasoning ability experiment as many as 3 students had low, medium, and high categories. Of the 9 students, they will be interviewed further related to their mathematical reasoning skills. Criteria for students' mathematical reasoning abilities are presented in Table 1.

Table 1. Mathematical Reasoning Ability Criteria

Percentage of Mathematical Reasoning Ability	Criteria
$\mathbf{P > 70\%}$	High
$\mathbf{55\% \leq P \leq 70\%}$	Medium
$\mathbf{P < 55\%}$	Low

Note. From Julaeha and Kadarisma (2020).

Furthermore, a data credibility (validity) test was carried out to test the truth of the results obtained. According to (Sugiyono, 2019) triangulation is divided into three, namely source, technique, and time. The type of triangulation used is the type of technique. Researchers compared data generated from the same research subject, namely class VIII students of SMPN 13 Magelang through test and interview techniques.

RESULTS AND DISCUSSION

Result

After obtaining the results of the learning style questionnaire, grouping was carried out. The results of grouping the learning styles of the 58 students showed that 30 people had a visual learning style of 52%, 15 people had an auditory learning style of 26%, and 13 people had a kinesthetic learning style of 22%. Thus, it can be concluded that the tendency of learning methods for class VIII students of SMPN 13 Magelang is a visual learning style, namely 30 people with a percentage of 52%.

Furthermore, data on the results of the mathematical reasoning skills test, it was found that visual students had moderate criterion mathematical reasoning skills, namely a percentage of 61.8%, auditory students had moderate criteria mathematical reasoning skills with a percentage of 69.3%, and kinesthetic students had reasoning skills. low criterion mathematics, namely the percentage of 54.7%. Thus, it is concluded that students' mathematical reasoning skills who have visual, auditory, and kinesthetic learning methods are included in the moderate criteria with a percentage of 61.9%.

Then the mathematical reasoning skills test results of students with visual, auditory, and kinesthetic learning styles were grouped into low, medium, and high reasoning skills to be interviewed to understand students' actual mathematical reasoning skills. A total of 9 students were selected as research subjects presented in Table 2.

Table 2. Research Subject Data

No.	Subject	Learning Style Type	Mathematical Reasoning Ability Criteria	Subject Code
1	S.22	Visual	High	V1
2	S.42	Visual	Medium	V2
3	S.54	Visual	Low	V3
4	S.06	Auditory	High	A1
5	S.47	Auditory	Medium	A2
6	S.50	Auditory	Low	A3
7	S.55	Kinesthetic	High	K1
8	S.16	Kinesthetic	Medium	K2
9	S.44	Kinesthetic	Low	K3

The following is an example of the work of 3 students consisting of each student from a visual, auditory, and kinesthetic learning style type with high, medium, and low mathematical reasoning abilities.

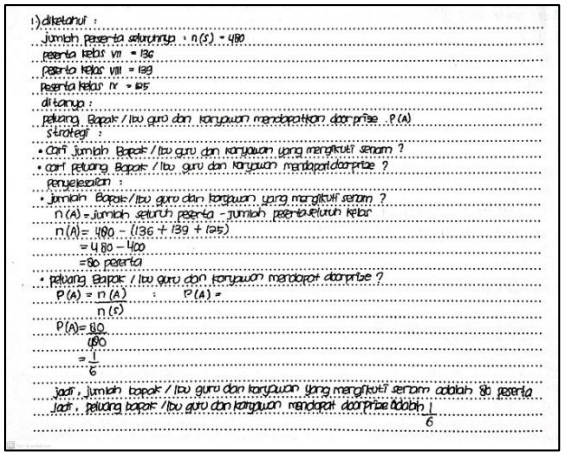

Figure 1. The results of V1's work

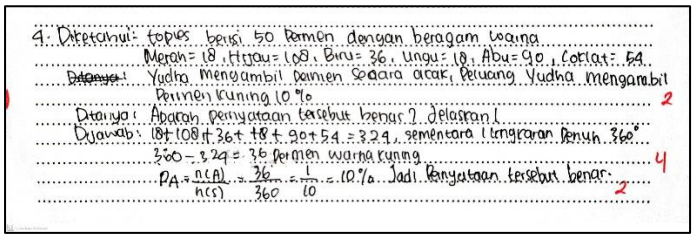

Figure 2. The results of A2's work

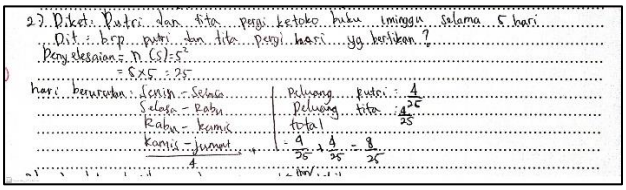

Figure 3. The result of K3's work

Discussion

The following discussion will discuss mathematical reasoning abilities seen from Bobbi DePorter's learning methods (visual, auditory, and kinesthetic) in solving problems on the topic of opportunity and adjusted to the parameters of the set mathematical reasoning skills.

Mathematical reasoning ability with visual learning style (V1, V2, V3)

Based on the results of work and interviews with subjects V1, V2, and V3, further analysis will be carried out regarding mathematical reasoning abilities based on each mathematical reasoning ability indicator as follows:

a) The first indicator: Identifying the assumptions used and presenting them in a mathematical form.

The results of the analysis of the three visual learning style subjects in the first indicator are that the subject tends to be able to mention things that are known and questions that are questionable correctly and completely. Even though one of the subjects, namely subject V1 on the answer sheet (see Figure 1), did not fully explain the information obtained. Then when interviewed, can identify reports that are known in full.

b) Second indicator: Determine the pattern of mathematical traits or symptoms.

The results of the analysis of the three visual learning style subjects in the second indicator, namely subjects V1 and V2, were able to determine the method/strategy used to solve the problem appropriately. However, subject V3 could not determine the correct way to solve the problem because they did not understand the meaning of the question. So that it can be

concluded that the three subjects tend to be able to determine the method used to solve the problem appropriately.

c) The third indicator: Performing mathematical manipulation.

The results of the analysis of the three visual learning style subjects on the third indicator are that the subject tends to be able to use the concept of opportunity, can use strategies in solving problems, and is able to explain the steps for solving the problem in finding the purpose. Even though there was one subject, namely V3, he was unable to use the concept of opportunity, settlement strategy, and was unable to explain the completion steps precisely because he did not pay attention to the explanation and did not record the material. Fourth indicator:

d) Check the truth of a statement and draw conclusions.

The results of the analysis of the three visual learning style subjects on the fourth indicator are that most of the subjects are able to find the right answers from the strategies used, are able to make a conclusion, and check the answers they get again. However, subject V3 could not find the right answer from the strategy used, was unable to make a conclusion, and did not believe the answer even though he had re-examined it.

The characteristics of the type of visual learning style are being able to identify things that are obtained and those that are asked according to the questions correctly and intact. According to the characteristics of visual students according to DePorter & Hernacki (2013) someone who pays close attention to details and easily does something well if his sense of sight is involved. However, this result is inconsistent with opinion Fauziah et al. (2021) where visual students have accuracy obstacles to solve mathematical reasoning questions. In addition, visual type students can solve problems correctly if they plan a strategy in advance. In opinion DePorter & Hernacki (2013) where the visual type is someone who is organized and has the ability to plan and manage time well. In line with research Sayuri et al. (2020) who argues that a good learning style according to the parameters sets the pattern and nature of mathematical signs in realizing a generalization, namely the visual learning style.

Mathematical reasoning ability on auditory learning style (A1, A2, A3)

Based on the results of work and interviews with subjects A1, A2, and A3, further analysis will be carried out regarding mathematical reasoning abilities based on each mathematical reasoning ability indicator as follows

a) The first indicator: Identifying the assumptions used and presenting them in a mathematical form.

The results of the analysis of the three auditory learning style subjects in the first indicator are that the subject tends to be able to convey what is known to the questions correctly and completely and can mention the things asked correctly. However, subject A3 could not put down what was and was questioned through the answer sheet because he was used to not writing down when working on questions, but when interviewed A3 was able to explain what was understood and questioned in the question.

b) Second indicator: Determine the pattern of mathematical traits or symptoms.

The results of the analysis of the three auditory learning style subjects on the second indicator, namely subjects A1 and A2 respectively, can determine the appropriate way to solve problems in the questions correctly. While question number 4, subject A3 cannot determine existing problem-solving strategies. Thus, it can be concluded that auditory subjects tend to be able to determine strategies for solving the appropriate problems used to deal with them.

c) The third indicator: Performing mathematical manipulation.

The results of the analysis of the three auditory learning style subjects on the third indicator are that most of the auditory subjects can use the concept of opportunity, are able to use strategies in solving problems, and are able to explain the completion steps in finding the purpose of the problem. However, subject A3 was unable to apply the concept of probability

and could not explain the steps for solving correctly because there was an error in the calculation because according to A3 question number four was difficult to understand.

d) Fourth indicator: Checking the truth of a statement and drawing conclusions.

The results of the analysis of the three auditory learning style subjects on the fourth indicator, namely subjects A1 and A2 are able to find the correct answer from the strategies that have been used, are able to make a conclusion, and believe in the answers obtained even though they are not re-examined (see Figure 2). Meanwhile, subject A3 was unable to get the correct answer from the method that had been used so he was unable to make a conclusion and did not believe in the answer because he did not re-check the answer. So, it is concluded that auditory subjects tend to be able to get the correct answers from the strategies that have been used, are able to draw a conclusion, and tend to believe the answers obtained and do not re-examine the answers.

The characteristics of the type of auditory learning style tend not to re-examine the answers obtained because they feel confident and lazy to read again. However, not according to opinion DePorter & Hernacki (2013) who say auditory students like to read repeatedly. Auditory subjects also tend not to write strategies but are able to explain them well. In line with the characteristics of the auditory subject where they find it difficult to write but are good at explaining at length (DePorter & Hernacki, 2013). Auditory subjects can work on questions well because they always pay attention to material explanations during learning and ask friends if they don't understand. In opinion DePorter & Hernacki (2013) that is, auditory people carry out learning by listening and like to discuss.

Mathematical reasoning ability on kinesthetic learning styles (K1, K2, K3)

Based on the results of the work and interviews with subjects A1, A2, and A3, further analysis will be carried out regarding mathematical reasoning abilities based on each mathematical reasoning ability indicator as follows.

a) The first indicator: Identifying the assumptions used and presenting them in a mathematical form.

The results of the analysis of the three subjects K1, K2, and K3 on the first indicator are that subjects tend to be able to write down and mention reports obtained on questions and questions correctly and completely.

b) Second indicator: Determine the pattern of mathematical traits or symptoms.

The results of the analysis of the three kinesthetic learning style subjects on the second indicator, namely sequentially subjects K1 and K2 can determine the appropriate method to use in solving questions, while subject K3 cannot determine the correct method to use in solving problems in questions because they do not understand the questions. So, it can be concluded that most of the kinesthetic subjects can determine the resolution strategy used to deal with problems with questions correctly.

c) The third indicator: Performing mathematical manipulation.

The results of the analysis of the three kinesthetic learning style subjects on the third indicator are that the subject tends to be able to use the concept of opportunity, is able to use strategies in solving problems, and is able to explain the steps for solving in finding the purpose of the questions and the answers obtained are also correct. Even though the K3 subject was unable because he found it difficult to do the work and did not know the origin of the answers obtained (see Figure 3).

d) Fourth indicator: Checking the truth of a statement and drawing conclusions.

The results of the analysis of the three kinesthetic learning style subjects on the fourth indicator, namely subjects K1 and K2, tend to be able to find answers from the strategies used. However, the three kinesthetic subjects were unable to make a conclusion that was obtained, and tended to believe the answers had been obtained and did not re-examine the answers.

The characteristics of the type of kinesthetic learning style are less able to make a conclusion from the answers that have been obtained and tend not to write them down. In line

with research Marwiyah et al. (2020) which states kinesthetic students are less able to compile evidence and draw a conclusion. Kinesthetic subjects also tend not to check the validity of the answers they get, because the subject includes people who want to finish quickly and don't want to be complicated (Puspita et al., 2020). The type of kinesthetic learning style is the type with the lowest percentage between visual and auditory. This is because the subject does not understand the concept and the results received are also not appropriate. However, it differs from the results of the study Ulfa (2021) where kinesthetic students have a higher level of reasoning compared to visual students and auditory students.

CONCLUSION

From the results and discussion of the analysis of the mathematical reasoning skills of class VIII students of SMPN 13 Magelang in terms of Bobbi DePorter's learning style, it can be concluded that the ability of mathematical reasoning to visual learning styles is classified at a moderate level with a percentage of 61.8%. Subjects V1 and V2 were able to fulfill all indicators of mathematical reasoning skills. While subject V3 can only complete one of the four parameters of mathematical reasoning skills, namely knowing the opinions used and pouring them into mathematical forms. Students who have a visual learning method are conscientious, good planners, and can remember anything that is seen rather than heard. Furthermore, the ability of mathematical reasoning on auditory learning styles is classified as at a moderate level with a percentage of 69.3%. Subjects A1 and A2 were able to fulfill all indicators of mathematical reasoning skills. Whereas type A3 is only able to complete one parameter of mathematical reasoning skills, namely identifying assumptions used and presenting them in a mathematical style. Auditory students have difficulty writing but are great at speaking, so they are able to explain things at length, like to listen and discuss. However, it has a weakness in doing work if there is commotion. Lastly, the ability of mathematical reasoning to kinesthetic learning style is classified at a low level with a percentage of 54.7%. Subject K1 is able to fulfill all indicators of mathematical reasoning skills, subject K2 can complete 3 of the 4 parameters of mathematical reasoning skills, and K3 subject only meets one indicator of mathematical reasoning skills. Students with the kinesthetic learning method want to get their work done quickly, don't want to be complicated, prefer learning by practice, and don't like to stay for long periods of time.

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