Profile of Students' Mathematical Literacy in HOTS Problem Solving during the Pandemic in terms of Learning Styles

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Abstract.

This study aims to determine students' mathematical literacy abilities in terms of the learning styles of class X students of SMA Negeri 2 Pati in solving each level of thinking ability on PISA questions. The research subjects were students of class X SMA Negeri 2 Pati consisting of six students. Subject criteria selected based on learning styles are visual learning styles, auditory learning styles, and kinesthetic learning styles. The instruments used in this study were a learning style questionnaire, a PISA model of mathematical literacy test, and an interview guide. The validity of the data uses source triangulation, namely comparing the results of information obtained from different sources. Results of tests and interviews 1) Mathematical literacy skills of students with a visual learning style complete PISA level 1 to level 3 at the low-order thinking stage well, while at the high-order thinking stage from level 4 to level 6 students are only able to solve level 4 questions 2) The mathematical literacy skills of students with auditory learning styles can solve PISA questions level 1 to level 3 at the low order thinking stage well, while at the high order thinking stage students can solve level 4 to level 5 questions. 3) Mathematical literacy skills of students with a learning style kinesthetic learning can solve PISA questions from level 1 to level 3 at the low-order thinking stage well, while at the high-order thinking stage students can solve questions from level 4 to level 5. Meanwhile, for level 6 questions, the PISA model of the three types of learning styles has not been able to solve it.

Keywords: Profile; Mathematical Literacy; Learning Style

1. Introduction

Mathematical literacy is a person's ability to efficiently formulate, use, and interpret mathematics in various contexts of everyday life problems. The intended mathematics includes all concepts, procedures, facts, and mathematical tools both in terms of calculation, numbers, and space. In terms of process, this ability is not only limited to the ability to count, but also how to communicate, reason and other mathematical thinking processes [1]. Mathematical literacy is an individual's ability to formulate, use, and interpret mathematics in various contexts [2]. Mathematical literacy is one of the skills of the 21st century. Factors that influence students' mathematical literacy include (a) student aptitude variables including initial ability/achievement, motivation/self-concept, and age/development level; (b) instructional (teaching) variables including quantity/time and quality of teaching, and (c) environmental variables include home, classroom, friends, exposure to mass media. Mathematical Literacy is an individual's capacity to formulate, use, and interpret mathematics in various contexts. This includes mathematical reasoning and using mathematical concepts, procedures, facts and tools to describe, explain, and predict phenomena. It helps individuals

to recognize the role that mathematics plays in the world and to make the reasoned judgments and decisions that are required for constructive, engaged, and reflective citizens. In PISA itself mathematical literacy can be interpreted as follows: "Mathematical literacy is an individual's capacity to formulate, employ, and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts, and tools to describe, explain, and predict phenomena. It assists individuals to recognize the role that mathematics plays in the world and to make the well-founded judgments and decisions needed by constructive, engaged, and reflective citizens." [3].

Concerning the increasing spread of Coronavirus Disease (COVID-19), the mental health of students, teachers, principals, and all school members is a major consideration in implementing educational policies. In this regard, based on the second point of the Ministry of Education and Culture circular letter number 4 of 2020, the learning process from home is carried out with the following conditions: a. Learning from home through online/distance learning is carried out to provide a meaningful learning experience for students, without burdening the demands of completing all curriculum achievements for grade promotion or graduation; b. Learning from home can be focused on life skills education, including regarding COVID-19; c. Learning activities and tasks for learning from home can vary between students, according to their respective interests and conditions, including considering the gap in access/study facilities at home; d. Evidence or products of learning activities from home are given qualitative and useful feedback from the teacher, without being required to give a quantitative score/value [4]. This certainly affects the achievement of students understanding the subject matter based on the school curriculum. This achievement concerns the learning styles of students while studying the material provided by their class teacher. A person's ability to understand and absorb lessons is at a different level [5]. Some are fast and medium, and some are very slow. Everyone not only learns at a different rate but also processes information differently. Therefore, they often must take different ways to understand the same information or lesson. Visual, auditory, and kinesthetic learning styles are a combination of how students absorb, organize, and process information which will ultimately affect student achievement [6]. Individual learning styles can be divided into 3 (three) categories based on sensory preferences or the brain's ability to absorb, manage, and convey information [7]. The three categories are visual, auditory, and kinesthetic learning styles which are characterized by certain behavioral traits. So the learning style determines how far students' ability to understand the material is the way they develop mathematical literacy skills in solving a problem related to mathematics.

Then the importance of mathematical literacy skills in individual HOTS abilities is conveyed by Dinni [8] "Similar to literacy, mathematical literacy skills and high order thinking skills are not just counting, but also how to apply mathematics in everyday life to solve a problem, how to communicate it, thus it can be seen how the thinking process mathematizes students." The higher-order thinking skills in solving mathematical problems of students with different types of learning styles are relatively low, but from the test results students with visual learning styles have an average higher than students with auditory and kinesthetic learning styles [9]. Based on some of these studies indicate that student learning styles affect the learning outcomes and student achievement.

The description above provides several descriptions of the factors that influence students' mathematical literacy abilities in solving mathematical problems. Therefore researchers are interested in knowing how far students' mathematical literacy skills are in

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adapting and being able to understand mathematics subject matter from their learning style during a pandemic where teaching and learning activities are limited by the government.

2. Method

The qualitative research method is defined as an approach or search to explore and understand a central symptom [10]. Qualitative research is research whose research procedures produce descriptive data in the form of written or spoken words from the subject being observed, whereas the results of qualitative research emphasize meaning more than generalizations [11]. Case study type research is a type of qualitative research, in which researchers conduct in-depth exploration of programs, events, processes, and activities, against one or more people [12]. A case is bound by time and activity and researchers collect data in detail using various data collection procedures and in continuous time.

Based on this statement in research on "Students' Mathematical Literacy Profiles in Solving HOTS Problems during the Pandemic given Learning Styles", the researchers used a qualitative research method with a case study type of research (case study) to describe students' mathematical literacy abilities in terms of learning styles. This research was carried out in August 2022 at Pati 2 Public High School, Pati Regency where the research target was aimed at students from class X SMA Negeri 2 Pati totaling two classes with each class consisting of 36 students, because during the pandemic the school environment was still are required to use health protocols and reduce group activities. Therefore, research subjects are taken that easily allow data to be collected so that the research is carried out more effectively.

In this study, the sampling technique used was purposive sampling and snowballing. Purposive sampling is a sampling technique for data sources with certain considerations, for example, the person is considered to know what is expected. Snowball sampling is a sampling technique for data sources that are initially small, but gradually become large. Determination of the subjects in this study was based on the results of the learning style questionnaire scoring, where the highest number of scores on the questionnaire determined the type of student learning style as the research subject, so from a class of 36 students, 6 types of styles were taken study as a research subject [13].

The data collection technique in this study used the source triangulation method. In addition to collecting data, the researcher also tested the credibility of the data through triangulation of data collection techniques and data source triangulation. Technical triangulation means that researchers collect data with various data collection techniques including observation, interviews, and documentation for the same data source. While source triangulation aims to obtain data from different sources using the same technique. According to Susan Stainback (1988) in Sugiyono [14] states that "the aim is not to determine the truth, about some social phenomenon, rather the purpose of triangulation is to increase one's understanding of whatever is being suspected". The purpose of triangulation is not to find the truth about some phenomena but rather to increase the researcher's understanding of what has been found. Triangulation can build on the strengths of each type of data collection while minimizing the weaknesses in any single approach. This means that triangulation will further increase the strength of the data when compared to one approach.

The data collection in this study was carried out after validating several devices for data collection including, a questionnaire in the form of a learning style questionnaire, then a PISA model test that was used to determine students' mathematical literacy abilities, as well as

interview guidelines to find out more about students' experiences while working on the test. given.

3.   Result and Discussion

Before carrying out tests of students' mathematical literacy abilities, the researcher first found out the percentage of learning style types from the classes used as research subjects using a learning style questionnaire and the results are shown in Figure 1 below.
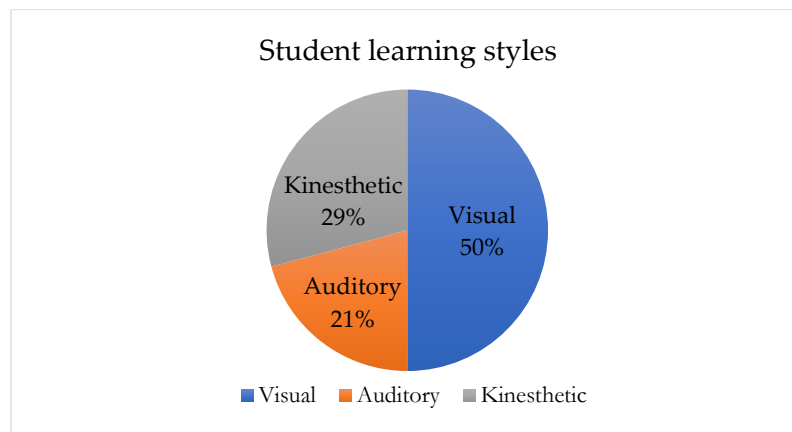

Figure 1. Circle Graph of Percentage of Differences in Types of Student Learning Styles in Class

According to the graphic results of the above learning style questionnaire, it can be seen that students with a visual learning style have the highest percentage of 50%, then students with a kinesthetic learning style have a percentage of 29%, while students with an auditory learning style have the lowest percentage of 21% of the total students from that class. The researcher then took six students from each of these classes to be used as subjects for a series of data collection processes in the form of written tests and interviews twice which were carried out in class X-5 SMA Negeri 2 Pati on Thursday 22 and 25 August 2022 respectively 60 minutes in two different classes, namely X-5 and X-6 from eight classes in SMA Negeri 2 Pati due to limited time at school with the aim that if the test results from the first data collection are not consistent then the results of the second data collection are used as a comparison so that the data The results can be triangulated and the results analyzed, where the six students with visual (V), auditory (A), and kinesthetic (K) learning styles were asked to work on tests of students' mathematical literacy abilities in the form of PISA questions with six levels of difficulty according to Bloom's taxonomy. Based on the results of the 60-minute test, the research subjects were asked to work on six questions at different levels, along with an explanation of the test scores obtained from the research subjects.

Table 1. Results of Obtaining Scores for Each Subject per Problem Worked on.

Subject	Question Numbers for Each PISA Level					
	1	2	3	4	5	6
V1	3	2	3	2	0	0
V2	3	1	2	1	0	0
V3	3	1	3	2	3	1

A1	3	2	3	1	3	0
A2	3	1	3	3	3	1
A3	3	2	2	3	2	1
K1	3	3	3	2	1	1
K2	3	2	3	3	3	1
K3	3	2	3	3	3	1

The score results in the table above are the level of students' problem solving literacy abilities in working on each question according to the indicators at the PISA question level with the following achievement criteria in Table 2.

Table 2. Criteria for achieving Mathematical Literacy.

Mathematical Literacy Ability Level	Score	Achievement Criteria
Tinggi	3	Very Good
Medium	2	Good
Low	1	Enough
Very Low	0	Poorly

After carrying out a series of data collection activities with tests and interviews related to the profile of students' mathematical literacy abilities according to their learning styles in working on the PISA model questions given by researchers starting from the stages of low-order thinking skills to high-order thinking skills which are the main focus of the research. The following discussion is based on the results of research on students' mathematical literacy abilities in solving HOTS (high-order thinking skills) problems in terms of learning styles.

In the first question of PISA with the lowest level of thinking skills at the stage of low order thinking skills. This question doesn't need to use high reasoning because the problem description has been presented, besides that, they also found this question when they were in junior high school so it's quite simple to do. Students only need accuracy in understanding the order of questions in calculating the average value of different classes because the questions presented are a little tricky. At this level, the aspect that is measured is that students can use their knowledge to solve problems and solve problems in a general context. Based on this statement from the conclusions of the research results presented earlier, it is known that the literacy skills of each student with visual, auditory, and kinesthetic learning styles in solving level 1 questions are very good because they can understand the problems contained in the questions and solve them using the model math properly. At level 1 the obstacles found while working on the questions were in the ability to understand and analyze the questions. Even though the six students with each learning style in their calculations were able to work on the problem, there were still some students who were fooled by the question information given, because in the questions presented, there were average scores from different classes, and some students the average value is unknown. So less careful students will calculate all these values simultaneously. However, these weaknesses can be reduced by getting students used to working on story problems whose problems are taken from everyday life.

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In the second question of PISA with the level of thinking ability level 2 stages on the low order thinking skill. This problem also does not need to use high reasoning related to communication, mathematization, and representation abilities. At this level, the aspect that is measured is that students can interpret problems and solve them with formulas. Based on this statement, from the conclusions of the research results that have been presented, it is known that the literacy skills of students with a visual learning style in solving level 2 questions are still lacking. This is because in answering the questions they have not been able to interpret the problems in the questions properly and still have difficulty determining the appropriate mathematical model in solving word problems with simple problems. Whereas the literacy skills of students with auditory and kinesthetic learning styles in solving these problems are quite good, because in answering the questions they are not good enough to interpret the problems in the questions and determine the appropriate mathematical model in solving story problems with simple problems. Related to this, even though the level of difficulty is still low, some students provide incomplete answers and communicate their answers in mathematical form. At level 2, the obstacles that were found while students were working on the questions were in the ability to calculate, understand, and analyze questions, as well as the ability to explain reasons for the answers they worked on. In this matter, the calculations are fairly simple, and the level of reasoning is still easy, but some students still do not write down their answers in mathematical form. In addition, the explanation regarding the answers that were done was still sober and did not properly fulfill the intent of the problem in the question, even though the answer chosen was correct.

In the third question of PISA with the level of thinking ability level 3 stages on low order thinking skills. Compared to the previous questions, this question requires students to understand the questions, understand concepts, present, design strategies for completion, and accuracy in calculations and reasoning. Even though the question level is higher, it turns out that students have not found it difficult and can do the problem well and answer correctly using almost the same model in solving the problem. At level 3 questions, the aspect that is measured is that students can carry out procedures well in solving problems and can choose strategies for solving problems in questions. Based on this statement, from the conclusions of the research results, it is known that the literacy skills of each student with visual, auditory, and kinesthetic learning styles in solving problems are very good. This is because they can correctly write down the steps and use strategies to solve problems in real-world contexts. Actually, at level 3 the obstacles encountered while students were working on the questions were not too high, but in terms of calculations the level of difficulty experienced by students increased, this indicated that the higher the level of ability to analyze the questions tested. However, this did not affect the students' answers in working on question number 3, because the six students with visual, auditory, and kinesthetic learning styles were still able to answer the question well.

In the fourth question of PISA with the level of thinking ability level 4 at the High Order Thinking Skill (HOTS) stage. This question talks about shape and size, where students are instructed to make profits from selling pizza based on the information on the shape and size that has been provided which leads to the student's abilities to mathematize, represent, plan strategies, operate numbers, and reason, even though the level of reasoning in these questions is relatively low. The initial idea in solving this problem is to find the price of each slice of pizza in a unit area, from this initial idea students need high reasoning and analytical skills. At this level, the aspect that is measured is that students can work effectively with models and

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can choose and integrate different representations and then connect a problem with everyday life. Based on this statement from the conclusions of the research results that have been previously described, it is known that the literacy skills of students with a visual learning style in solving level 4 questions are quite good, where they can use models and explanations in solving problems well, but in analyzing the results of solving problems that presented in the question is still not right. The literacy skills of students with auditory and kinesthetic learning styles in solving level 4 questions very well, because they can use models and explanations to solve the problems presented in the questions properly and analyze problem-solving correctly. At level 4 the obstacles were found while students were working on the questions, namely when analyzing the questions, where in concluding the final results of the answers there was still a misunderstanding of the information available on the questions. In addition, there are still students who have not been able to do the calculations properly using the correct mathematical formula. However, some students stated that they were able to understand the problem solve the problem, and conclude the results of their answers well.

In the fifth question of PISA with the ability to think at level 5 at the High Order Thinking Skill (HOTS) stage. Related to the previous questions, this question talks about space and shape, so students need a high level of reasoning to understand the problem and be able to solve the problem properly and correctly using their knowledge. Even though it is classified as a problem that is not easy, there are still some students who can do the questions and answer correctly with reasonable reasons. Based on this statement from the conclusions of the research results that have been presented previously, it is known that the literacy skills of students with a visual learning style are still lacking in solving these problems because they have not been able to use models to solve complex situations and complicated questions using their reasoning. The literacy skills of students with auditory and kinesthetic learning styles in solving level 5 questions are very good, where they can use their reasoning to be able to work on problems using models to solve complex situations presented in questions in the context of everyday life correctly. At level 5 the problems found by students began to appear to increase when working on the questions because on these questions the difficulty in analyzing questions was different from the previous levels. Almost all students experience difficulties when working on questions at this level, although there are still some students who can answer questions correctly. This question emphasizes more on students' ability to estimate the number of objects in a room, choose a contextual answer based on the answer choices provided in the question, and state the reasons for the answer they chose in mathematical form. This question is more directed at the ability to represent questions based on the information described in the questions regarding the size of the field and the number of spectators which emphasizes students' representation abilities.

Finally, for the sixth question of PISA with the level of thinking ability level 6 or the highest level at the High Order Thinking Skill (HOTS) stage. This problem is considered difficult because it involves students' literacy skills in mathematics, reasoning, designing strategies, and interpretation. Even though the students had tried to answer, the six students who were used as test subjects had not been able to answer the questions and give the correct reasons according to the questions given. Based on this statement from the conclusions of the research results that have been presented previously, it is known that the literacy skills of students with a visual learning style in solving problems are still lacking, because they are still having difficulties and have not been able to use their reasoning in understanding and designing strategies mathematically to solve problems in problems with Correct. The literacy

skills of students with auditory and kinesthetic learning styles in solving problems are still lacking, and they are still not able to use reasoning to understand the problems contained in the questions and determine strategies to solve problems in the questions correctly. On level 6 questions which is the highest level of PISA questions on students' mathematical literacy ability tests. At this level, the obstacles that students encounter in analyzing questions are very high, and all students with visual, auditory, and kinesthetic learning styles who are used as research subjects are not able to solve problems properly. Based on the summary results of the interviews, the six students who worked on these questions experienced confusion in solving the questions given, because they did not know what to do with the questions, then what formula should be used to answer these questions. Even though some students claimed to understand and tried to work on the questions the results of the answers and explanations given were still not under the problems in the questions. This is because students do not understand the information and problems contained in the questions properly and thoroughly.

Based on the explanation regarding the mathematical literacy abilities of each student with different learning styles, both students with visual, auditory, and kinesthetic learning styles at each level of questions, it can be seen that the ability to analyze questions is a fundamental obstacle that students experience when solving problems. do questions. The higher the level, the higher the difficulty level of analyzing the problem. This happens because students are not familiar with questions that require reasoning to solve them, or in other words, students are used to questions that only use practical calculations. In addition, when looking at the form of the questions, students' difficulty in analyzing the questions was high when the questions were presented in story form. Thus it can be said that students still have difficulty understanding questions in the form of stories [15]. Students are still not familiar with questions that require logical, critical thinking and applicable solutions [16]. About 78% of students can solve routine questions, 58% of students can interpret problems and solve them with formulas, 65% of students can carry out procedures properly, 19% of students can deal with complex situations and use their reasoning in solving problems, and 54% of students can work effectively and interpret different representations and then relate them to the real world".

In addition to discussing students' mathematical literacy abilities in working on questions with six different levels of difficulty, the researcher also asked about their experiences while learning about questions in the form of PISA which in this case refers to the ability of the High Oder Thinking Skill (HOTS) in solving contextual problems in mathematical problems. . It turned out that most of the students who were used as research subjects did not know about PISA questions and rarely got questions that emphasized their ability to analyze problems presented in the form of stories while attending school lessons. Even more so during the pandemic that occurred in the last few years where students were forced to take part in online learning activities and the material they were able to learn was only a little because most of their activities while participating in learning only got assignments from their teachers at school.

4. Conclusion

PISA is an international study that examines students' thinking skills to find out whether students can apply their knowledge in everyday life. The questions on PISA are used as a tool to see the extent of mathematical literacy skills because they require reasoning and problem-

solving abilities so that it can be seen whether students belong to high-order thinking or low-order thinking. Based on the results and discussion described in the previous chapter, it was concluded that the mathematical literacy skills of students with visual, auditory, and kinesthetic learning styles in this study were able to solve questions with difficulty level level 1 to level 3 at the low order thinking skill stage quite well, it's just that solving problems with simple calculations at level 2 has not been completely solved mathematically, even though they can understand and analyze the problems contained in the questions correctly. Then for students' mathematical literacy skills in solving questions with difficulty level level 4 to level 6 at the high order thinking skill (HOTS) stage of the three types of different learning styles in this study, it is known that students with a visual learning style are only able to solve questions with a level of difficulty level 4 properly and correctly, while for questions with difficulty level 5 and level 6 they were unable to solve them. In contrast to students with auditory and kinesthetic learning styles, they are still able to solve questions with level 4 and level 5 difficulties well, but in questions with difficulty level 6, their abilities are still lacking, due to a lack of knowledge in determining strategies and mathematical models to solve problems questions with complex situations regarding everyday life presented in the form of story questions.

5. Acknowledgements

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