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Analysis of Students' Mathematical Concept Understanding Ability on Circle Material Based on Learning Style

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Abstract
This research aims to analyze students' mathematical concept understanding ability in solving circle material problems by considering learning styles. The method used in this research is qualitative method with descriptive approach. This research was conducted on students of class XI Culinary 1 at SMKN 6 Semarang which amounted to 36 students. Data were collected through mathematical concept understanding test and student learning style questionnaire. The subjects in this study were three students who represented each student's learning style. The techniques used to collect data were observation, mathematical concept understanding ability test, interview and documentation. The results showed variations in learning styles and variations in students' mathematical concept understanding abilities in solving circle material problems. Learners with visual and auditory learning styles tend to have better understanding abilities in solving the problem, while learners with kinesthetic styles show different patterns. So it can be concluded that the learning style of learners can affect students' mathematical understanding ability in solving circle material problems, therefore the importance of recognizing the learning style of students in the mathematics learning process. Each learner with a different learning style has a different mathematical concept understanding ability, so an approach that is in accordance with the characteristics of learners is needed to improve students' mathematical concept understanding ability.
Keywords: *mathematical comprehension ability, learning style, circle*

INTRODUCTION

Science and technology are growing along with the times. Education is the most important aspect in a nation to build the progress of the nation. This is because the quality of a nation's education quality determines and is determined by the quality of its human resources. Concept understanding is one of the aspects that must be developed in learning. Because this makes a considerable contribution in developing technology and educational innovation (Subekhi, 2021). One of them is the field of mathematics. Mathematics is a basic discipline that has a major role in everyday life as well as the advancement of science and technology in this 21st century educational era. Mathematics is also a field of study studied by all students starting from elementary school to college level. Therefore, the teaching of mathematics and other basic sciences must be fully supervised by various parties, especially those whose implementation is directly related to education (Indah Lestari, 2018).

One of the targets to be achieved in learning mathematics is the ability to understand mathematical concepts well. The materials in mathematics are closely related. To learn the material, students are required to have an understanding of the prerequisite material or previous material. Therefore, in learning mathematics, students are required not only to memorize but really understand what students learn (Ruqoyyah, et al, 2020). Mathematics is

a lesson that deals with many concepts (Khasanah, Utami, & Rasiman, 2020). Concepts are abstract ideas that allow us to classify objects into examples and non- examples. By mastering concepts, students can gain unlimited new knowledge. Learning will be hampered without concepts. (Fajar *et al*., 2018).

In the world of education, mathematical understanding is more than just memorizing facts or formulas, but also includes the ability to understand concepts, apply principles, and solve problems with critical thinking. The ability to understand concepts in mathematics is needed by every student. So that the learning process must emphasize understanding mathematical concepts (Hernawati & Pradipta, 2021). Understanding mathematical ideas is likened to building a multi-storey building, which requires a floor and a solid foundation. Students will more easily understand future topics if they understand the basic principles (Sapilin et al., 2019).

One of the areas of mathematics that requires a strong understanding is the circle, which has a variety of applications in various disciplines. In this case, it explains that to know a topic of discussion in mathematics, students are expected to have the ability to understand mathematical concepts in order to face world challenges (Suraji, Maimunah, & Saragih, 2018).

However, challenges in education arise when we consider the diversity of learners' learning styles. Each individual has unique learning preferences and tendencies. Learning styles include preferences in receiving and processing information, as well as strategies used in understanding and remembering material. In the context of mathematical understanding, learners' learning styles can affect their ability to solve circle problems. The ability to understand concepts can be done one of them by identifying learning styles, each learner has a different level of understanding of mathematical concepts such as preferring graphics, printed words, hearing, using experience and practice in representing information. This is driven by several factors, one of which is learning style (Ulum & Pujiastuti, 2020).

According to Wassahua (2016) learning style is the key to developing performance in school work rather than in interpersonal situations, so learning style will affect a person in absorbing and processing information so that it can affect achievement. According to Jaenudin (2017) there are three learning style models, namely visual, auditorial and kinesthetic. According to De Porter and Hernacki (2013), there are generally three types of learning styles, namely visual, which means learning through what is seen, auditorial, which means learning through what they hear, and finally kinesthetic learning style, which means learning through movement or touch.

In learning, especially learning mathematics, students often have to use and take different ways to understand a concept that is learned. Learners have different levels of understanding depending on the speed of learning and the level of performance in learning. There are learners who immediately understand the concept just by reading the book, but there are also learners who have to listen to the teacher's explanation first in order to understand the concept. It is this difference in learning that shows that this is the easiest and preferred way. For students to get learning resources in the learning process, we can call it a learning style (Septiani & Pujiastuti, 2020).

Therefore, it is important to conduct a careful analysis of the relationship between mathematical understanding ability in solving circle problems and learners' learning styles. By understanding how learning styles affect the mathematical comprehension process, educators can develop more effective and inclusive teaching strategies, which can accommodate the needs of diverse learners.

In this article, the researcher will conduct an in-depth analysis of the relationship between mathematical understanding ability in solving circle problems and students' learning styles. This research raises a problem about the ability to understand mathematical concepts. Until now, it is still found that some students do not understand mathematical concepts. Low concept understanding results in less effective learning. In addition, the researcher will investigate the various learning styles that have an impact on mathematical understanding and its implications in the context of circle learning. It is hoped that the results of this analysis can provide valuable insights for educational practitioners in designing learning experiences that are more effective, inclusive for all learners, as well as a reference for implementing learning activities by providing routine problems so that students' mathematical understanding skills will be better and can achieve optimal results.

In previous research conducted by Khairunnisa Soro (2021), it was found that students with visual learning styles were able to interpret the conceptual understanding of the material for the system of linear equations of two variables system system with systematic and detailed, and were able to present graphs clearly, and fulfill all indicators of achieving concept understanding, so it was concluded that students with visual learning styles had better concept understanding than students who had auditorial and kinesthetic learning styles. Based on research conducted by Yulpa Nur Arsy, et al (2022), the results show that the mathematical problem solving ability of subjects with visual learning styles is in the sufficient category, subjects with auditorial learning styles are in the very poor category, and subjects with kinesthetic learning styles are in the sufficient category.

METHODS

In this study the method used is qualitative which aims to know directly how students are able to understand mathematical concepts in solving circle problems in terms of the cognitive style of students. The approach used is a descriptive qualitative approach, because it emphasizes sentences rather than numbers (Yudhanegara & Lestari. 2015: 3). The subjects of this study were students of class XI Culinary 1 SMKN 6 Semarang as many as 3 people. The sampling technique is from 36 students to 3 students who are students representing each learning style.

In this study, the data collection techniques used were questionnaire techniques, test techniques, and interview techniques. test questions, In this study researchers used the main instrument that played a role in the data collection process, while other instruments such as questionnaire sheets, test questions and interview guidelines will act as supporting instruments (Wijaya, 2018: 52). The data analysis used is the Miles & Huberman model which includes *data* reduction, *data* presentation, and *conclusion* (Sugiyono, 2015: 337). The steps in carrying out this research are the first research preparation, namely compiling a research design, preparing research instruments in the form of a student learning style

questionnaire, test questions for students' mathematical concept understanding abilities, instrument grids, scoring guidelines for mathematical concept understanding abilities, interview guidelines, and validating research instruments. The second step in the implementation of the research is to give a learning style questionnaire, analyze the results of the questionnaire, then group and take 3 subjects according to their respective learning styles according to the results of the questionnaire obtained. Then give a test of understanding of mathematical concepts and conduct interviews with the 3 subjects. Third, analyze the results of the mathematical concept understanding test by collecting data results according to the learning style category. The final stage is compiling a research report and drawing conclusions.

While the instrument used to determine the learning style of students consisting of 24 questions. If students choose many answer choices point A then these students can be categorized into the type of visual learning style. If students choose many answer choices point B then these students can be categorized into the type of auditorial learning style. And if students choose many answer choices point C then they can be categorized into the kinesthetic learning style type. This learning style questionnaire is given to students in class in the form of multiple choices through google forms. After students fill out the learning style agket, 3 subjects are taken with each 1 subject representing according to their learning style to be given a concept understanding test.

While the indicators of understanding the mathematical concepts of researchers adopt indicators that have been validated and carried out by Damayanti and Annita (2023) indicators contained in understanding the concept include: 1) Restate a concept, 2) Give examples and not examples and 3) Apply concepts in problem solving algorithms. The scoring technique for concept understanding ability in each category is determined by the following formula

$$students'score = \frac{n}{N} x\ 100\%$$

description:

N : maximum score

n : number of learners' scores

Furthermore, students' scores based on their respective abilities will be categorized into three categories, namely high, medium, and low categories. The following are the grouping guidelines (Arjuna Rambe, 2020).

Table 1. Criteria for Concept Understanding Ability Level

Value Interval	Category
0-60	Low
61-75	Medium
76-100	High

While in this study using data validity withdrawal techniques triangulation method. Triangulation method is comparing observation data (written test) with interview data.

RESULTS AND DISCUSSION

Before conducting research, researchers have classified students according to their learning style by conducting a student learning style questionnaire test. From the questionnaire, the results obtained were 15 with visual learning styles, 12 kinesthetic styles and 9 had auditory learning styles. Then taking subjects in this study as many as three students, namely 1 student with a visual learning style, 1 student with an auditorial learning style, and 1 student with a kinesthetic learning style.

After getting a sample, the researcher conducted a mathematical understanding ability test which was carried out individually. Before carrying out the test, the researcher first asked students to look at the instructions for working on the questions. Furthermore, the results of the mathematical concept understanding test will be used as a reference to determine and analyze the concept understanding ability. Then later it will be checked with the results of interviews with research subjects.

Table 2. Mathematical Concept Understanding Test Results

Subject Initials	Score for each question			Final Grade	Description
	1	2	3		
V	9	9	6	85,2	High
A	9	9	3	81,4	High
K	9	9	6	63	Medium

Work Result Analysis of Problem Number 1

Problem number 1 on this test is to find out and describe students' understanding in solving circle problems by applying arc length problems in everyday life. The following are the results of the answers to question number 1 by the three subjects and their analysis.

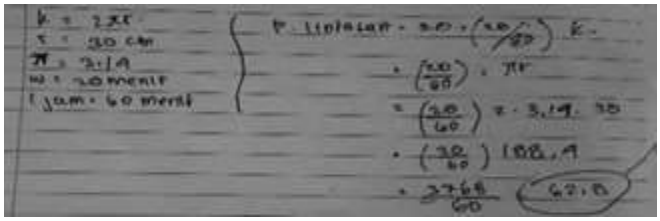

Figure 1.1. Work Result of Problem Number 1 of Subject V

Based on the data from the test results and subject V's interview on question number 1, it can be seen that subject V is able to understand the problem well and fulfill the 3 indicators of understanding the concept in solving problem number 1. In the answer sheet, subject V is able to restate a concept by writing what is known and what is asked from question number 1, namely by writing the formula for the circumference of a circle = $2\pi r$, r = 30 cm, time 20 minutes. Subject V was then able to give examples and non-examples of a concept by applying the concept to existing problems. Then subject V can apply the concept of a circle and the circle solution algorithm by finding the final result of the path length of 62,8 cm. Based on the results of the interview, it can be seen that the visual learning style subject is able to understand and explain well what is known in the problem and what is asked in the problem and can choose the right way to solve the problem, the results of subject V's

answers are also good and correct and able to conclude the results obtained correctly.

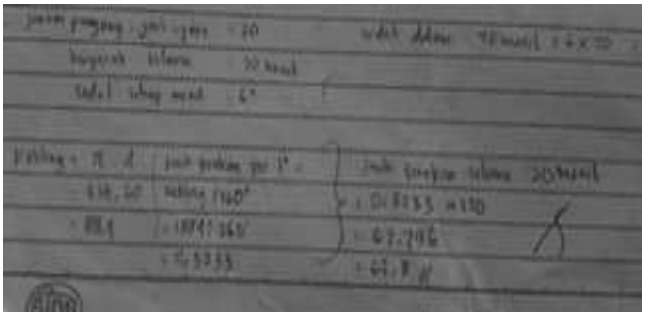

Figure 1.2. Work Result of Problem Number 1 of Subject A

Based on the data from the test results and subject A's interview on question number 1, it can be seen that subject A is able to understand the problem well. This can be seen from the fulfillment of three indicators of concept understanding in solving problem number 1. Subject A is able to restate a concept by being able to write down what is informed and what is asked from problem number 1 in detail, namely writing the long hand of the clock = radius = 30, the angle every minute is 6° then the angle in 20 minutes is equal to 120°. Then able to give examples and non-examples of a concept involving the circumference of a circle and related angles. Then subject A is also able to apply concepts and solution algorithms by finding the final result of the track length of 62,8 cm. Then from the interview, learning style subject A is able to understand and explain well what information is known in the problem and what is asked in the problem and can choose the right way to solve the problem, the results of subject A's answers are also good and correct and able to conclude the results obtained correctly.

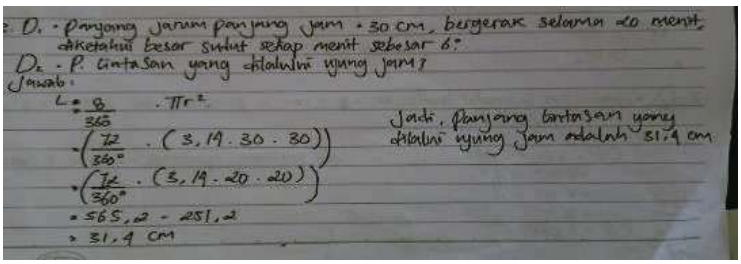

Figure 1.3. Work Result of Problem Number 1 Subject K

Based on the data from the test and interview results of subject K in question number 1, it can be seen that subject K has not been able to fully understand the problem properly. This can be seen from the unfulfillment of three indicators of concept understanding in solving problem number 1. Subject K is able to restate a concept by being able to write what is known with a statement and knowing what is asked from problem number 1 but not yet in detail. In the next indicator, subject K has not been able to apply examples of concepts and non-examples of the problem correctly. Then subject K also has not been able to apply the concept of a circle and the solution algorithm, this can be seen from the final result obtained which is 31,4 cm. Then from the results of the interview, it can be said that the subject of learning style K has not been able to understand well what is known and asked in the problem and has not been able to choose the right strategy application to solve the problem, the results of subject K's answers are also not correct.

Work Result Analysis of Problem Number 2

Problem number 2 on this test is to find out and describe the understanding of students in solving circle problems by applying the problem of the tangent line of the outer fellowship in everyday life. The following is an analysis of the answers to question number 2 by the three subjects.

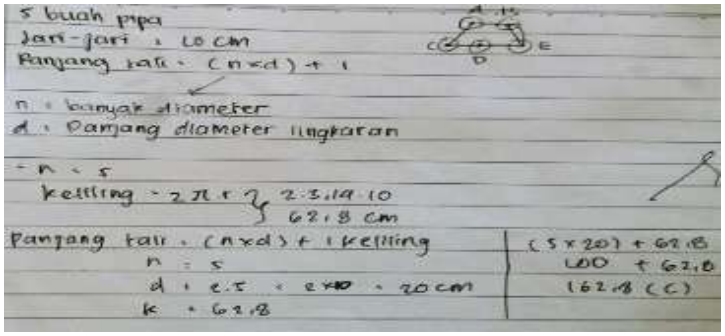

Figure 2.1. Work Result of Problem Number 2 of Subject V

Based on the data from the test results and subject V's interview on question number 2, it can be seen that subject V is able to understand the problem well. This can be seen from the achievement of three indicators of concept understanding in solving problem number 2. In the answer sheet subject V is able to restate a concept by writing what is known, namely by writing the formula for the radius of the circle = 10 cm and the number of pipes = 5 then being able to state what is asked. Subject V was then able to give an example of a circle concept by applying it to the existing problem by writing the formula for the length of the rope = (n x d) + K. Then subject V is able to apply the concept and solution algorithm by finding the final result of the rope length of 162,8 cm. While based on the interview, the visual learning style subject is able to explain and understand well what is informed in the problem and can choose the right strategy to solve the problem, the results of subject V's answers are also good and correct and able to conclude the results obtained correctly.

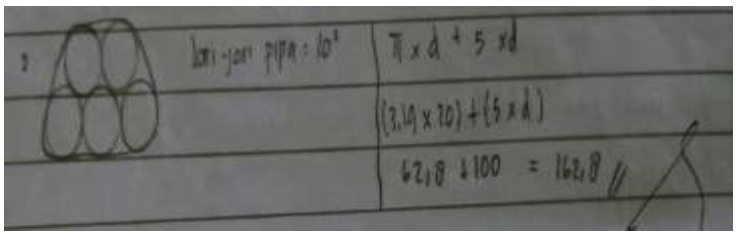

Figure 2.2. Work Result of Problem Number 2 Subject A

Based on the data from the test results and subject A's interview on question number 2, it can be seen that subject A was able to understand the problem well. This can be seen from the fulfillment of three indicators of concept understanding in solving problem number 2. Subject A is able to restate a concept by being able to write what is informed and asked from problem number 2, namely writing the finger = 10. Then able to give examples of concepts involving the circumference of the circle and the number of pipes. Then subject A is also able to apply concepts and solution algorithms by finding the final result of the track length of 162,8 cm. Then from the interview, it can be concluded that learning style subject A is able to understand well what is informed in the problem and can choose the right

application to solve the problem, the results of subject A's answers are also good and correct and able to conclude the results obtained correctly.

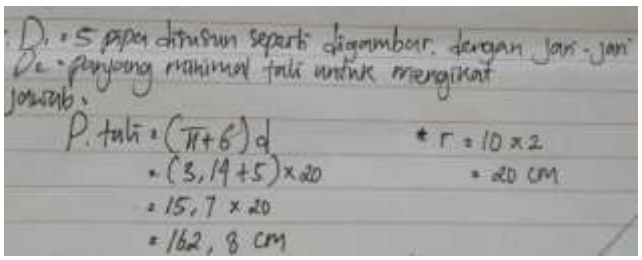

Figure 2.3 Work Result of Problem Number 2 Subject K

Based on the data from the test results and subject K's interview on question number 3, it can be seen that subject K has not been able to fully understand the problem properly, because three indicators of concept understanding have not been fulfilled in solving problem number 3. Subject K is able to restate a concept by being able to write down what is informed from question number 3. And in the next indicator, subject K has not been able to apply the concept of a circle appropriately, this can be seen from the writing of the length of the rope = (π + 6)d. Then subject K also has not been able to apply the concept and solution algorithm, this can be seen from the final result obtained which is 162,8 cm but the method of completion is not correct. Then from the results of the interview the subject of learning style K has not been able to choose the right strategy to solve the problem so that the results of subject K's answer are also not correct.

Work Result Analysis of Problem Number Three

Problem number 3 on this test is to find out and describe the understanding of students in solving circle problems by proving the theorem related to the bowstring and the quadrilateral of the bowstring. The following is an analysis of the answers to question number 3 by the three subjects.

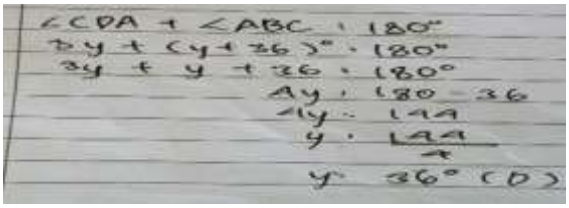

Figure 3.1 Work Result of Problem Number 3 of Subject V

Based on the data from the test results and subject V's interview on question number 3, it can be seen that subject V can understand the problem quite well. In the answer sheet, subject V did not restate a concept by writing what was informed and asked from problem number 3. However, it can fulfill the indicator of giving examples and non-examples of a concept by applying the concept to the existing problem by writing ∠CDA + ∠ABC = 180°. Then subject V is able to apply the concept and solution algorithm by finding the final result 36°. Judging from the results of the interview, it can be said that the visual learning style subject has not been able to understand well enough what is in the problem but has not been able to restate the concept, but subject V can choose the right way of application to solve the problem, the results of subject V's answers are also good and correct and able to conclude

the results obtained correctly.

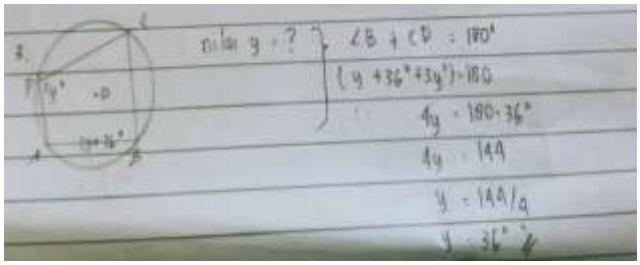

Figure 3.2 Work Result of Problem Number 3 Subject A

In the answer sheet subject A does not restate a concept by writing what is known and asked from question number 3. However, it can fulfill the indicator of giving an example of a concept by applying the concept to the existing problem by writing ∠CDA + ∠ABC = 180°. Then subject A is able to apply the concept and solution algorithm by finding the final result 36°. Judging from the results of the interview, it can be said that learning style subject A does not understand well what needs to be known and asked in the problem but can choose the right strategy to solve the problem, the results of subject A's answers are also good and correct and able to conclude the results obtained correctly.

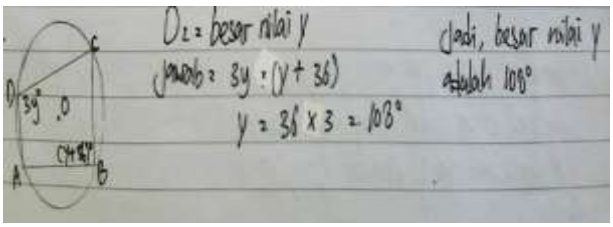

Figure 3.3 Work Result of Question Number 3 Subject K

The following is presented the data from the test results and interviews of learning style subject K in problem number three, from the results of this work it can be seen that subject K has not been able to understand the problem properly. This can be seen from the unfulfillment of three indicators of concept understanding in solving problem number three, namely kinesthetic subjects have not been able to restate a concept by writing what is known and asked from problem number 3, then the subject has not been able to apply the concept to the existing problem by only writing 3y = y +36. Then subject A has not been able to apply the concept and solution algorithm with the final result is not correct, namely 108° . Judging from the results of the interview, it can be said that the subject of learning style K has not been able to understand well the three indicators of concept understanding, from the question and answer subject K has not been able to explain what is known and asked in the problem, has not been able to choose the right strategy to solve the problem and has not been able to conclude the results correctly.

CONCLUSION

Based on the results of research and discussion of the ability to understand mathematical concepts in terms of learning styles of students in class XI Culinary 1 SMKN 6 Semarang in the 2023/2024 school year on circle material, it can be concluded that of the 36 students who have a visual learning style as many as 15 students or 41.66%, auditorial

learning style 12 students or 33.34% and for kinesthetic learning style only 9 students or 25%. The ability to understand the mathematical concepts of students with visual and auditory learning styles can be categorized as good while kinesthetic learning styles can be categorized as moderate. This can be seen from the achievement of each subject's concept understanding indicators. In question number 1 subjects V and A fulfill three indicators of understanding while subject K only fulfills 1 indicator. In question number 2 subjects V and A met three indicators of understanding while subject K only met 1 indicator. In question number 3 subjects V and A meet two indicators of understanding while subject K has not met the indicators of understanding A special treatment or treatment is needed so that all indicators are met in each learning style. The category of each indicator obtained good results in the first indicator, good in the first indicator indicator seta indicator two, while for indicator three it is sufficient.

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