

Solving Circle Material Problems with the Help of Van Hiele's Bridge Theory for Sixth Class Students of Madrasah Ibtidaiyah "Miftahul Ulum" Mranggen, Demak, Indonesia

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Abstract: The aim of this research is to improve the learning activities of class VI students of Madrasah Ibtidaiyah "Miftahul Ulum" Mranggen-Demak Indonesia through the application of the van Hiele Bridge theory in the discussion of circular flat planes. The research used is descriptive qualitative. Geometry material, a learning theory that is suitable for teaching geometry material is van Hiele's theory. Van Hiele's theory with five levels of students' geometric thinking, namely level 0 (visualization), level 1 (analysis), level 2 (informal deduction), level 3 (deduction), and level 4 (rigor), and is supported by five phases: (1) information phase; (2) directional orientation; (3) explanation; (4) free orientation; and (5) integration. Problem solving learning model with the van Hiele bridge as a guide to the learning steps of van Hiele theory with the model teacher playing the role of accompanying students in solving problems. The results of the research show that student activity in learning has increased, namely that students actively ask questions about the solutions they are working on, or whether the problem is unclear. Conclusion: Students feel meaningful in participating in mathematics learning.

Keywords: Circle Geometry, Van Hiele's Bridge, Problem Solving.

INTRODUCTION

Until now, mathematics learning in schools still places students as objects rather than subjects, where students only receive, listen, note down explanations given by the teacher and work on questions according to the teacher's examples and directions [1]–[3]. In addition, if the teacher repeats the material presented, students tend to remain silent. It can be said that students are passive so that there is no reciprocity between teachers and students during the learning process [4], [5]. This can be caused by poor classroom learning processes, the application of learning models that are not appropriate to class conditions, or students who are less enthusiastic about learning. This is reflected in classroom observations at the "Miftahul Ulum" Mranggen-Demak madrasah, showing that learning is still teacher-centered, so that students are passive and this has the implication that learning activities are not dynamic.

Efforts that can be made to increase student learning activities are by implementing appropriate learning models so that they can achieve learning objectives [6]–[9]. Mathematics learning is a teaching and learning process built by teachers to develop students' creative thinking which can improve students' thinking abilities, and can improve students' thinking abilities, and can improve their ability to construct new knowledge as an effort to improve good mastery of mathematics [10]. Learning activities consist of learning and teaching activities. These two activities will collaborate into an activity that creates interaction between students and teachers, students and students, and students and their environment.

According to Utama (2014:75), education in elementary school plays a very important role in overall educational success, so that all parties who are actors in the learning process in elementary school must be really serious in carrying out each role. Teachers and students both become active actors in achieving mathematics learning goals. Seeing these conditions, it is a good opportunity for the class teacher to hand over control to the researcher to manage the class in order to implement the research idea, namely making students active in activities in an effort to create a pleasant atmosphere for students in participating in learning geometry regarding the elements of circles and the area of circles. And learning focuses on students, by placing the teacher as a learning partner to accompany students in problem solving activities.

According to Retnaning, Sugiarti, and Yuliati (2013:1), geometry is an important topic in school mathematics, including in Madrasah Ibtidaiyah or Elementary Schools, both as a stand-alone topic and as a support for other topics. The aim of learning geometry at Madrasah Ibtidaiyah (MI) is so that students can analyze geometric objects in their environment and to improve student learning outcomes in geometry learning.

Based on the results of initial observations made during mathematics learning in class, the teacher started the lesson by directly explaining the concept. According to van Hiele's level of learning theory, this activity is in the explanation phase. After explaining the concept, the teacher gives individual assignments to students. The task learning activities are in the free orientation phase. From the results of these observations, it can be concluded that mathematics learning on circle element material at Madrasah Ibtidaiyah "Miftahul Ulum" Mranggen Demak-Indonesia does not go through the phases in the Van Hiele learning theory assisted by the van Hiele Bridge.

Hutama (2014:75) explains that one effort that can be made to create a quality education process is through the learning process at school. Someone who plays an important role in improving the quality of learning is a teacher. Teachers can create ideal learning. Ideal learning is learning that is sustainable between theories, models, methods, and learning media. This is expected to make learning more meaningful and improve student learning outcomes. One effort that teachers can make is to choose a learning theory that is appropriate to the material being taught. Of the various existing mathematical theories, one learning theory that is suitable for teaching geometry material to students is Van Hiele's learning theory.

Van Hiele's learning theory consists of 5 phases (Sunardi, 2012:42), namely: (1) information phase; (2) directional orientation; (3) explanation; (4) free orientation; and (5) integration. The phases in van Hiele's learning theory contain activities that can increase student activity in the learning process. According to Van Hiele (in Sunardi, 2015: 204) there are five levels of geometry learning for students, namely level 0 (visualization), level 1 (analysis), level 2 (informal deduction), level 3 (deduction), and level 4 (rigor). The mathematics learning outcomes of class VI students at Madrasah Ibtidaiyah "Miftahul Ulum" Mranggen Demak-Indonesia are still low.

Researchers have carried out research projects using the Van Hiele Bridge (VHB) to promote the teaching and learning of geometry in the classroom. The research used van Hiele's pre-level design with a group of 28 students from Class 6 and the teacher showed an introduction to the material with the reality that geometry students know in everyday life. The research took place over two consecutive weeks, with a total of 4 sessions with each session lasting 40 minutes. The topic of this research is two-dimensional geometry sub-topic "construction and identification of the properties of circles and circle areas". Sessions include assignments aimed at helping students use pre-levels to become more formal. This study finds the need for learning geometry by linking the daily reality of geometry material based on Van Hiele levels.

RESEARCH METHODS

This research uses qualitative methods with a case study strategy. Qualitative methods are methods that aim to find out events or phenomena experienced by the subject by describing them in words and sentences [13]. Case studies are empirical investigations that aim to investigate contemporary phenomena in real-life contexts [14]. The qualitative research method with a case study strategy is research that aims to find out contextual problems by providing treatment.

This research was carried out at Madrasah Ibtidaiyah "Miftahul Ulum" Mranggen Demak-Indonesia. The research subjects were all class VI students of Madrasah Ibtidaiyah "Miftahul Ulum" Mranggen Demak-Indonesia for the 2023/2024 academic year with a total of 28 students.

Qualitative descriptive method of data collection through observation, interviews, questionnaires and documentation. The learning activities observed in the application of van Hiele's learning theory are: (1) observing circular flat shapes, (2) understanding the concept of circle geometry, (3) implementing the van Hiele bridge in circle geometry problems (4) making conclusions. The learning outcomes assessed in this research are learning outcomes based on the level of geometric thinking ability of class VI students in Van Hiele's learning theory on the subject of circle elements.

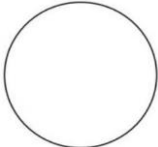
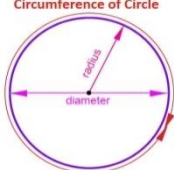
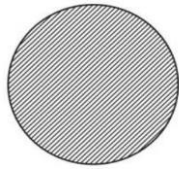
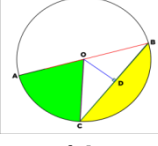
RESULTS AND DISCUSSION

Van Hiele's theory is a theory that concerns students' level of thinking in delegating geometry and the level of learning that can be used in the geometry learning process. Van Hiele explains the level of development

of students' thinking in learning geometry in five levels: 1) Level of visualization, 2) Level of analysis, 3) Level of abstraction (informal deduction), 4) Level of formal deduction, and 5) Level of Rigor (accuracy), as well as several the stages used in learning geometry consist of five stages: 1) Inquiry/information, 2) Directed orientation, 3) Explication, 4) Free orientation, 5) Integration.

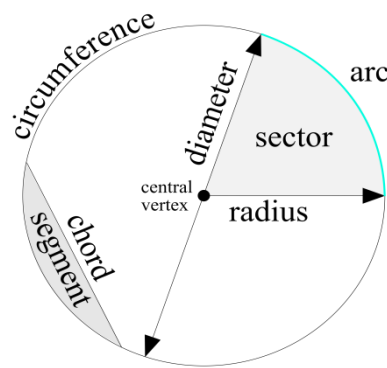
Research Implementation Activities

Implementation of the van Hiele bridge (VHB) in circle material by introducing students' reality material in everyday life in the school environment, as well as outside the school. The research uses van Hiele's pre-level design as a first step in exploring van Hiele's levels. The research took place over two consecutive weeks, with a total of 4 sessions with each session lasting 40 minutes. The topic of this research is the two-dimensional geometry sub-topic "Construction and Identification of Circle Properties and Circle Area". Sessions include assignments aimed at helping students use pre-levels in a more formal way. Illustration of the use of the van Hiele bridge (VHB) using circle material:

Circumference of a circle		
Realistic image	Geometric shapes	Description of circle elements
 Holahoop	 Circle	Holahop toy, example of a circle
 Wagon wheels	 Circumference of a circle	wagon wheel, example of a circle with its elements: diameter, radius
Circle area		
 Money coins	 Circle area	Money coins example from the circle area
 Cake	 Part of the circle area	cake that shows part of the circle area: yellow segment and green sector

Student activities are active in learning

The teacher gives exercises, give an explanation of the following picture:



Student Explanation:

1. S1: Circumference is a set of points forming a circular line

S2: Circumference is a closed, circular curve

S3: Circumference images can be made from circles of coins

S4: Circumference images can be made from circles of coins

S5: Draw a Circumference formed by rotating the radius

S6: Circumference is a closed curve with points equidistant from its center point.

There were 6 students who gave explanations and from direct monitoring all students wrote answers or explanations

2. S1: Central vertex is the point located in the middle of the circle

S2: Central vertex is the center point of a circle where the points on the circumference of the circle are the same distance

There were 2 students who gave explanations and from direct monitoring all students wrote answers or explanations

3. S1: Diameter is a line connecting two points on a circle through central vertex of the circle

S2: Diameter is the longest line connecting two points on a circle

S3: Diameter is a line formed from extended radius to form a diameter

There were 3 students who gave explanations and from direct monitoring all students wrote answers or explanations

4. S1: Radius is the line that connects the center of the circle with a point on the circle

S2: Radius is half a line diameter

There were 2 students who gave explanations and from direct monitoring all students wrote answers or explanations.

5. S1: A chord is a line connecting two points on a circle

S2: A special chord is a line that connects two points on a circle and passes through the center of the circle which is the diameter of the circle.

There were 2 students who gave explanations and from direct monitoring all students wrote answers or explanations

6. S1: An arc is a curved line bounded by two points on a circle that connects two points on a circle

S2: An arc is a curved line part of a circle bounded by two points on the circle.

There were 2 students who gave explanations and from direct monitoring all students wrote answers or explanations

7. S1: Sector is a circular area with two boundaries, radius and arc

S2: Sector is the area from the central corner of the circle which is part of the circle area.

There were 2 students who gave explanations and from direct monitoring all students wrote answers or explanations

8. A segment is a part of a circular area that limits arcs and chords is part of the circle area.

There were 1 student who gave explanations and from direct monitoring all students wrote answers or explanations with the teacher as a learning partner, students become comfortable participating in lessons, fear as a factor inhibiting the growth of thinking changes to a feeling of joy and feeling meaningful in learning. With meaningfulness, problems and problem solving become food for the brain, which has long been held hostage due to a lack of meaningfulness in learning. Through research and implementation of van Hiele's theory with VHB and teachers as learning partners, learning has a new paradigm, namely students learning and teachers as learning partners. So, problems and problem solving are a form of brain training that students need to do to become sharp.

Based on the results of previous research on the application of the Van Hiele bridge as a pre-level Van Hiele theory at SDIT "Al-Mawadah" (L. Sulisty, 2022), for 85% of the superior category, students did not experience problems but for 15% of the adequate and less superior categories, then Students need assistance in order to keep students happy and meaningful in learning mathematics

In particular, MI's research "Miftahul Ulum", positions the researcher as a model teacher examining the initial level of Van Hiele geometric thinking, students on the elements of circles and how their Van Hiele level is changed by level-based instruction with the help of VHB. The research includes four sessions where in the first session, the researcher conducted observations/interviews on each sample to determine the initial level of students' geometric understanding of circle elements and circle areas, shown in the illustrative table as VHB functioning pre-level 0 - level 0, pre-level 1 - level 1 and so on. In the second and third sessions, students were taught the properties of circle elements and circle areas through the Van Hiele level with the help of VHB, followed by student activities showing the demonstration media they had made and writing down the properties of circle elements and circle areas that they understood. In the fourth session, the model teacher conducts questions and answers to determine the level of students' geometric thinking after solving problems as learning material for the Van Hiele model using the help of VHB. The findings revealed that the Van Hiele level of MI "Mitahul Ulum" students ranged from Level 0 to Level 1. After teaching with the help of VHB, the students' Van Hiele level experienced a significant increase

CONCLUSIONS

The application of van Hiele's learning theory in mathematics learning is carried out in accordance with the phases of van Hiele's theory, namely the information phase, directed orientation, confirmation, free orientation and integration. Of the five phases, the integration phase is the phase that is most difficult to implement because students are embarrassed to present the results of group assignments so the teacher has to choose one of the group representatives to present the results of their work in front of the class, while the directed orientation phase is the phase where students are very active in learning, because students can learn while playing with the available media and this can be done smoothly.

Application of van Hiele's learning theory in mathematics learning regarding the area of squares, rectangles and triangles in class VI Madrasah Ibtidaiyah "Miftahul Ulum" Mranggen Demak-Indonesia for the 2023/2024 academic year there has been an increase. Application of van Hiele's learning theory to mathematics learning on the subject of area of squares, rectangles and triangles in class VI Madrasah Ibtidaiyah "Miftahul Ulum" Mranggen Demak-Indonesia for the 2023/2024 academic year there has been an increase. Suggestion Suggestions that need to be considered for the application of van Hiele's learning theory in increasing student activity and learning outcomes on the subject of area of squares, rectangles and triangles, namely (a) For teachers, in order to continue and maximize the application of van Hiele's learning theory for further material so that student activity and learning outcomes increase, and students' level of understanding of geometry can increase. Teachers should provide more questions that can explore students' initial understanding in the information phase. (b) For students, this research makes students more active and less likely to get bored during the learning process. Increasing activity and learning outcomes by applying van Hiele's learning theory can be achieved well if students are able to play an active role in learning together. (c) For other researchers, it is hoped that through the research

results of the application of van Hiele's learning theory, it can be used as a reference in conducting further research, and even better in applying the phases of van Hiele's learning theory, especially in the information phase, where in this research the teacher was less than optimal in providing example of flat material.

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